Contract Documents

Volume I

Meetinghouse Pond Area Collection System and Pumping Station

Contract No. 2022-01 and SRF No. 7150

Town of Orleans, MA

Prepared For

Department of Public Works & Natural Resources

AECOM Technical Services, Inc.

March 2023

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SECTION 00100

ADVERTISEMENT FOR BIDS

TOWN OF ORLEANS, MASSACHUSETTS

MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION

CONTRACT NO. 2022-01 AND SRF NO. 7150

1. The Town of Orleans, MA acting through the Town of Orleans Town Administrator will receive sealed bids for Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150. The scope of work includes constructing approximately 19,100 linear feet of 8-inch, 10-inch, 12-inch, and 18-inch PVC gravity sewer and appurtenances, approximately 8,300 linear feet of 8-inch PVC force main and appurtenances, approximately 20,300 linear feet of 1.5-inch, 2-inch and 3-inch low pressure sewer and appurtenances and 1 Submersible Pumping Station and all appurtenances to provide wastewater service to the Meetinghouse Pond Area of Orleans, MA.

2. The Work of the Project shall be completed within 880 calendar days following execution of the Contract Document using not more than 529 working days.

3. Sealed bids will be received at the Town Administrator's Office, Orleans Town Hall, 19 School Road, Orleans, Massachusetts, 02653 until 10:00 a.m. prevailing time, on April 19, 2023 at which time and place said bids will be publicly opened and read aloud. Any bid received after this date and time will be returned to the applicant unopened. No exceptions will be made. Faxed/emailed bids will not be accepted.

   Unforeseen Office Closure – if, at the time of the scheduled bid opening, Orleans Town Hall is closed due to uncontrolled events such as fire, snow, ice, wind, or building evacuation, the bid opening will be postponed until 9:00 a.m. on the next normal business day. Bids will be accepted until that date and time.

   Bids must be submitted in a sealed envelope indicating the applicant's name and address and clearly marked "Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150".

4. Bidding Documents may be obtained electronically from AECOM Technical Services, Inc. (ENGINEER), Attention: Ms. Amy Hunter at amy.hunter@aecom.com. Bidding Documents will be provided via e-mail as portable document format (PDF) files. Neither the Town of Orleans, MA (OWNER) nor ENGINEER will be responsible for full or partial sets of the Bidding Documents, including Addenda, if any, obtained from sources other than the Issuing Office. Partial sets of Bidding Documents will not be provided by the OWNER nor ENGINEER. Contract Documents will be available for distribution on March 8, 2023.

   Bidders will be added to the "plan holders" or prospective bidders list upon request for the bidding documents for the project.

   The Instructions to Bidders, Form of General Bid, Agreement, Plans, Specifications, Performance and Payment Bond, and other Contract Documents may be examined between the hours of 9:00 am and 3:00 pm at Town of Orleans Department of Public Works and Natural Resources, 40 Giddiah Hill Road, Orleans, MA, 02653.

   Interpretations or clarifications to questions (submitted through the ENGINEER to the attention of Ms. Amy Hunter in writing – emailed, not handwritten), considered necessary by ENGINEER in response to such questions will be issued by Addenda via e-mail as portable document format (PDF) files and delivered to all parties recorded as having received the Bidding Documents. Questions received less than seven working days prior to the date for opening of Bids may not be answered..

5. A non-mandatory Pre-bid Conference will be held on March 29, 2023 at the Orleans Town Hall, 19 School Road, Orleans, Massachusetts, 02653 at 9:00 a.m. prevailing time. Bidders will have an opportunity to view the site of the work during the non-mandatory Pre-bid Conference.

6. Each bid must be accompanied by a five (5) Percent Bid Security in the form of a bid bond, cash, certified check, treasurer's or cashier's check payable to the Owner in the amount of five percent of the bid, in accordance with SECTION 00200 - INSTRUCTIONS TO BIDDERS. If, upon acceptance of a Bid, a Bidder fails to enter into a Contract with the Town of Orleans, MA, the bid security shall be forfeited to and become the property of the Town of Orleans, MA.

   Contract payment will be by the unit price method and the lump sum price method as indicated on the Bid Proposal. No Bidder may withdraw his/her Bid prior to June 30, 2023 or the date of award, whichever shall occur first.

   The successful Bidder must furnish a 100 percent Performance Bond and a 100 percent Payment Bond with a surety company satisfactory to the Town of Orleans, MA and conforming to SECTION 00610, PERFORMANCE BOND and SECTION 00615, PAYMENT BOND.

   All bids for this project are subject to applicable bidding laws of Massachusetts, including General Laws Chapter 30, Section 39M as amended. This project shall also comply with Sections 39F, 39K, 39N, and 39O of Chapter 30 of the General Laws of the Commonwealth of Massachusetts as last revised.

7. Minimum Wage Rates as determined by the Executive Office of Labor and Workforce Development under the provision of the Massachusetts General Laws, Chapter 149, Sections 26 to 27D, as amended, apply to this project. It is the responsibility of the contractor, before bid opening, to request if necessary, any additional information on Minimum Wage Rates for those trades people who may be employed for the proposed work under this contract. Federal Minimum Wage Rates as determined by the United States Department of Labor under the Davis-Bacon Act also apply to this project.

   The Prevailing Wage Rates for those trades people who may be employed for the proposed installation work under this contract is included in the RFP documents. Prevailing Wage Rates for this project were obtain and are included in Document 00830 under Attachment A.

   A weekly certified payroll submittal shall be required of the successful bidder in accordance with MGL C149, S27B. No payments will be made by the Town of Orleans, MA until all payroll information necessary for the Town to determine compliance with prevailing wage law requirements for the time period of the payment request have been submitted.

8. Bidders are not to include in their Bid Proposal sales and compensating use taxes on materials and supplies purchased for this project. All materials used are tax exempt.

9. This Contract to be awarded as the result of this Advertisement for Bids is funded in part through the Massachusetts Department of Environmental Protection, Bureau of Resource Protection, by loans from the Massachusetts Clean Water Trust. This Contract will be subject to the Department of Environmental Protection regulations contained in 310 CMR 44.00, "DEP Selection, Approval and Regulation of Water Pollution Abatement Projects Receiving Financial Assistance from the State Revolving Fund" in effect on the date of issuance of the assistance award (DEP Project Approval Certificate) by the Department.

10. Disadvantaged Business Enterprise (DBE) goals are applicable to the total dollars paid to the construction contract. The goals for this project are a minimum of 4.2 percent D/MBE participation and 4.5 percent D/WBE participation by certified DBEs. The two low bidders shall submit completed DBE forms (EEO-DEP-190C, EEO-DEP-191C and the DBE Certification of United States Citizenship form) by the close of business on the third business day after bid opening. Failure to comply with the requirements of this paragraph may be deemed to render a proposal non-responsive. No waiver of any provision of this section will be granted unless approved by the Department of Environmental Protection (MassDEP)."

11. The project does not require the Contractor to have a DCAM Certification or MassDOT Highway Division Certification.

12. The Project requires compliance with the Massachusetts Diesel Retrofit Program (MDRP) by use of engine emission controls that are EPA certified, or their equivalent, on the off-road (non-registered) diesel vehicles/equipment used at the job site. Bidders must submit a signed and dated Statement of Intent to Comply as part of their Bid Proposal Document. Failure to comply with these MassDEP requirements may be deemed to render a proposal nonresponsive. No waiver of any provision of these MassDEP requirements will be granted unless approved by the MassDEP.

13. The Contractor shall not discriminate about the personnel employed on this project on the basis of race, color, creed, national origin, gender, sexual preference, handicap or age.

14. The Owner reserves the right to award the Project subject to appropriation.
15. The Town of Orleans, MA reserves the right to accept and/or reject any and all bids and to waive any informalities to the extent allowed by law, and to make the award as deemed to be in the best interest of the Town.

Town of Orleans, MA

Orleans Town Administrator

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SECTION 00200

INSTRUCTIONS TO BIDDERS

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1.01 RECEIPT AMD OPENING OF BIDS

A. Town of Orleans, MA herein called the OWNER, will receive sealed Bids for the Meetinghouse Pond Area Collection system and pumping station, Contract No. 2022-01 and SRF No. 7150.

B. Sealed bids will be received by the Owner at the Orleans Town Hall, 19 School Road, Orleans, Massachusetts, 02653 until 10:00 a.m. prevailing time, on April 19, 2023 at which time and place said bids will be publicly opened and read aloud. Any bid received after this date and time will be returned to the applicant unopened. Any bid received from a bidder who did not attend the mandatory pre-bid conference will be returned to the applicant unopened. No exceptions will be made. Faxed/emailed bids will not be accepted.

C. If the building at which bids are to be received is closed for any reason on the date and time that bids are due, receipt of bids by the Owner will be postponed until the next business day at the time originally stated for receipt of bids.

D. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified will not be considered. By submission of a bid, the bidder agrees that this bid shall be good and may not be withdrawn for the number of days, after the opening of bids, as stipulated in the FORM OF GENERAL BID.

E. A non-mandatory Pre-Bid Conference will be held on March 29, 2023 at 9:00 am at the Town of Orleans, 19 School Road, Orleans, MA 02653. Attendance List and Presentation will be provided to plan holders via addendum.

1.02 LOCATION AND WORK TO BE DONE

A. The location, general characteristics, and principal details of the Work are indicated on a set of drawings titled "Meetinghouse Pond Area Collection System and Pumping Station".

B. Additional drawings showing details in accordance with which the Work is to be done may be furnished by addendum from time to time during the bidding period by the Engineer, and shall then become a part of the Contract Documents.

C. The Contractor shall furnish all superintendence, labor, services, materials, equipment, plant, machinery, apparatus, appliances, tools, supplies, bailing, shoring, removal, and all other things necessary to do all work required for the completion of each item of the Work and as herein specified.

D. The Work to be done and paid for under any item shall not be limited to the exact extent mentioned or described but shall include all incidental work necessary or customarily done for the completion of that item.

1.03 PREPARATION OF BID

A. Each bid must be submitted on the prescribed form in SECTION 00410- FORM OF GENERAL BID. All blank spaces for bid prices must be filled in, in ink or typewritten, in both words and figures.

B. Enclosed with the bid shall be the following:

1) Microsoft Excel Proposal Form (hard copy in Landscape Format and ".xlsm" format copy on Thumb Drive);

2) Bid Security (5%);

3) Completed and signed Bid Proposal and Project Reference List;

4) Insurance Requirements for Inclusion in All Specifications and Contracts;

5) Statement of State Tax Compliance;

6) Certificate of Non-Collusion;

7) Acknowledgement of Principal, if a Corporation;

8) Acknowledgement of Principal, if a Partnership;

9) Certification of OSHA 10-Hour Training.

10) Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply.

11) MassDEP Appendix B - Diesel Retrofit Program

12) MassDEP Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

C. Each bid must be submitted in a sealed envelope bearing on the outside the name of the bidder, its address, and endorsed with the name of the project as specified in Receipt and Opening of Bids, above.

D. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in Receipt and Opening of Bids, above.

1.04 MODIFICATION OF BIDS

A. Any bidder may modify its bid by email at any time prior to the scheduled closing time for receipt of bids, provided such transmission is received by the OWNER prior to the closing time, and, provided further, the OWNER is satisfied that a written confirmation of the modification over the signature of the bidder was mailed prior to the closing time. Email bid modifications to mailto:mmiteva@town.orleans.ma.us.

B. The modification communication shall not reveal the bid price but shall provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed bid is opened. If written confirmation is not received within two days prior to the closing time, no consideration will be given to the email transmission.

1.05 OBLIGATION OF BIDDER

A. At the time of the opening of bids each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Contract Documents (including all addenda). The failure or omission of any bidder to examine any form, instrument, or document shall in no way relieve any bidder from any obligation in respect of its bid.

1.06 INFORMATION NOT GUARANTEED

A. All information given in the Contract Documents relating to subsurface and other conditions, natural phenomena, existing pipes, and other structures is from the best sources at present available to the Owner. All such information is furnished only for the information and convenience of bidders and is not guaranteed.

B. It is agreed and understood that the OWNER does not warrant or guarantee that the subsurface or other conditions, natural phenomena, existing pipes, or other structures encountered during construction will be the same as those indicated in the Contract Documents.

C. It is further agreed and understood that no bidder or Contractor shall use or be entitled to use any of the information made available to it or obtained in any examination made by it in any manner as a basis of or grounds for any claim or demand against the Owner or the Engineer, arising from or by reason of any variance which may exist between the information made available and the actual subsurface or other conditions, natural phenomena, existing pipes or other structures actually encountered during the construction work, except as may otherwise be expressly provided for in the Contract Documents.

1.07 BID SECURITY

A. Each bid must be accompanied by a certified check, a bid bond, cash, a treasurer's or cashier's check, payable to the OWNER, in the amount stated in SECTION 00100 - ADVERTISEMENT FOR BIDS. Such deposits will be returned to all except the three lowest responsible and eligible bidders within five days, Saturdays, Sundays, and legal holidays excluded, after the opening of bids, and the remaining deposits will be returned promptly after the OWNER and the accepted bidder have executed the Contract, or if no notice of intent to award has been presented to any bidder within 30 days, Saturdays, Sundays and legal holidays excluded, after the date of the opening of bids, upon demand of the bidder at any time thereafter.

1.08 TIME FOR COMPLETION

A. The bidder must agree to commence work on or before a date to be specified in the written "Notice to Proceed" from the OWNER and to fully complete the project within the time limit stated in Section 00410 - FORM OF GENERAL BID.

1.09 ADDENDA AND INTERPRETATIONS

A. No interpretation of the meaning of the plans, specifications or other pre-bid documents will be made to any bidder orally, and if provided orally, shall not be relied upon by bidders unless confirmed in a written addendum. All information given to bidders other than by means of the plans, specifications, or by addenda, as described below, is given informally and shall not be used as the basis of a claim against the OWNER or the ENGINEER.

B. Every request for such interpretation should be in writing (typed, not handwritten) and addressed to AECOM, Attention: Ms. Amy Hunter, sent via email at amy.hunter@aecom.com and to be given consideration must be received at least seven working days prior to the date fixed for the opening of bids.

C. Addenda will be emailed to all prospective bidders to email addresses furnished by them for such purposes. Bidders picking up sets of bid documents will be given all addenda issued to date and will be required to sign for all documents, acknowledging receipt.

D. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under its bid as submitted and each bidder must confirm for itself that it has received all addenda. All addenda so issued shall become part of the Contract Documents.

1.10 BID OPENING PROCEDURE

A. The following list of requirements shall be met by each filed bid.

B. Bids shall be filed at the place and before the time specified in Receipt and Opening of Bids, above.

C. The bid and all accompanying documents so required shall be signed by the Bidder or its authorized representative before submission.

D. All bidders shall include with their bids written acknowledgment of receipt of all addenda. Refer to acknowledgment form provided in SECTION 00410, FORM OF GENERAL BID.

E. The total dollar amount of each bid will be read, and the three apparent lowest bids will be selected for further consideration. These three apparent low bids will be read aloud for the benefit of the other bidders and the bid opening procedure will be closed. All those present at the bid opening may examine all bids after the bid opening and after the reading of the three apparent low bids.

1.11 COMPARISON OF BIDS

A. Bids will be compared on the basis of the quantities and unit and lump sum prices stated in the bid forms.

B. In the event that there is a discrepancy in SECTION 00410 - FORM OF GENERAL BID between the lump sum or unit prices written in words and figures, the prices written in words will govern.

C. The Owner agrees to examine and consider each SECTION 00410 - FORM OF GENERAL BID submitted in accordance with the terms and conditions set forth herein and as set forth in SECTION 00410, FORM OF GENERAL BID.

1.12 STATUTES REGULATING COMPETITIVE BIDDING

A. Any bid, which does not comply with the provisions of Massachusetts General Laws Chapter 30, Section 39M as amended, need not be accepted and the OWNER may reject every such bid.

1.13 RIGHT TO REJECT BID

A. The OWNER may consider informal any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all bids, should the OWNER deem it to be in the public interest to do so.

B. The OWNER may also reject bids which in its sole judgment are either incomplete, conditional, obscure or not responsive or which contain additions not called for, erasures not properly initialed, alterations, or similar irregularities, and may reject bids for any other reason permitted by law, or the OWNER may waive such omissions, conditions or irregularities.

1.14 ABILITY AND EXPERIENCE OF BIDDER

A. No award will be made to any bidder who cannot satisfy the OWNER that he has sufficient ability and experience in this class of work and sufficient capital and plant to enable him to prosecute and complete the work successfully within the time named. The OWNER's decision or judgment on these matters will be final, conclusive, and binding to the fullest extent permitted by law.

B. The OWNER may make such investigations as it deems necessary, and the bidder shall furnish to the OWNER, under oath if so required, all such information and data for this purpose as the OWNER may request.

1.15 CONDITIONS OF WORK

A. Each bidder must inform itself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of its obligation to furnish all material and labor necessary to carry out the provisions of its contract. Insofar as possible the CONTRACTOR, in carrying out its work, must employ such methods or means as will not cause any interruption of or interference with the work of any other contractor.

1.16 SECURITY FOR FAITHFUL PERFORMANCE

A. Simultaneously with his delivery of the executed Contract, the CONTRACTOR shall furnish a surety bond or bonds as security for faithful performance of this Contract and for the payment of all persons performing labor and materials under this Contract as specified in SECTION - 00700, GENERAL CONDITIONS included herein, each in the amount of 100 percent of its bid. The surety on such bond or bonds shall be a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the OWNER. The bonds shall remain in force for one year after final acceptance of the work by the OWNER, unless the OWNER, in writing, releases the CONTRACTOR from the obligation sooner.

1.17 POWER OF ATTORNEY

A. Attorneys-in-fact who sign Contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

1.18 LAWS AND REGULATIONS

A. Applicable provisions of Massachusetts General Laws and Regulations and/or the United States Code and Code of Federal Regulations govern this Contract and any provision in violation of the foregoing shall be deemed null, void and of no effect. Where conflict between Code of Federal Regulations and State Laws and Regulations exist, the more stringent requirement shall apply

B. The bidder's attention is directed to the fact that all applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

C. Attention is directed to SECTION 00830 - STATE REGULATIONS and to other applicable sections of this specification. In the event of any conflict between provisions of law or regulation quoted or paraphrased in the Contract Documents, the actual provisions of law or regulation shall control.

D. Whenever it is written that an equipment manufacturer must have a specified period of experience with its product, equipment which does not meet the specified experience period can be considered, if the equipment supplier or manufacturer is willing to provide a Letter of Credit or cash deposit for the duration of the specified time period which will guarantee replacement of that equipment in the event of failure.

1.19 LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT

A. The successful bidder, upon its failure or refusal to execute and deliver the Contract, Bonds and Certificates of Insurance required within 10 days after receipt of notice of the acceptance of the bid, shall, except as otherwise provided by applicable law, forfeit to the OWNER, as liquidated damages for such failure or refusal, the security deposited with its bid, provided that the amount forfeited shall not exceed the difference between its bid price and the bid price of the next lowest responsible and eligible bidder.

B. In case of death, disability, bonafide clerical or mechanical error of a substantial nature, or other similar unforeseen circumstances affecting the bidder, its bid deposit will be returned.

1.20 INDETERMINATE ITEMS AND ESTIMATED QUANTITIES

A. The work to be done under this Contract has been divided into parts or items, if applicable, to enable each bidder to bid on different portions of the work in accordance with its estimate of their cost and so that the actual quantity of work executed under each item may be paid for at the price bid for that particular item, even though each bidder may have judged that such quantity may be greater or less than the estimated quantity stated in SECTION 00410 - FORM OF GENERAL BID.

1.21 CONTRACTOR RECORDS

A. The CONTRACTOR shall comply with the provisions of Massachusetts General Laws, Chapter 30, Section 39R, concerning CONTRACTOR records. This section has been reprinted in Section 00830, STATE REGULATIONS.

1.22 MINIMUM WAGE RATES – BIDDER'S RESPONSIBILITY

A. Minimum Wage Rates as determined by the Executive Office of Labor and Workforce Development under the provision of the Massachusetts General Laws, Chapter 149, Sections 26 to 27D, as amended, apply to this project. It is the responsibility of the contractor, before bid opening, to request if necessary, any additional information on Minimum Wage Rates for those trades people who may be employed for the proposed work under this contract. Federal Minimum Wage Rates as determined by the United States Department of Labor under the Davis-Bacon Act also apply to this project.

B. It is the responsibility of the Bidder, before bid opening, to request if necessary, any additional information on Minimum Wage Rates for those trades people who may be employed for the proposed work under this contract.

1.23 BIDDER CERTIFICATION – OSHA TRAINING

A. All employees who work on Massachusetts public works construction sites, on projects estimated to cost more than $10,000, must have no less than ten (10) hours of OSHA- approved safety and health training.

B. The Massachusetts Attorney General is authorized to restrain award of construction contracts to any contractor who is in violation of this requirement and to restrain the performance of these contracts by non-complying contractors.

C. Noncompliance with this law will disqualify contractors from bidding on public contracts.

1.24 SALES TAX EXEMPTION

A. Materials and equipment purchased for permanent installation in this project will be exempt from the Massachusetts Sales and Use Tax. The exemption certificate number will be furnished to the Contractor. Each bidder shall take exemption into account in calculating his/her bid for the work.

1.25 GUARANTEE

A. The Contractor guarantees that the Work and Services to be performed under the Contract, and all workmanship, materials and equipment performed, furnished, used or installed in the construction of the same shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Drawings, Specifications, and other contract documents, that the strength of all parts of all manufactured equipment shall be adequate and as specified and that the performance test requirements of the Contract shall be fulfilled. This guarantee shall be for a period of one year from and after the date of completion and acceptance of the Work as stated in the final estimate. If part of the Work is accepted in accordance with that subsection of this AGREEMENT titled "Partial Acceptance", the guarantee for that part of the Work shall be for a period of one year from the date fixed for such acceptance.

B. If at any time within the said period of guarantee any part of the Work requires repairing, correction or replacement, the Owner may notify the Contractor in writing to make the required repairs, correction or replacements. If the Contractor neglects to commence making such repairs, corrections or replacements to the satisfaction of the Owner within seven (7) days from the date of receipt of such notice, or having commenced fails to prosecute such Work with diligence, the Owner may employ other persons to make said repairs, correction or replacements, and charge the costs, including compensation for additional professional services, to the Contractor.

C. It is expressly understood, however, that these guarantee provisions shall not absolve the Contractor from any liability to the Owner arising out of a failure to substantially complete the work in accordance with the Drawings and Specifications.

1.26 BONDING AND INSURANCE

A. The Contractor must furnish Performance and Payment Bonds, each of which shall be in an amount not less than one hundred (100) percent of the contract price. Contractors should obtain such construction insurance (e.g., Fire and Extended Coverage, Workmen's Compensation, Public Liability and Property Damage, and "All Risk" Builder's Risk) as indicated in the Supplemental Conditions (Section 00800).

1.27 HEALTH AND SAFETY REGULATIONS

A. This project is subject to all the Health and Safety Regulations (CFR 29 Part 1926 and all subsequent amendments) as promulgated by the U.S. Department of Labor on June 24, 1974. Contractors are urged to become familiar with the requirements of these regulations, as well as the Occupational Safety and Health Administration's (OSHA) 29 CFR 1910.120.

1.28 BUY AMERICAN

A. This project is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

1.29 ACCESS TO THE PROJECT

A. The successful Bidder shall provide full and complete access to the project site or any portion thereof by any authorized agent of the Town of Orleans any time during normal working hours throughout the duration of the Contract.

1.30 TRAFFIC POLICE

A. Traffic control, when required by the Chief of Police or the Owner, will be paid for by the Owner. The Contractor is required to directly coordinate all Police details.

B. Any police overtime expenses incurred by the Town due to the Contractor working longer than the specified normal workday (ten consecutive hours, Sundays, or holidays) shall be the responsibility of the Contractor, the cost of which will be deducted from the monthly pay requisition. The Contractor will also be charged for any police expenses when police coverage is requested or scheduled in advance by the Contractor, but the Contractor does not work.

1.31 THIRD PARTY WORK

A. The Contractor is responsible for maintaining a safe and secure worksite at all times, and for expeditiously repairing any damage done to private property. If, in the opinion of the Owner, the Contractor is negligent in these duties the Owner shall have the right to employ a third party to remedy the problem.

B. Situations which develop and require the services of and payment to a third party will be handled in the following manner:

1) The Contractor will be given a reasonable period of time determined at the discretion of the Owner to remedy the situation without third party involvement. If the Contractor is unavailable, the Owner will authorize work by a third party on the Contractor’s behalf;

2) Third party work authorized on the Contractor's behalf by the Owner shall be paid for by the Contractor within a reasonable time period (generally two weeks). If payment is not made within a reasonable time period the Owner will make payment and deduct the cost from the next pay requisition; and

3) In the case of inadequately secured worksites necessitating extra or increase police details or other public safety personnel, the following procedure will be followed. The Contractor (if available) will be notified that the worksite needs to be secured in order to prevent the need for weekend/night police coverage. If the area is not immediately secured as determined by the Owner or Engineer, a police, fire, or highway department detail will be used and the Contractor will be charged for the cost. It is understood that in many instances worksites cannot realistically be secured to a point where police or other safety personnel are not needed. In these instances, the Owner will continue to pay for the coverages.

1.32 AWARDING AUTHORITY AND PROJECT ADMINISTRATOR

A. The Awarding Authority for this Project is the Town of Orleans, MA, acting through , Town Administrator, 19 School Road, Orleans, MA 02653.

B. The Project Administrator for this Project is the Town of Orleans acting through Thomas Daley, Director of Public Works & Natural Resources, 40 Giddiah Hill Road, Orleans, MA 02653.

1.33 SAFETY AND HEALTH REGULATIONS

A. This project is subject to the Safety and Health Regulations of the U.S. Department of Labor set forth in Title 29 CFR, Part 1926 and to all subsequent amendments, and to any applicable Massachusetts regulations. Contractors shall be familiar with the requirements of these regulations.

1.34 MANUFACTURER'S EXPERIENCE

A. Whenever it is written that an equipment manufacturer must have a specified period of experience with his product, equipment which does not meet the specified experience period can be considered if the equipment supplier or manufacturer is willing to provide an "Efficiency Guarantee Bond" or cash deposit for the duration of the specified time period which will guarantee replacement of that equipment in the event of failure.

1.35 DIESEL RETROFIT PROGRAM

A. This project is subject to the requirements of the Department of Environmental Protection's Diesel Retrofit Program. Bidders must submit a signed and dated Statement of Intent to Comply form as part of their bid proposal documents.

END OF DOCUMENT

SECTION 00310

BID BOND

Know all men by these presents, that we, the undersigned, _____

_____ as Principal, and _____

as Surety, are hereby held and firmly bound unto the Town of Orleans, MA, 19 School Road, Orleans, MA 02653 hereinafter called "Owner", in the penal sum of five (5) percent of the value of the Bid for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed, this _____ day of _____.

The Condition of the above obligation is such that whereas the Principal has submitted to the Town of Orleans, MA, 19 School Road, Orleans, MA 02653, hereinafter called "Owner", attached hereto and hereby made a part hereof to enter into a Contract in writing for Contract No. 2022-01, Meetinghouse Pond Area Collection System and Pumping Station.

Now, therefore,

(a) If said Bid shall be rejected, or

(b) If said Bid shall be accepted and the Principal shall execute and deliver a Contract in SECTION 00520, AGREEMENT attached hereto (properly completed in accordance with said Bid) and shall furnish a Bond for its faithful performance of said Contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid, then this obligation, shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its Bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid and said Surety does hereby waive notice of any such extension.

In witness whereof, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

Principal	Surety
Principal Signature	Surety Signature

Important - Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the Project is located.

END OF SECTION

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PENAL SUM FORM

SECTION 00310

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name, and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID
Bid Due Date:
Description *(Project Name— Include Location)*:

BOND
Bond Number:
Date:
Penal sum _____ $ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
_____ (Seal)	_____ (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
Title	Title

Note: Addresses are to be used for giving any required notice.
Provide execution by any additional parties, such as joint venturers, if necessary.

Note: The Bidder may submit their standard Bid Bond as long as it fully complies with the requirements of DOCUMENT C-430.

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PENAL SUM FORM

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
   3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
   3.2 All Bids are rejected by Owner, or
   3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

END OF DOCUMENT

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SECTION 00410

FORM OF GENERAL BID

1. Proposal of _____ (hereinafter called "Bidder")*

   (_) a corporation, organized and existing under the laws of the State of _____

   (_) a partnership

   (_) a joint venture

   (_) a limited liability company

   (_) an individual doing business as _____

   *Check corporation, partnership, joint venture, LLC or individual as applicable.

2. To the Town of Orleans, MA (hereinafter called "Owner") regarding: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150.

   The Bidder, in compliance with your invitation for bids for Meetinghouse Pond Area Collection System and Pumping Station having examined the plans and specifications with related documents and the site of the proposed work and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all superintendence, labor, services, materials, equipment, plant, machinery, apparatus, appliances, tools, supplies, bailing, shoring, removal, and all other things necessary to construct the project in accordance with the contract documents, within the time set forth below, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the contract documents, of which this bid is a part.

   The Bidder hereby agrees that if selected as the Contractor it will commence work under this contract on or before a date to be fixed in the written "Notice to Proceed" given by the Owner to the Contractor and to fully complete the project within 880 calendar days, using not more than 529 working days.

   The Bidder further agrees to pay as liquidated damages the sum of $3,500 for each consecutive calendar day thereafter during which the work as not been fully completed beyond the contract completion date, as provided in the "Liquidated Damages" provisions of SECTION 00800 - SUPPLEMENTARY CONDITIONS.

3. Bidder acknowledges receipt of the following addenda:

No.	Dated
1	
2	
3	
4	
5	

4. Bidder agrees to perform all the work, including all incidental labor, materials and equipment necessary for the satisfactory completion of the work and in full compliance with the contents and intent of the Specifications and/or Drawings of the work.

5. Bid Proposal

   A. The BID PROPOSAL unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, engineering costs, etc., to cover the finished work of the several kinds called for. The Bidder understands that all bids for this project are subject to the applicable bidding laws of the Commonwealth of Massachusetts, including General Laws Chapter 30, Section 39M, as amended.

   B. Bidder shall complete and submit the Proposal Form. The bidder is not allowed to submit a proposal that has been printed out and prices typewritten or written by hand. Failure to utilize the Microsoft Excel Proposal Form shall void the bid.

   C. Use of the Microsoft Excel Proposal Form

      1) Upon Opening the Microsoft Excel Proposal Form:

         a) A yellow bar will appear on the top of the screen labeled as "*Security Warning*"

         b) You must select the "*Enable Content*" button in order to properly access the file.

            1) This will enable macros in the excel file, as you must enable macros to properly view the file.

            2) If you do not enable macros, the excel document will be invalid.

         c) Manually enter the Bidder's Name in the blue box.

         d) Manually enter the Date in the blue box.

         e) Manually enter the unit cost in the blue boxes for each bid item. Allowances have already been prepopulated.

         f) The document will automatically update the cost estimates (Unit Price in Words; Extended Totals and Bid Total based on the user's unit cost input into the blue boxes for each bid item.

      2) In Order to Save the Proposal Form Document.

         a) The document must be saved as a file with macros enabled.

         b) Please save as the file type "Excel Macro-Enabled Workbook (*.xlsm)".

         c) If the file is saved incorrectly as a different file type, the document will be invalid.

      This process must be repeated for every time the document is opened and saved.

   D. Bidder shall print out in Landscape Format and submit the completed Microsoft Excel Proposal Form. In addition, Bidder shall submit the completed Microsoft Excel Proposal Form in ".xlsm" format on a Thumb Drive.

   E. In the event of a discrepancy between the price in words and the price in figures, the words shall govern. In the event of a discrepancy between the total of the items and the total stated, the total of the items shall govern.

   F. In the event of a discrepancy between the printed out completed Microsoft Excel Proposal Form and the completed Microsoft Excel Proposal Form in ".xlsm" format, the printed out completed Microsoft Excel Proposal Form shall govern.

   G. Interlineation, alteration or erasure may void the bid.

   H. Bid security is attached in the sum of five percent (5%) of the total bid in accordance with the conditions of SECTION 00200 - INSTRUCTIONS TO BIDDERS. The bid security may become the property of the Owner in the event the contract and bond are not executed within the time set forth above.

   I. The undersigned states that no officer, agent or employees of the Owner directly or indirectly has a financial interest in this Bid.

6. The time period for holding bids, where Federal approval is not required is 30 days, Saturdays, Sundays and legal holidays excluded, after the opening of bids and where Federal approval is required, the time period for holding bids is 30 days, Saturdays, Sundays and holidays excluded after Federal approval.

7. State Taxes - Pursuant to M.G.L.c.62C, s49A I certify under the penalties of perjury that I, to my best knowledge and belief, have filed all state tax returns and paid all State Taxes required under law.

8. Award

   A. The contract will be awarded to the lowest responsible and eligible bidder.

   B. Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding as deemed to be in the best interest of the Owner.

   C. The Owner reserves the right to reject any bid in the event that any bid item or items are obviously unbalanced or appear to the Owner to be so unbalanced as to affect or to be liable to affect adversely any interest of the Owner.

   D. The Owner reserves the right to reject any or all bids if it deems it to be in its best interest to do so. The Owner reserves the right to award the Contract based on sufficiency of appropriated funds to complete the work.

   E. In the event the lowest bids from responsive and responsible bidders are tied, the following methods of breaking the tie shall be employed unless otherwise provided for in these bid documents: The bidder's names shall be entered on a slip of paper and placed in a hat. The award shall then be made to the bidder whose slip is drawn from the hat. The drawing of the slip from the hat shall be performed in the presence of the tied bidders unless they waive their right to be present in writing.

9. Within 10 days of receipt of the written notice of acceptance of this bid, the Bidder will execute the formal agreement attached in SECTION - AGREEMENT and provide the requisite payment and performance bonds and certificates of insurance.

10. The selected Contractor shall furnish a performance bond and a payment bond each in an amount at least equal to one hundred percent (100%) of the contract prices in accordance with SECTION 00610 - PERFORMANCE BOND, SECTION 00615 - PAYMENT BOND, and as stipulated in paragraph 5.01 of SECTION 00700 - GENERAL CONDITIONS of these specifications.

11. The Owner reserves the right to withhold the fair market value for work not completed in addition to the retainage on work completed. Unbalanced bid items will specifically be subject to review and to this potential withholding from periodic payment applications.

12. The Undersigned, as Bidder, declares as follows:

   A. The only parties interested in this BID as Principals are named herein;

   B. The Bidder has carefully examined the site of the proposed Work and fully informed and satisfied himself as to the conditions there existing, the character and requirements of the proposed Work, the difficulties attendant upon its execution and the accuracy of all estimated quantities stated in this BID, and has carefully read and examined the Drawings, the annexed proposed AGREEMENT and the Specifications and other Contract Documents therein referred to and knows and understands the terms and provisions thereof;

   C. This BID is made without collusion with any other person, firm, or corporation;

   D. No officer, agent, or employee of the Owner is directly or indirectly interested in this BID; and

   E. Understands that information relative to subsurface and other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) has been furnished only for his information and convenience without any warranty or guarantee, expressed or implied, that the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered will be the same as those shown on the Drawings or in any of the other Contract Documents and agrees that the Bidder shall not use or be entitled to use any such information made available to him through the Contract Documents or otherwise or obtained by him in his own examination of the site, as a basis of or ground for any claim against the Owner or the Engineer arising from or by reason of any variance which may exist between the aforesaid information made available to or acquired by him and the subsurface and/or other conditions, natural phenomena, existing pipes and other structures (surface and/or subsurface) actually encountered during the construction work, and has made due allowance therefore in this BID.

13. Equal Employment Opportunity/Affirmative Action Provisions - C.30 s39 (c)

A. The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work.

B. The undersigned bidder hereby certifies he/she will comply with the specific affirmative action steps contained in the Equal Employment Opportunity/Affirmative Action (EEO/AA) provisions of this Contract, including compliance with the Disadvantaged Business Enterprise provisions as required under these contract provisions. The contractor receiving the award of the contract shall incorporate the EEO/AA provisions of this contract into all subcontracts and purchase orders so that such provisions will be binding upon each subcontractor or vendor.

14. Non-Debarment - C.30 s39 (a)

A. The undersigned certifies under penalties of perjury that this bid is in all respects bonafide, fair and made without collusion or fraud with any other person. As use in this paragraph the "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

B. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

15. Suspension and Debarment

A. The EPA prohibits the use of suspended or debarred contractors and suppliers in SRF financed contracts. All SRF financed contracts and subcontracts must include the following language requiring compliance with 2 CFR 180 and 2 CFR 1532.

B. Bidders must fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled responsibilities of Participants Regarding transactions (Doing Business with Other Persons). Contractors, subcontractors, or suppliers that appear on the Excluded Parties List System at www.usgovxml.com/dataservice.aspx?ds=EPLS are not eligible for award of any contracts funded by the Massachusetts State Revolving Fund.

16. Diesel Retrofit Program - The undersigned bidder hereby certifies he/she will comply with the Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply (see Appendix B).

17. The undersigned offers the following information as evidence of its qualifications to perform the work as bid upon according to all the requirements of the plans and specifications.

A. Have been in business under present name for _____years.

B. The Bidder shall state below what work of a similar character to that included in the proposed contract it has done within the last 1o years, and give references that will enable the Owner to judge its experience, skill and business standing (add supplementary page(s) if necessary).

Project No. 1

Completion Date	Project Name	Contract Amount
Design Engineer	**Reference Name**	**Telephone No.**

Project No. 2

Completion Date	Project Name	Contract Amount
Design Engineer	**Reference Name**	**Telephone No.**

Project No. 3

Completion Date	Project Name	Contract Amount
Design Engineer	**Reference Name**	**Telephone No.**

Project No. 4

Completion Date	Project Name	Contract Amount
Design Engineer	**Reference Name**	**Telephone No.**

Project No. 5

Completion Date	Project Name	Contract Amount
Design Engineer	**Reference Name**	**Telephone No.**

C. The names and addresses of all persons interested in the bid (if made by a partnership or corporation) as Principals, are as follows (add supplementary page(s) if necessary):

Name	Address

18. Pursuant to M.G.L. CH. 62C, Sec 49A, the undersigned Bidder certifies under the penalties of perjury that it is in compliance with all laws of the Commonwealth relating to taxes, reporting of employees and contractors, and withholding and remitting child support.

19. The undersigned Bidder hereby certifies that (1) it is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; and (2) that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

20. The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity which sells materials, equipment or supplies used in or for, or engages in the performance of, the same or similar construction, reconstruction, installation, demolition, maintenance or repair work or any part thereof.

21. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, Section 25C (10) of Chapter 152 (workers' compensation) or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder.

Respectfully submitted:

Date: _____ By: _____

(Signature)

_____

(Name – Typed or Printed)

_____

(Title)

_____

(Business Name)

_____

(Federal ID Number)

_____

(Business Address)

_____

(City and State)

_____

(Telephone Number)

(SEAL - if bid is by a corporation)

22. The following documents are attached to and made a condition of the bid, and shall be submitted with the bid:
    A. Microsoft Excel Proposal Form (hard copy in Landscape Format and ".xlsm" format copy on Thumb Drive);
    B. Bid Security (5%);
    C. Completed and signed Bid Proposal and Project Reference List;
    D. Insurance Requirements for Inclusion in All Specifications and Contracts;
    E. Statement of State Tax Compliance;
    F. Certificate of Non-Collusion;
    G. Acknowledgement of Principal, if a Corporation;
    H. Acknowledgement of Principal, if a Partnership;
    I. Certification of OSHA 10-Hour Training.
    J. Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply.
    K. MassDEP Appendix B - Diesel Retrofit Program
    L. MassDEP Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

END OF TEXT

SEE ATTACHED PROPOSAL FORM

SEE ATTACHED APPENDIX

MassDEP Appendix B Diesel Retrofit Program

MassDEP Appendix E Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

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Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
	SRF ELIGIBLE BID ITEMS			
1	For Mobilization/Demobilization for Items 2 through 23 inclusive, as specified (maximum of five (5) percent of Items 2 through 23 inclusive bid), the sum of	l.s.	1	$ -
2A.	For furnishing and installing 1-1/4-inch through 3-inch, inclusive, Polyvinyl Chloride/High Density Polyethylene Low Pressure Sewer Pipe and Associated Fittings, All Depths, as specified, the sum of	per l.f.	20,610	$ -
2B.	For furnishing and installing 8-inch Polyvinyl Chloride Sewer Pipe and Associated Fittings, Less Than 10-feet in Depth, as specified, the sum of	per l.f.	8,330	$ -
2C.	For furnishing and installing 8-inch Polyvinyl Chloride Sewer Pipe and Associated Fittings, Greater Than 10-feet in Depth, as specified, the sum of	per l.f.	3,760	$ -
2D.	10-inch Polyvinyl Chloride Sewer Pipe and Associated Fittings - Not Used			
2E.	For furnishing and installing 12-inch Polyvinyl Chloride Sewer Pipe and Associated Fittings, All Depths, as specified, the sum of	per l.f.	4,620	$ -
2F.	For furnishing and installing 18-inch Polyvinyl Chloride Sewer Pipe and Associated Fittings, All Depths, as specified, the sum of	per l.f.	1,870	$ -

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
2G.	For furnishing and installing 8-inch PVC Force Main and Associated Fittings, All Depths, as specified, the sum of	per l.f.	7,460	$ -
2H.	For furnishing and installing 1-1/4-inch Polyvinyl Chloride Low-Pressure Sewer Service Connections and Associated Fittings from main line to property line, All Depths, as specified, the sum of	per l.f.	4,180	$ -
2I.	For furnishing and installing 6-inch Polyvinyl Chloride Service Connections and Associated Fittings from main line to property line as specified, the sum of	per l.f.	4,260	$ -
2J.	For furnishing and installing LPS Wyes, All Depths, as specified, the sum of	per each	200	$ -
2K.	For furnishing and installing 8-inch Polyvinyl Chloride Sewer Wyes, All Depths, as specified, the sum of	per each	120	$ -
2L.	10-inch Polyvinyl Chloride Sewer Wyes - Not Used			
2M.	For furnishing and installing 12-inch Polyvinyl Chloride Sewer Wyes, All Depths, as specified, the sum of	per each	50	$ -
2N.	For furnishing and installing 18-inch Polyvinyl Chloride Sewer Wyes, All Depths, as specified, the sum of	per each	10	$ -
2O.	For furnishing and installing Low Pressure Sewer Main Line Valves, All Sizes and Depths, as specified, the sum of	per each	50	$ -

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
3A.	For furnishing and installing 4-foot Diameter Precast Concrete Sewer Manholes, Less Than 10 feet in Depth, the sum of	per each	50	$ -
3B.	For furnishing and installing 4-foot Diameter Precast Concrete Sewer Manholes, Greater Than 10 feet in Depth, the sum of	per each	41	$ -
3C.	For furnishing and installing 5-foot Diameter Precast Concrete Sewer Manholes, All Depths, as specified, the sum of	per each	11	$ -
3D.	6-foot Diameter Precast Concrete Sewer Manholes - Not Used			
3E.	For furnishing and installing a Low Pressure Sewer Terminal Flushing Connection, All Depths, as specified, the sum of	per each	30	$ -
3F.	For furnishing and installing Low Pressure Sewer In-Line Flushing Connection, All Depths, as specified, the sum of	per each	22	$ -
3G.	For furnishing and installing 5-foot Diameter Precast Concrete Force Main Air Release/Vacuum Valve Manhole, All Depths, as specified, the sum of	per each	16	$ -
4A.	For furnishing and installing Manhole Frames and Covers, as specified, the sum of	per each	105	$ -
4B.	For furnishing and installing Watertight Manhole Frames and Covers, as specified, the sum of	per each	20	$ -

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
5	For furnishing and installing Interior Manhole Drop Connections, as specified, the sum of	per v.f.	30	$ -
6	For furnishing and installing chimneys, as specified, the sum of	per v.f.	700	$ -
7	For furnishing and placing miscellaneous cement concrete, as specified, the sum of	per c.y.	560	$ -
8	For Rock and Boulder Excavation including Replacement with Suitable Fill Material, as specified, the sum of *	per c.y.	830	$ -
	* Minimum Bid = $80/c.y.			
9A.	For Replacement of Unsuitable Material Below Trench Grade and/or Subgrade, as specified, the sum of	per c.y.	930	$ -
9B.	For Replacement of Unsuitable Material Above Trench Grade, as specified, the sum of	per c.y.	1,850	$ -
10	For Experimental Excavation, as specified, the sum of	per c.y.	560	$ -
11	Fill for embankments – Not Used			
12	Sheeting and/or shoring ordered left in place – Not Used			
13	For performing Soil Compaction Tests, as specified, the sum of	per each	190	$ -

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
14	For furnishing and placing Road Gravel Material, as specified, the sum of	per c.y.	12,200	$ -
15A.	Full Depth Reconstruction - Not Used			
15B.	For furnishing and placing Temporary Bituminous Concrete Trench Pavement in State Roadways (Base Course), as specified, the sum of * * Minimum Bid = $80/ton	per l.f.	210	$ -
15C.	For furnishing and placing Permanent Bituminous Concrete Trench Width Pavement in State Roadways (Base Course), as specified, the sum of * * Minimum Bid = $80/ton	per l.f.	210	$ -
15D.	Placing Permanent Bituminous Concrete Full Width Pavement in State Roadways (Top Course) - Not Used			
15E.	Milling and Placing Permanent Bituminous Concrete Full Width Pavement in State Roadways (Top Course) - Not Used			
15F.	For furnishing and placing Temporary Bituminous Concrete Trench Pavement in Town Roadways (Base Course), as specified, the sum of *	per l.f.	57,780	$ -
15G.	For furnishing and placing Permanent Bituminous Concrete Trench Width Pavement in Town Roadways (Base Course), as specified, the sum of *	per l.f.	57,780	$ -
15H.	For furnishing and placing Permanent Bituminous Concrete Full Width Pavement in Town Roadways (Top Course), as specified, the sum of * * Minimum Bid = $80/ton	per ton	2,470	$ -

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
15I.	For milling and furnishing and placing Permanent Bituminous Concrete Full Width Pavement in Town Roadways (Top Course), as specified, the sum of *	per ton	1,620	$ -
	* Minimum Bid = $80/ton			
15J.	For Miscellaneous Restoration of Municipal Roadways, as specified, the sum of *			
	One Hundred Thousand Dollars and No Cents $ 100,000.00	Allowance	1	$ 100,000.00
15K.	For furnishing and placing Miscellaneous Bituminous Concrete Pavement, as specified, the sum of *	per ton	610	$ -
	* Minimum Bid = $80/ton			
15L.	For furnishing and placing Dense Graded Gravel, as specified, the sum of			
	Fifty Thousand Dollars and No Cents $ 50,000.00	Allowance	1	$ 50,000.00
15M.	Vehicle Loop Detectors - Not Used			
15N.	For repainting of Traffic Markings - Lines, Symbols and Wording, as specified, the sum of			
	One Hundred Thousand Dollars and No Cents $ 100,000.00	Allowance	1	$ 100,000.00
15O.	For tracer wire, as specified, the sum of	per l.f.	55,050	$ -
16A.	For removal and relaying and/or replacement of Existing Water Mains and services, as specified, the sum of	per inch-foot	5,000	$ -
16B.	For removal and relaying and/or replacement of Existing Storm Drains, as specified, the sum of	per inch-foot	40,000	$ -

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
16C.	For removal and relaying and/or replacement of Existing Gas Mains and services, as specified, the sum of One Hundred Thousand Dollars and No Cents $ 100,000.00	Allowance	1	$ 100,000.00
16D.	For removal and relaying and/or replacement of Existing Miscellaneous Utilities, as specified, the sum of One Hundred Thousand Dollars and No Cents $ 100,000.00	Allowance	1	$ 100,000.00
16E.	For furnishing, installing and removal of 6-inch Water Main Line Stops, as specified, the sum of	per each	10	$ -
16F.	For furnishing, installing and removal of 8-inch Water Main Line Stops, as specified, the sum of	per each	10	$ -
17	Uniformed Traffic Police Officers - Paid by Owner			
18A.	For furnishing, installing, and removing Engineer's Field Office, as specified, the sum of	per l.s.	1	$ -
18B.	For maintaining Engineer's Field Office, as specified, the sum of	per month	30	$ -
19	For furnishing, installing, maintaining and removing Environmental Protection, as specified, the sum of	per l.f.	23,480	$ -
20	For furnishing, installing, maintaining and removing Trench Dewatering Equipment, as specified, the sum of	per l.f.	4,550	$ -
21	Temporary By-pass Pumping - Not Used			

Company's Name

Date

Company's Address

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

Item	Description		Unit of Measure	Quantity	Extended Total
22A.	For SCADA System Integrator, as specified, the sum of				
	Twenty Thousand Dollars and No Cents			1	$ 20,000.00
	$	20,000.00	Allowance		
22B.	For furnishing and installing SBR Transfer Pump, as specified, the sum of				
	Ninety Thousand Dollars and No Cents			1	$ 90,000.00
	$	90,000.00	Allowance		
22C.	For furnishing and installing SBR Blower, as specified, the sum of				
	Ninety Thousand Dollars and No Cents			1	$ 90,000.00
	$	90,000.00	Allowance		
22D.	For furnishing and installing SBR Aeration Grids, as specified, the sum of				
	Forty Thousand Dollars and No Cents			1	$ 40,000.00
	$	40,000.00	Allowance		
22E.	For furnishing and installing Variable Frequency Drives for SBR Transfer Pump and SBR Blower, as specified, the sum of				
	One Hundred Fifty Thousand Dollars and No Cents			1	$ 150,000.00
	$	150,000.00	Allowance		
23A.	For furnishing and installing Pumping Station No. 4, as specified, the sum of				
				1	$ -
			per l.s.		
23B.	For furnishing and installing Submersible Pumps, as specified, the sum of				
	One Hundred Thirty Five Thousand Dollars and No Cents			1	$ 135,000.00
	$	135,000.00	Allowance		
23C.	For furnishing and installing Variable Frequency Drives for Submersible Pumps, as specified, the sum of				
	One Hundred Fifty Thousand Dollars and No Cents			1	$ 150,000.00
	$	150,000.00	Allowance		
23D.	For furnishing and installing Odor Control System, as specified, the sum of				
	Forty Thousand Dollars and No Cents			1	$ 40,000.00
	$	40,000.00	Allowance		

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
23E.	For furnishing and installing Standby Diesel Engine Driven Generator Set, as specified, the sum of One Hundred Fifty Thousand Dollars and No Cents $ 150,000.00	Allowance	1	$ 150,000.00
23F.	For Davit Crane, as specified, the sum of Ten Thousand Dollars and No Cents $ 10,000.00	Allowance	1	$ 10,000.00
23G.	For Electric Company Connection/Service Fee, as specified, the sum of Fifty Thousand Dollars and No Cents $ 50,000.00	Allowance	1	$ 50,000.00
23H.	For Telephone Company Connection/Service Fee, as specified, the sum of Ten Thousand Dollars and No Cents $ 10,000.00	Allowance	1	$ 10,000.00
23I.	For Planting Operations, as specified, the sum of Twenty Thousand Dollars and No Cents $ 20,000.00	Allowance	1	$ 20,000.00

TOTAL AMOUNT OF BID BASED ON ENGINEER'S ESTIMATE OF QUANTITIES THE SUM OF (Bid Items 1 through 23, inclusive)

One Million Four Hundred Five Thousand Dollars and No Cents

$ 1,405,000.00

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
Item 24 - Replacement of Water Services				
24A.	For Mobilization/Demobilization for Items 24B through 24E inclusive, as specified (maximum of five (5) percent of Item 24B through 24E bid), the sum of	l.s.	1	$ -
24B.	For furnishing and installing Polyvinyl Chloride Water Services and Associated Fittings from water main to property line as specified, the sum of	per l.f.	3,750	$ -
24C.	For furnishing and placing Road Gravel Material, as specified, the sum of	per c.y.	670	$ -
24D.	For furnishing and placing Temporary Bituminous Concrete Trench Pavement, as specified, the sum of *	per ton	190	$ -
	* Minimum Bid = $80/ton			
24E.	For furnishing and placing Permanent Bituminous Concrete Trench Pavement, as specified, the sum of *	per ton	310	$ -
	* Minimum Bid = $80/ton			
	Item 24 - Replacement of Water Services (Bid Items 24A. through 24E., inclusive)			**$ -**

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
Item 25 - Replacement of Baxter Lane and Lucy's Lane Water Mains				
25A.	For Mobilization/Demobilization for Items 25B through 25I inclusive, as specified (maximum of five (5) percent of Item 25B through Item 25I bid), the sum of	l.s.	1	$ -
25B.	For furnishing and installing 8-inch DI water main and Associated Fittings, as specified, the sum of	per l.f.	1,600	$ -
25C.	For furnishing and installing 1-inch Polyvinyl Chloride Water Services and Associated Fittings from water main to property line as specified, the sum of	per l.f.	400	$ -
25D.	For furnishing and installing 6-inch Gate Valves and Boxes, as specified, the sum of	per each	4	$ -
25E.	For furnishing and installing 8-inch Gate Valves and Boxes, as specified, the sum of	per each	12	$ -
25F.	For furnishing and installing Fire Hydrants, as specified, the sum of	per each	5	$ -
25G.	For furnishing and placing Road Gravel Material, as specified, the sum of	per c.y.	300	$ -

Company's Name

Date

Company's Address

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

Item	Description	Unit of Measure	Quantity	Extended Total
25H.	For furnishing and placing Temporary Bituminous Concrete Trench Pavement, as specified, the sum of * * Minimum Bid = $80/ton	per ton	100	$ -
25I.	For furnishing and placing Permanent Bituminous Concrete Trench Pavement, as specified, the sum of * * Minimum Bid = $80/ton	per ton	150	$ -
	Item 25 - Replacement of Canal Road Water Main (Bid Items 25A. through 25I., inclusive)			**$ -**

Item 26 - Water Quality Improvements

26A.	For Mobilization/Demobilization for Items 26B through 26D inclusive, as specified (maximum of five (5) percent of Item 26B through Item 26D bid), the sum of	l.s.	1	$ -
26B.	For Pond Road Water Quality Improvements, as specified, the sum of	per l.s.	1	$ -
26C.	For Monument Road Water Quality Improvements, as specified, the sum of	per l.s.	1	$ -
26D.	For Water Quality Improvements at Pond Road and Monument Road, as specified, the sum of	per l.s.	1	$ -
	Item 26 - Water Quality Improvements (Bid Items 26A. through 26D., inclusive)			**$ -**

BASIS OF AWARD

BASIS OF AWARD = TOTAL AMOUNT SRF ELIGIBLE BID ITEMS BASED ON ENGINEER'S ESTIMATE OF QUANTITIES (Bid Items 1 through 26, inclusive)

One Million Four Hundred Five Thousand Dollars and No Cents

$ 1,405,000.00

APPENDIX B

APPENDIX B
DIESEL RETROFIT PROGRAM

The Department of Environmental Protection ("DEP") has developed the Diesel Retrofit Program in response to increasing public health concerns with the emissions from diesel engines and vehicles.

Diesel Construction Equipment Standard

All diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") must have the following pollution control device installed unless exempt as provided below:

1. Emission control technology verified by U.S. Environmental Protection Agency ("EPA") or the California Air Resources Board ("CARB") for use with non-road engines;
2. Emission control technology verified by EPA or CARB for use with on-road engines provided that such equipment is operated with diesel fuel that has no more than 15 parts per million sulfur content (i.e. Ultra Low Sulfur Diesel fuel); or
3. Emission control technology certified by the manufacturer that such technology meets or exceeds the emission reductions provided by on-road or off-road emission control technology verified by EPA or CARB, i.e. that a Diesel Oxidation Catalyst is achieving the following minimum emission reductions: particulate matter 20%; carbon monoxide 40%; volatile organic compounds 50%; or a Diesel Particulate Filter is achieving a minimum of 85% emission reductions for particulate matter.

Emission control devices, such as oxidation catalysts or particulate filters, shall be installed on the exhaust system side of the Diesel Construction Equipment. The Contractor shall be responsible to insure that the emissions control technology is operated, maintained, and serviced as recommended by the manufacturer.

For the latest up-to-date list of EPA verified-technologies, see:
https://www.epa.gov/verified-diesel-tech
For the latest up-to-date list of CARB verified technologies, see:
http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Exemptions

The following Diesel Construction Equipment shall be exempt from the standard above. The Contractor shall include such Diesel Construction Equipment in the required recordkeeping:

1. Diesel Construction Equipment not owned by the Contractor and used in the performance of the work under this Contract for 30 calendar days (cumulative days but not necessarily consecutive) or less;
2. Unless otherwise exempt, additional Diesel Construction Equipment originally not anticipated to be used under the Contract or used as permanent replacement after the work under the Contract has commenced, for 15 calendars days from the date such Diesel Construction Equipment is brought on site;

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APPENDIX B (cont.)
DIESEL RETROFIT PROGRAM

3. Diesel Construction Equipment with an engine that meets the EPA particulate matter (PM) Tier emission standards in effect at the start of the Contract for non-road diesel engines for the applicable engine power group (e.g., as of January 1, 2009, a piece of Diesel Construction Equipment with a Tier 3 engine is exempt from meeting the standard until the piece of Diesel Construction Equipment is available with a Tier 4 engine) provided that if such emissions standards are superseded during the Contract then such Diesel Construction Equipment must be retrofitted in accordance with the standards above prior to the end of the Contract;
4. A large crane (e.g. a sky crane or link belt crane which is responsible for critical lift operations) if such device would adversely affect the operation of the crane provided the Contractor submits to the municipality's project engineer written technical justification documenting the adverse impact on operation; and
5. Diesel Construction Equipment that the project engineer has determined is necessary to control a compelling emergency including but not limited to, the need for rescue vehicles or other equipment to prevent harm to human beings or additional equipment required to address a catastrophic emergency such as structure collapse or imminent collapse. After the compelling emergency is controlled, such non-compliant equipment must be removed from the Contract site and may not be used in further performance of the work under this Contract. Meeting Contract deadlines is not a compelling emergency.

Contractor Certification

Each bidder shall submit as part of its bid, the Statement of Intent to Comply. Within 10 days of being notified that it has been awarded a contract, the bidder and each of its Contractors and Subcontractors shall submit a Diesel Retrofit Program Contractor Certification. Each such Certification shall contain the following information for each piece of Diesel Construction Equipment:

1. Contractor or Subcontractor name;
2. Equipment type, make, model;
3. Vehicle Identification Number or VIN;
4. Engine model and year of manufacture;
5. Engine HP rating;
6. Emission Control Device (ECD) type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
7. ECD make, model, and manufacturer;
8. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
9. ECD installation date;
10. Type of fuel to be used; and
11. Whether the equipment is owned or rented.

Recordkeeping

Each Contractor and Subcontractor shall maintain detailed records of all Diesel Construction Equipment used under the Contract, including the dates and duration times the Diesel Construction Equipment is

APPENDIX B (cont.)
DIESEL RETROFIT PROGRAM

used at the Contract site. Records shall be available for inspection by DEP. Each Contractor and Subcontractor shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site.

For Diesel Construction Equipment that has an emissions control device with a manufacturer's certification, the Contractor shall maintain records of all supporting emissions test data and test procedures. If upon review the emissions reductions are not supported by the test data and test procedures, then the emissions control device may need to be replaced with a compliant retrofit device.

Project Regulatory Agreement

The following language shall be included section 4 (Covenants of the Borrower) of the municipality's Project Regulatory Agreement if it receives funds from the State Revolving Fund:

> The Borrower shall require each Contractor and Subcontractor to submit the Diesel Retrofit Program Contractor Certification to DEP and the Borrower prior to commencing work on the Project. The Borrower shall not allow any Contractor or Subcontractor to commence work at the Project site prior to submitting such Certification.

APPENDIX B (cont.)
DIESEL RETROFIT PROGRAM

STATEMENT OF INTENT TO COMPLY

This form must be signed and submitted by the bidder as part of the bid.

Local Governmental Unit _____ **SRF Project No.** _____

Contract No. _____ **Contact Title** _____

Bidder _____

The undersigned, on behalf of the above-named Bidder, agrees that, if awarded the Contract:

1. **the Bidder shall comply with the Massachusetts Department of Environmental Protection's ("MassDEP") Diesel Retrofit Program by ensuring that all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard;**
2. **the Bidder shall require all Subcontractors to comply with MassDEP's Diesel Retrofit Program by ensuring all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard; and**

3. **The Bidder shall submit and shall require each Subcontractor to submit a Diesel Retrofit Program Contractor Certification (form attached) with a Diesel Retrofit List to MassDEP Municipal Services and the Bidder within 10 days of the bidder being notified that it has been awarded the Contract. The Bidder shall require each Subcontractor to update such Certification and List within 2 days of using additional Diesel Construction Equipment on the project under the Contract.**

_____

(Signature of Bidder's Authorized Representative) **(Date)**

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APPENDIX B (cont.)
DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION

Each Contractor and its Subcontractor(s) must sign and email this form to the DEP DMS project engineer, within 10 days after the contractor is awarded.

Local Governmental Unit _____ **SRF Project No.** _____

Contract No. _____ **Contact Title** _____

Contractor _____

I, _____, an authorized signatory for _____, whose principal place of business is at _____ do hereby certify that any and all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") have pollution control devices, such as oxidation catalysts or particulate filters, installed on the exhaust system side of the diesel combustion engine equipment in accordance with the Diesel Retrofit Program Standard.

I am submitting on behalf of _____ a list of all said Diesel Construction Equipment, labeled "Diesel Retrofit List," that will be used in connection with this Contract by _____. I hereby certify that the information on the attached Diesel Retrofit List is correct and accurate as of the date of signature. The List includes the following information for each piece of Diesel Construction Equipment:

1. Equipment type, make, model;
2. Vehicle Identification Number or VIN;
3. Engine model and year of manufacture;
4. Engine HP rating;
5. Emission Control Device ("ECD") type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
6. ECD make, model, and manufacturer;
7. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
8. ECD installation date;
9. Type of fuel to be used; and
10. Whether the equipment is owned or rented.

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APPENDIX B (cont.)

DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION

_____shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site. _____shall maintain detailed records of all Diesel Construction Equipment used at the Contract site, including the dates and duration times the Diesel Construction Equipment is used at the Contract site. _____ shall make such records available for inspection by DEP. _____shall ensure that the emissions control technology for each piece of Diesel Construction Equipment is operated, maintained, and serviced as recommended by the manufacturer. _____ shall retrofit prior to the end of the Contract any Diesel Construction Equipment no longer exempt from meeting the Diesel Construction Equipment Standard under exemption 3 (because it had an engine that met the EPA particulate matter (PM) Tier emission standards currently in effect at the start of the Contract for non-road diesel engines for the applicable engine power group and such emissions standards were superseded during the Contract).

I acknowledge that this certificate is being furnished as a requirement under this Contract and is subject to applicable State and federal laws, both criminal and civil. Signed under pains and penalty of perjury on this date _____.

Signature_____

Name: _____

Title: _____

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APPENDIX E

APPENDIX E
CONSTRUCTION BID SPECIFICATIONS
SPECIAL PROVISIONS FOR DISADVANTAGED BUSINESS ENTERPRISES
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM BACKGROUND

In May 2008 a United States Environmental Protection Agency (EPA) rule became effective that changed the Minority Business Enterprise (MBE) and Women Business Enterprise (WBE) Program to a Disadvantaged Business Enterprise (DBE) Program.

For firms to qualify under the old MBE/WBE program they needed to be socially disadvantaged and had to be certified by the Supplier Diversity Office (SDO). Under the new DBE rule, the firms must be both **socially** and **economically** disadvantaged, **citizens of the United States**, and certified as a DBE. Women and certain minorities are presumed to be socially disadvantaged. The economic disadvantage is measured by the owner's initial and continuing personal net worth of less than $1,320,000.

Because the Clean Water Act requires the use of MBEs and WBEs, these firms will still be utilized in the State Revolving Fund (SRF) Loan Program, but they must also be certified as DBEs.

SDO will continue to be the certifying agency for the SRF program. SDO certifies firms under the federal Department of Transportation program, which is acceptable for use in the SRF program. An additional form has been added to the DBE package to verify that DBEs are owned or controlled by United States citizens.

BID SPECIFICATIONS

I. In this contract, the percentage of business activity to be performed by disadvantaged business enterprise(s) (DBE) shall not be less than the following percentages of the total contract price or the percentage submitted by the contractor in the Schedule of Participation, whichever is greater:

Disadvantaged MBE (D/MBE) 4.2% Disadvantaged WBE (D/WBE) 4.5%

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II. DEFINITIONS

For the purpose of these provisions, the following terms are defined as follows:

A. Awarding Authority – Entity that awards a prime contract under a State Revolving Fund loan.

B. Bidder - Any individual, partnership, joint venture, corporation, or firm submitting a price, directly or through an authorized representative, for the purpose of performing construction or construction related activities under a Contract.

C. Certified DBE – A DBE certified by the United States Small Business Administration, under its 8(a) Business Development Program (13 CFR part 124, subpart A) or its Small Disadvantaged Business Program (13 CFR part 124, subpart B); The United States Department of Transportation (DOT), under its regulations for Participation by DBSs in DOT programs (49 CFR parts 23 and 26); or SDO in accordance with 40 CFR part 33; provided that the certification meets the U.S. citizenship requirement under 40 CFR §33.202 or §33.203.

D. Compliance Unit - A subdivision of MassDEP's Affirmative Action Office designated to ensure compliance under these provisions.

E. Contractor - Any business that contracts or subcontracts for construction, demolition, renovation, survey, or maintenance work in the various classifications customarily used in work and that is acting in this capacity under the subject contract.

F. Construction Related Services - Those services performed at the work site ancillary to, and/or in support of, the construction work, such as hauling, trucking, equipment operation, surveying or other technical services, etc. For the purposes hereof, supply and delivery of materials (e.g. pre-cast concrete elements) to the site by a supplier who has manufactured those goods, or substantially altered them before re-sales shall be considered as "construction related services

G. Construction Work - The activities at the work site, or labor and use of materials in the performance of constructing, reconstructing, erecting, demolishing, altering, installing, disassembling, excavating, etc, all or part of the work required by the Contract Documents.

H. Disadvantaged Business Enterprise (DBE) - An entity owned or controlled by a socially and economically disadvantaged individual as described by Public Law 102-389 (42 U.S.C. 4370d) or an entity owned and controlled by a socially and economically disadvantaged individual as described by Title X of the Clean Air Act Amendments of 1990 (42 U.S.C. 7601 note); a Small Business Enterprise (SBE); a Small Business in a Rural Area (SBRA); or a Labor Surplus Area Firm (LAF), a Historically Underutilized Business (HUB) Zone Small Business Concern, or a concern under a successor program.

I. Equipment Rental Firm - A firm that owns equipment and assumes actual and contractual responsibility for renting said equipment to perform a useful function of the work of the contract consistent with normal industry practice

J. Good Faith Efforts – The race and/or gender neutral measures described in 40 CFR 33, subpart C.

K. HUBZone - A historically underutilized business zone, which is an area located within one or more qualified census tracts, qualified metropolitan counties, or lands within the external boundaries of an Indian reservation.

L. HUBZone small business concern - A small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

M. Joint Venture - An agreement between SDO certified DBE and a non-DBE or non-DBE controlled enterprise.

1. A pairing of companies will be considered a DBE joint venture if the SDO certified DBE which is part of the relationship has more than 51% of the profits that are derived from that project.

2. A joint venture between a certified DBE subcontractor and a non DBE subcontractor, in which the DBE for that proportion of the joint venture's contract equal to the DBE participation in the joint venture.

3. Whenever a general bid is filed by a joint venture with a certified DBE participant in the joint venture that does not exercise more than 51% control over management and profits, that joint venture shall be entitled to credit as a DBE for that portion of the joint venture's contract equal to the DBE participation in the joint venture. Minority As deemed by SDO.

N. Labor surplus area firm (LSAF) - A concern that together with its first-tier subcontractors will perform substantially in labor surplus areas (as identified by the Department of Labor in accordance with 20 CFR part 654). Performance is substantially in labor surplus areas if the costs incurred under the contract on account of manufacturing, production or performance of appropriate services in labor surplus areas exceed 50 percent of the contract price.

O. Letter of Intent – Certified document signed by the principal(s) of the DBE with respect to the work to be performed under contract.

P. Local Government Unit (LGU) – A city, town, or municipal district which applies for a loan under the Clean Water Trust Program.

Q. Material Supplier – A vendor certified by SDO as a DBE in sales to supply industry from an established place of business or source of supply, and that vendor.

1. Manufactures goods from raw materials, or substantially utilizes them in the work, or substantially alters them before resale, entitling the general contractor to DBE credit for 100% of the purchase order.

2. Provides and maintains a storage facility for materials utilized in the work, entitling the general contractor to DBE credit for 10% of the purchase order

R. Minority and Women Business Enterprise (M/WBE) – Any business concern certified by the SDO as a bona-fide M/WBE. A bona-fide M/WBE is a business whose minority group/women ownership interests are real, which have at least 51% ownership and control over management and operation.

S. Percent of Total Price – Is the percentage to be paid to the DBE, work they perform, as compared to the total bid price

T. Recipient - An agency, person or political subdivision which has been awarded or received financial assistance by the Trust or MassDEP.

U. Small business, small business concern or small business enterprise (SBE) - A concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding, and qualified as a small business under the criteria and size standards in 13 CFR part 121.

V. Small business in a rural area (SBRA) - A small business operating in an area identified as a rural county with a code 6-9 in the Rural-Urban continuum Classification Code developed by the United States Department of Agriculture in 1980.

W. SDO – The Supplier Diversity Office.

X. Subcontractor – A company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

Y. Total Contract Price – The total amount of compensation to be paid for all materials, work or services rendered in the performance of the contract

Z. Trust – The Massachusetts Clean Water Trust established by M.G.L. c.29.

III. REQUIREMENTS FOR CONTRACT AWARD

DBE packages must be submitted by the two lowest bidders on the project. Following bid opening, the LGU shall notify the two lowest bidders to submit DBE packages to the LGU or the LGUs consultant, as directed. By the close of business on the third business day after notification, the two lowest bidders, including a bidder who is a MBE, WBE or DBE, shall submit the following information:

A. A Schedule of Participation (Form EEO-DEP-190). The Schedule of Participation shall list those certified DBEs the bidder intends to use in fulfilling the contract obligations, the nature of the work to be performed by each certified DBE subcontractor and the total price they are to be paid.

1. A listing of bona-fide services such as a professional, technical, consultant or managerial services, assistance in the procurement of essential personnel, facilities, equipment, materials, or supplies required for performance of the contract, and reasonable fees or commissions charged.

2. A listing of haulers, truckers, or delivery services, not the contractors, including reasonable fees for delivery of said materials or supplies to be included on the project.

B. A Letter of Intent (Form EEO-DEP-191) for each DBE the bidder intends to use on the project. The Letter of Intent shall include, among other things, a reasonable description of the work the certified DBE is proposing to perform and the prices the certified DBE proposes to charge for the work. A Letter of Intent shall be jointly signed by the certified DBE and the General Contractor who proposes to use them in the performance of the Contract.

C. Each DBE must also sign and return the DBE Certification of United States Citizenship form to verify that the firm is owned or controlled by a United States citizen.

D. The SDO "DBE Certification" as prepared by each certified DBE.

E. A completed Request for Waiver form and backup documentation should the goals not be achieved (See IV below).

IV. REQUIREMENTS FOR MODIFICATION OR WAIVERS.

The bidder shall make every possible effort to meet the minimum requirements of certified DBE participation. If the percentage of DBE participation submitted by the bidder on its Schedule of Participation (EEO-DEP-190) does not meet the minimum requirements, the bid may be rejected by the Awarding Authority and found not to be eligible for award of the contract.

In the event that the bidder is unable to meet the minimum requirements of DBE participation, the bidder shall submit with his/her submittal required in Section III. Requirement of Contract Award a Request for Waiver form (EEO-DEP-490). The Awarding Authority shall review the waiver request to determine if the request should proceed. If approved by the Awarding Authority, the Awarding Authority shall submit the waiver request and supporting documentation, with a recommendation to MassDEP within five days of receipt of the Request for Waiver. MassDEP in conjunction with the project manager, Compliance Unit, will determine whether the waiver will be granted.

The waiver request shall include detailed information as specified below to establish that the bidder has made a good faith effort to comply with the minimum requirements of DBE participation specified in Part I. In addition, the bidder must show that such efforts were undertaken well in advance of the time set for opening of bids to allow adequate response. A waiver request shall include the following:

A. A detailed record of the effort made to contact and negotiate with the certified DBE, including, but not limited to:

   1. names, addresses and telephone numbers of all such companies contacted;

   2. copies of written notices(s) which were sent to certified DBE potential subcontractors, prior to bid opening;

   3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

   4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price;

   5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/ women-focused media detailing the opportunities for participation.

B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after MassDEP receives all required information and documentation, it shall make a decision in writing, whether the waiver is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing. If the waiver request is denied, the bid shall be rejected by the Awarding Authority, or the contract will be determined ineligible for SRF funding.

   If a Request for Waiver is denied by MassDEP and the bid is rejected by the Awarding Authority, the Awarding Authority may then move to the second bidder on the project. At the Awarding Authority's discretion, it may collect a DBE package from the third bidder on the project.

V. DISADVANTAGED BUSINESS ENTERPRISES PARTICIPATION

A. Reporting Requirements

1. The Contractor's utilization of certified DBEs will be documented based upon submittal of the LGU's monthly Payment Requisitions as reported on Form-2000. The Form-2000 form will show all certified DBEs performing work on the project regardless of any billing activity for that month. For auditing and accounting purposes, the Contractor periodically may be required to submit copies of canceled checks verifying that payments have been made to the certified DBE as listed on the schedule. The Contractor may also be required to submit current schedules on utilization of all DBEs to indicate when their services will commence and be billed for.

2. During the life of the Contract, the Contractor's fulfillment of the percentage requirements in Part I shall be determined with reference to the Contract price as follows:

   A. If the price in the Contract executed exceeds the base bid price (e.g., because an alternate was selected or because unit prices were used in awarding the Contract), the Contractor shall submit for approval by MassDEP a revised Schedule of Participation by certified DBEs satisfying the percentage requirements and such other information concerning additional DBE participation as may be requested by MassDEP.

   B. If the Contract price increases after execution due to change orders or other adjustments, MassDEP may require the Contractor to subcontract additional work or to purchase additional goods and services from certified DBEs up to the percentages stated in Part I.

VI. COMPLIANCE

A. If the Schedule or any of the Letters of Intent are materially incomplete or not submitted in a timely manner, the LGU may rescind its vote of award; treat the bid informal as to substance and reject the bid. If the bid is incomplete in any other respect than the Schedule the LGU with the approval of MassDEP may waive the informalities upon satisfactory completion of the required information by the Contractor and the certified DBE as applicable.

B. If the LGU finds that the percentage of certified DBE participation submitted by the contractor on its Schedule does not meet the percentage requirement in Part I, it shall rescind its vote of award and find such contractor not to be eligible for award of the contract.

C. The Contractor shall not perform with its own organization, or subcontract to any other primary or subcontractor any work designated for the named certified DBEs on the schedule submitted by the Contractor under Part III without the approval of MassDEP.

D. A Contractor's compliance with the percentage requirement in Part I shall continue to be determined by reference to the required percentage of the total contract price as stated in Section I even though the total of actual contract payments may be greater or less than the bid price.

E. If the Contractor for reasons beyond its control cannot comply with Part III in accordance with the Schedule submitted under Part III, Section B, the contractor must submit to MassDEP as soon as they are aware of the deficiency, the reason for its inability to comply. Proposed revisions to the Schedule stating how the contractor intends to meet its obligations under these conditions must be submitted within ten (10) working days of notification.

F. If the Contractor is becomes aware by any means that that DBE is no longer certified, the Contractor shall immediately notify MassDEP. The Contractor shall use good faith efforts to retain a substitute certified DBE.

G. If a certified DBE listed by the bidder in its Schedule of M/WBE contractors fails to obtain a performance or payment bond requested by the bidder, said failure shall not entitle the bidder to avoid the requirements of Part III (A). After a bidder has been awarded the contract, he shall not change the certified DBE listed in its Schedule at the time of the award or make any other such substitutions without the written approval of MassDEP.

VII. SANCTIONS

A. If the Contractor does not comply with the terms of these Special Provisions, the Awarding Authority may (1) suspend any payment for the work that should have been performed by a certified DBE pursuant to the schedule, or (2) require specific performance of the Contractor's obligation by requiring the Contractor to subcontract with a DBE for any contract or specialty item at the contract price established for that item in the proposal submitted by the Contractor.

B. To the extent that the Contractor has not complied with the terms of these Special Provisions, the Awarding Authority may retain in connection with Estimates and Payments an amount determined by multiplying the bid price of this contract by the percentage in Section I, less the amount paid to DBE's for work performed under the contract and any payments already suspended under VII A.

C. The Awarding Authority may suspend, terminate or cancel this contract, in whole or in part, or may call upon the Contractor's surety to perform all terms and conditions in the contract, unless the contractor is able to demonstrate his compliance with the terms

of these Special Provisions, and further deny to the Contractor, the right to participate in any future contracts awarded by the Awarding Authority for a period of up to three years.

D. In any proceeding involving the imposition of sanctions by the Awarding Authority, no sanctions shall be imposed if the Awarding Authority finds that the contractor has taken every possible measure to comply with these Special Provisions or that some other justifiable reason exists for waiving these Special Provisions in whole or in part.

E. The contract shall provide such information as is necessary in the judgment of the Awarding Authority to ascertain its compliance with the terms of these Special Provisions.

F. A contractor shall have the right to request suspension of any sanctions imposed under this section upon demonstrating that he is in compliance with these Special Provisions.

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

SCHEDULE OF PARTICIPATION FOR SRF CONSTRUCTION

Project Title: _____ **Project Location:** _____

Disadvantaged Minority Business Enterprise Participation in the SRF Loan Work

Name & Address of D/MBE	Nature of Participation	Dollar Value of Participation
1.		
2.		
3.		
	Total D/MBE Commitment:	**$**
Percentage D/MBE Participation = (Total D/MBE Commitment) / (Bid Price) =		**%**

Disadvantaged Women Business Enterprise Participation in the SRF Loan Work

Name & Address of D/WBE	Nature of Participation	Dollar Value of Participation
1.		
2.		
3.		
	Total D/WBE Commitment:	**$**
Percentage D/WBE Participation = (Total D/WBE Commitment) / (Bid Price) =		**%**

The Bidder agrees to furnish implementation reports as required by MassDEP to indicate the D/MBEs and D/WBE(s) which it has used or intends to use. Breach of this commitment constitutes a breach of the contract.

Name of Bidder: _____

Date: _____ By: _____
Signature

NOTE: Participation of a DBE may be counted in only their certified category; the same dollar participation cannot be used in computing the percentage of D/MBE participation and again of D/WBE participation.

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LETTER OF INTENT FOR SRF CONSTRUCTION

This form is to be completed by the D/MBE and D/WBE and must be submitted by the Bidder no later than close of business on the third business day after notification by the LGU. A separate form must be completed for each D/MBE and D/WBE involved in the project.

Project Title: _____ Project Location: _____

TO: _____
(Name of Bidder)

FROM: _____
(Please Indicate Status [ ] D/MBE or [ ] D/WBE)

º I/we intend to perform work in connection with the above project as (check one):

[ ] An individual
[ ] A corporation
[ ] A partnership
[ ] A joint venture with: _____
[ ] Other (explain): _____

º It is understood that if you are awarded the contract, you intend to enter into an agreement to perform the activity described below for the prices indicated.

DBE PARTICIPATION

Description of Activity	Date of Project Commencement	$ Amount	% Bid Price
		$	**%**

º The undersigned certify that they will enter into a formal agreement upon execution of the contract for the above referenced project.

BIDDER	**DBE**
(Authorized Original Signature) Date ADDRESS:	(Authorized Original Signature) Date ADDRESS:
TELEPHONE #:	TELEPHONE #:
FEIN:	FEIN:
EMAIL ADDRESS:	EMAIL ADDRESS:

ORIGINALS:
- **º Compliance Mgr. City/Town Project Location**
- **º DEP Program Manager for DEP's AAO Director**

*** Attach a copy of current (within 2 years) DBE Certification**

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DBE CERTIFICATION OF UNITED STATES CITIZENSHIP

For the SRF program, under the EPA Disadvantage Business Enterprise (DBE) Rule, a DBE must be owned or controlled by a socially and economically disadvantaged person that is also a **citizen of the United States** (*See* 40 CFR 33.202). "Ownership" is defined at 13 CFR 124.105 and "control" is defined at 13 CFR 124.106.

DBEs are certified for the SRF program through the Supplier Diversity Office using the federal Department of Transportation (DOT) DBE rules. EPA allows the use of DBEs certified under the DOT rules as long as they are also United States citizens. To ensure compliance with the EPA rule, MassDEP must verify United States citizenship through the completion of the following form for each DBE used on the project.

SRF Project Number _____

Contract Number _____

Contract Title _____

DBE Subcontractor _____

The undersigned, on behalf of the above named DBE subcontractor, hereby certifies that the DBE firm is either owned or controlled by a person or persons that are citizens of the United States.

_____
Printed Name and Title of DBE Signatory

_____
DBE Signature

_____
Date

DISADVANTAGED BUSINESS ENTERPRISE
PROGRAM DBE SUBCONTRACTOR PARTICIPATION
FORM

The United States Environmental Protection Agency (EPA) requires that this form be provided to all subcontractors on the project. At the option of the subcontractor, this form may be filled out and submitted directly to the EPA DBE Coordinator.

NAME OF SUBCONTRACTOR	PROJECT NAME
ADDRESS	CONTRACT NO.
TELEPHONE NO.	E-MAIL ADDRESS
PRIME CONTRACTOR NAME:	

Please use the space below to report any concerns regarding the above EPA-funded project (e.g., reason for termination by prime contractor, late payment, etc.).

_____

_____

_____

_____

_____

CONTRACT ITEM NO.	ITEM OF WORK OR DESCRIPTION OF SERVICES RECEIVED FROM THE PRIME CONTRACTOR	AMOUNT SUBCONTRACTOR WAS PAID BY PRIME CONTRACTOR

_____ _____
Subcontractor Signature Title/Date

Equivalent to EPA form 6100-2

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REQUEST FOR WAIVER FOR SRF CONSTRUCTION

Upon exhausting all known sources and making every possible effort to meet the minimum requirements for DBE participation, the Bidder may seek relief either partially or entirely from these requirements by submitting a completed waiver package by the close of business on the third business day after notification by the LGU. Failure to comply with this process shall be cause to reject the bid thereby rendering the Bidder not eligible for award of the contract.

General Information

Project Title: _____ Project Location: _____

Bid Opening (time/date) _____

Bidder: _____

Mailing Address: _____

Contact Person: _____ Telephone No. ( ) _____ Ext. _____

Minimum Requirements

The bidder must demonstrate that good faith efforts were undertaken to comply with the percentage goals as specified. The firm seeking relief must show that such efforts were taken appropriately in advance of the time set for opening bid proposals to allow adequate time for response(s) by submitting the following:

A. A detailed record of the effort made to contact and negotiate with disadvantaged minority and/or woman owned businesses, including:

1. names, addresses, telephone numbers and contact dates of all such companies contacted;

2. copies of written notice(s) which were sent to DBE potential subcontractors prior to bid opening;

3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price.

5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/women-focused media detailing the opportunities for participation;

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B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after submission of all required information and documentation, MassDEP shall make a determination, in writing, whether the waiver request is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing.

CERTIFICATION

The undersigned herewith certifies that the above information and appropriate attachments are true and accurate to the best of my knowledge and that I have been authorized to act on behalf of the bidder in this matter.

_____ _____

(authorized original signature) DATE

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

STATE REVOLVING FUND LOAN PROGRAM – SCHEDULE OF SUBCONTRACTOR PARTICIPATION

Local Governmental Unit _____

Project Name _____

SRF Identification Number _____

General Contractor _____

Contract Value _____

The United States Environmental Protection Agency (EPA) requires that all SRF borrowers develop and maintain a list of all MBE/WBE and non MBE/WBE subcontractors on the project.

This form must be completed and returned to MassDEP within 90 days of award of the contract.

Subcontractor	Point of Contact	Mailing Address	Telephone Number	E-Mail Address	MBE	WBE	DBE	Subcontract Value

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SECTION 00520

AGREEMENT

Made in triplicate this the _____ day of _____, 20___ between the Town of Orleans, MA

AND

hereafter the "Contractor".

WITNESSETH: That for and in consideration of the following mutual covenants contained herein the parties agree with each other as follows:

ARTICLE I: The Contractor agrees to sell and/or deliver to the Town of Orleans, MA materials and/or services in accordance with the following: MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION, Contract No. 2022-01 and SRF No. 7150:

Exhibit 1. Quote/bid dated

Exhibit 2. Certificate of Non-Collusion

Exhibit 3. Statement of State Tax Compliance

Exhibit 4. Acknowledgement of Principal

Exhibit 5. Certificate of Insurance

Exhibit 6. Certification of OSHA 10-Hour Training

ARTICLE II: The Town of Orleans, MA agrees to process the bills for payment to the Contractor upon the execution of the contract, satisfactory completion of the services as outlined in the specifications and approval by the appropriate Department Manager, Town Administrator and Town Accountant in the amount of _____-- and 00/100 ($___.00) Dollars.

ARTICLE III

1. The Contractor agrees that it will fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled Responsibilities of Participants Regarding Transactions (Doing Business with Other Persons). The Contractor shall not award any subcontracts or purchase any materials from suppliers that appear on the Excluded Parties List System.

   The Contractor shall include this requirement in each subcontract and require it to be included in all subcontracts regardless of tier. The Contractor shall maintain reasonable records to demonstrate compliance with these requirements.

2. The fair share goals for disadvantaged business enterprise (DBE) participation for this contract are a minimum of 4.2 percent Disadvantaged Minority Business Enterprise (D/MBE) participation and 4.5 percent Disadvantaged Women Business Enterprise(D/WBE) participation, applicable to the total dollar amount paid for the construction contract. The Contractor shall take all affirmative steps necessary to achieve this goal, and shall provide reports documenting the portion of contract and subcontract dollars paid to DBEs, and its efforts to achieve the goals, with each invoice submitted or at such greater intervals as specified by the (municipality). The contractor shall require similar reports from its subcontractors.

3. Equal Employment Opportunity/Affirmative Action (EEO/AA) Requirements - During the performance of this contract, the contractor agrees as follows:

   A. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

B. The contractor will, in all solicitations or advancements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

C. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under Section 202 of Executive Order No. 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

D. The contractor will comply with all provisions of Executive Order No. 11246 of Sept. 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

E. The contractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders. Comp., p. 684, EO 12086 of Oct. 5, 1978, 43 FR 46501, 3 CFR, 1978 Comp., p. 230

F. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be cancelled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of Sept. 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

G. The contractor will include the provisions of paragraphs (A) through (G) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the contractor may request the United States to enter into such litigation to protect the interests of the United States." [Sec. 202 amended by EO 11375 of Oct. 13, 1967, 32 FR 14303, 3 CFR, 1966- 1970”

4. The contractor shall not participate in or cooperate with an international boycott, as defined in Section 999 (b)(3) and (4) of the Internal Revenue code 1986, as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Massachusetts General Laws.

5. The Bidder hereby agrees that if selected as the Contractor it will commence work under this contract on or before a date to be fixed in the written “Notice to Proceed” given by the Owner to the Contractor and to fully complete the project within 880 calendar days, using not more than 529 working days split into four phases.

6. The Bidder further agrees to pay as liquidated damages the sum of $3,500 for each consecutive calendar day thereafter during which the work as not been fully completed beyond the contract completion date, as provided in the “Liquidated Damages” provisions of SECTION 00800, SUPPLEMENTARY CONDITIONS.

7. As per MassDEP’s Policy Memorandum #10 – the agreed upon DIRECT LABOR MARKUP (percentage) for Change Orders on this project shall be ___ percent.

8. American Iron and Steel (AIS) Requirements - The Contractor acknowledges to and for the benefit of the Town of Orleans ("Purchaser") and the Commonwealth of Massachusetts (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees)incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

9. All contracts for clean and drinking water projects awarded as a result of a proposal or invitation for bids under MGL Chapter 30 section 39M shall include a price adjustment clause for fuel, both diesel and gasoline; liquid asphalt; and Portland cement contained in cast-in-place concrete. A base price for each material shall be set by the awarding authority or agency and shall be included in the bid documents at the time the project is advertised. The awarding authority or agency shall also identify in the bid documents the price index to be used for each material. The price adjustment clause shall provide for a contract adjustment to be made on a monthly basis when the monthly cost change exceeds plus or minus 5 percent.

10. All construction contracts are subject to the Davis Bacon wage rate requirements.

11. The Contractor agrees that it will fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled Responsibilities of Participants Regarding Transactions (Doing Business with Other Persons). The Contractor shall not award any subcontracts or purchase any materials from suppliers that appear on the Excluded Parties List System. The Contractor shall include this requirement in each subcontract and require it to be included in all subcontracts regardless of tier. The Contractor shall maintain reasonable records to demonstrate compliance with these requirements.

IN WITNESS: Whereof the respective parties hereto have caused this instrument to be duly subscribed and sealed.

TOWN OF ORLEANS, MA **(INSERT VENDOR'S NAME)**

_____ _____

Orleans Town Administrator Signature of Individual or Corporate Name (Mandatory)

APPROVED AS TO APPROPRIATIONS: Pursuant to M.G.L. c.44, s31C, I certify that an appropriation has been made in the total amount of the contract.

_____

Cathy Doane
Finance Director

SOURCE: _____

_____

Corporate Officer

(Mandatory, If applicable)

EIN # (Mandatory) _____

Not to Exceed: $_____

END OF DOCUMENT

SECTION 00520

ATTACHMENT A

ADDITIONAL FORMS TO BE SUBMITTED WITH THE BID

A. Microsoft Excel Proposal Form (hard copy in Landscape Format and ".xlsm" format copy on Thumb Drive);

B. Bid Security (5%);

C. Completed and signed Bid Proposal and Project Reference List;

D. Insurance Requirements for Inclusion in All Specifications and Contracts;

E. Statement of State Tax Compliance;

F. Certificate of Non-Collusion;

G. Acknowledgement of Principal, if a Corporation;

H. Acknowledgement of Principal, if a Partnership;

I. Certification of OSHA 10-Hour Training.

J. Massachusetts Department of Environmental Protection's Diesel Retrofit Program Statement of Intent to Comply.

K. MassDEP Appendix B - Diesel Retrofit Program

L. MassDEP Appendix E - Construction Bid Specifications – Special Provisions for Disadvantaged Business Enterprises – Massachusetts Department of Environmental Protection Division of Municipal Services

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INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150

Insurance. The Contractor shall carry and maintain in effect during the entire currency of the contract, at his own expense, the following kinds and minimum amounts of insurance in a company or companies approved by the Town of Orleans, MA. Such insurance shall cover claims and suits which arise out of or result from the Contractor's execution of the contract work whether such execution by the Contractor himself or by any Subcontractor.

1) X - Worker's Compensation as required by the Worker's Compensation Laws of the Commonwealth of Massachusetts and, in conjunction therewith, Employer's Liability with a minimum limit as required by statute.

2) X - "Broad Form" Comprehensive General Liability including, but not limited to, Bodily Injury, Personal Injury and Property Damage Liability, Full Contractual Liability and liability arising from Explosion, Collapse and Underground Damage and all other applicable insurance necessary to carry out the contractual obligation to proceed under the contract. Provide a minimum limit of liability of $5,000,000.00 utilizing: (a) a standalone certificate or (b) a minimum $2,000,000.00 General Liability Policy combined with Umbrella Policy.

3) X - Automobile Bodily Injury and Property Damage Liability for all owned, non-owned and hired automobiles operated in connection with the performance of the contract. Minimum limits of liability: Single limits of Property Damage and Bodily Injury $1,000,000.

4) X - Builder's Risk - Amount of the General Contractor's Contract

5) __ - Professional Liability/ Errors and Omissions – Not Required

Certificate of Insurance - Prior to beginning work under the contract, the Contractor shall furnish the Town of Orleans, MA a Certificate of Insurance naming the Town of Orleans, MA and AECOM Technical Services, Inc. as additional insured. Such Certificate also shall provide that the Town of Orleans, MA will be notified at least 30 days in advance of the cancellation or non-renewal of any insurance covered by the Certificate.

END OF DOCUMENT

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STATEMENT OF STATE TAX COMPLIANCE

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150

Pursuant to Ch. 233 of the Acts of 1983, §49A(b), I, _____, acknowledge that I am the authorized signatory for _____, whose principal place of business is at _____ , and as such, do hereby certify under the pains of penalties of perjury that this company has complied with all laws of the Commonwealth relating to taxes.

Social Security or Federal ID Number: _____

Subscribed and sworn to this _____day of _____, 20____.

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

END OF DOCUMENT

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CERTIFICATE OF NON-COLLUSION

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150

Pursuant to M.G.L. Ch. 30, the undersigned certifies under penalties of perjury that this bid or proposal has been made and submitted in good faith and without collusion or fraud with any other person. As used in this certification, the word "person" shall mean any natural person, business, partnership, corporation, union, committee, club, or other organization, entity, or group of individuals.

_____

Name of business

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

END OF DOCUMENT

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ACKNOWLEDGEMENT OF PRINCIPAL, IF A CORPORATION

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150

State of _____

County of _____

SS: _____

On this ___ day of _____, 20__, before me personally came and appeared to me who, being by me duly sworn, did depose and say to me that he resides at _____ that he is of _____, the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the impressions affixed to said instrument is an impression of such seal; that it was so affixed by the order of the directors of said corporation, and that he signed his name thereto by like order.

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

END OF DOCUMENT

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ACKNOWLEDGEMENT OF PRINCIPAL, IF A PARTNERSHIP

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150

State of _____

County of _____

SS: _____

On this ___ day of _____, 20__, before me personally came and appeared _____ to me known, and known to me to be one of the members of the firm described in and which executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

END OF DOCUMENT

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CERTIFICATION OF OSHA 10-HOUR TRAINING

OWNERS NAME: Town of Orleans, MA

PROJECT NAME: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01 and SRF No. 7150

A contractor will not be eligible for award of a contract unless such contractor has submitted the following certification, which is deemed a part of the resulting contract.

All employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

State of _____

County of _____

SS: _____

On this ___ day of _____, 20__, before me personally came and appeared _____ to me known, and known to me to be one of the members of the firm described in and which executed the foregoing instrument and he acknowledged to me that he executed the same as and for the act and deed of said firm.

_____

Contractor's Signature

_____

Notary Public Signature

(Seal)

My Commission expires on: _____

END OF DOCUMENT

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SECTION 00610

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That we _____
(Name of Contractor)

a _____ hereinafter called "Principal" and
(Corporation, Partnership, Joint Venture, LLC or Individual)

_____ of _____, State of _____
(Surety) (City)

hereinafter called the "Surety" and licensed by the State Division of Insurance to do business under the laws of the Commonwealth of Massachusetts, are held and firmly bound to the Town of Orleans, MA, Orleans, Massachusetts, hereinafter called "Owner", in the penal sum of _____Dollars and _____Cents ($) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas the Principal has entered into a certain contract with the Owner (the "Construction Contract"), dated the _____ day of _____, 20____, for the construction described as follows:

MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION

Contract No. 2022-01 and SRF No. 7150

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of the Construction Contract during the original term thereof, and any extensions thereof which may be granted by the Owner, with or without notice to the Surety, and if he shall satisfy all claims and demands incurred under the Construction Contract, and shall fully indemnify and save harmless the Owner from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any default, then this obligation shall be void; otherwise, this obligation shall remain in full force and effect.

PROVIDED, FURTHER, that the Surety's obligation under this Bond shall arise after (1) the Owner has declared the Principal in default of the Construction Contract or any provision thereof, or (2) has declared that the Principal has failed, or is otherwise unable or unwilling, to execute the work consistent with, and in conformance to, the Construction Contract (collectively referred to as a "Contractor Default"). The determination of a Contractor Default shall be made solely by the Owner. The Owner need not terminate the Construction Contract to declare a Contractor Default or to invoke its rights under this Bond, and Contractor hereby agrees not to assert any claims against Surety under any indemnity or similar agreements on the grounds that Surety has interfered with the Construction Contract by fulfilling its obligations hereunder in the absence of a termination of said contract.

When the Surety's obligation under this Bond arises, the Surety, at its sole expense and at the consent and election of the Owner, shall promptly take one of following steps: (1) arrange for the Principal to perform and complete the work of the Construction Contract; (2) arrange for a contractor other than the Principal to perform and complete the work of the Construction Contract;
(3) reimburse the Owner, in a manner and at such time as the Owner shall reasonably decide, for all costs and expenses incurred by the Owner in performing and completing the work of the Construction Contract. Surety will keep Owner reasonably informed of the progress, status and results of any investigation of any claim of the Owner.

If the Surety does not proceed as provided in this Bond with due diligence and all deliberate speed, the Surety shall be deemed to be in default of this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner.

After the Surety's obligation under this Bond arises, the Surety is obligated, to the limit of the amounts of this Bond, for (1) the correction of defective work and completion of the Construction Contract; (2) additional design, professional services, and legal costs, including attorney's fees, resulting from the Contractor Default or from the default of the Surety under this Bond; (3) any additional work beyond the Construction Contract made necessary by the Contractor Default or default of the Surety under this Bond; (4) indemnification obligations of the Principal, if any, as provided in the Construction Contract; and (5) liquidated damages as provided in the Construction Contract, or if no such damages are specified, actual damages and consequential damages resulting from the Contractor Default or any default of the Surety under this Bond.

Any proceeding, legal or equitable, under this Bond shall be instituted in any court of competent jurisdiction in the Commonwealth of Massachusetts.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Construction Contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Construction Contract or to the work or to the specifications.

The Surety providing the Bond shall have a rating of A or better within Best's Key Rating Guide.

IN WITNESS WHEREOF, this instrument is executed in three (3) counterparts, each one of which shall be deemed an original, this _____ day of _____, 20____.

ATTEST:

Principal	Witness
Principal Signature	Witness as to Principal Signature
Name and Title	Name and Title
Address	Address
City and State	City and State

(SEAL)

ATTEST:

Surety	Witness
Attorney-in-Fact Signature	Witness as to Surety Signature
Name and Title	Name and Title
Address	Address
City and State	City and State

(SEAL)

NOTES: Date of Bond must not be prior to date of Contract.
If Contractor is a Partnership, all partners shall execute Bond.

END OF DOCUMENT

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SECTION 00615

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That we _____
(Name of Contractor)

a _____ hereinafter called "Principal" and
(Corporation, Partnership, Joint Venture, LLC or Individual)

_____ of _____, State of _____
(Surety) (City)

hereinafter called the "Surety" and licensed by the State Division of Insurance to do business under the laws of the Commonwealth of Massachusetts, are held and firmly bound to the Town of Orleans, MA, Orleans, Massachusetts, hereinafter called "Owner", in the penal sum of _____Dollars and _____Cents ($) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas the Principal has entered into a certain contract with the Owner (the "Construction Contract"), dated the _____ day of _____, 20____, for the construction described as follows:

MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION

CONTRACT NO. 2022-01 AND SRF NO. 7150

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms, subcontractors, and corporations furnishing materials for or performing labor in the prosecution of the work provided for in such contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such work, and all insurance premiums on said work, and for all labor, performed in such work whether by subcontractor or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of this contract or to the work or to the specifications. The Surety Company providing the bond shall have a rating of A or better within the Best Key Rating Guide.

PROVIDED, FURTHER, that no final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____ ( ) counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20__.

ATTEST:

Principal	Witness
Principal Signature	Witness as to Principal Signature
Name and Title	Name and Title
Address	Address
City and State	City and State

ATTEST:

Surety	Witness
Attorney-in-Fact Signature	Witness as to Surety Signature
Name and Title	Name and Title
Address	Address
City and State	City and State

(SEAL)

NOTES: Date of Bond must not be prior to date of Contract.
If Contractor is a Partnership, all partners shall execute Bond.

END OF DOCUMENT

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE

a practice division of the

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

_____

AMERICAN CONSULTING ENGINEERS COUNCIL

_____

AMERICAN SOCIETY OF CIVIL ENGINEERS

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American Consulting Engineers Council

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GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

A. Wherever used in the Contract Documents and printed with initial or all capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between OWNER and CONTRACTOR covering the Work.

3. *Application for Payment*--The form acceptable to ENGINEER which is to be used by CON- TRACTOR during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a bidder submit- ted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidding Documents*--The Bidding Requirements and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

7. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, Bid security form, if any, and the Bid form with any supplements.

8. *Bonds*--Performance and payment bonds and other instruments of security.

9. *Change Order*--A document recommended by ENGINEER which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by OWNER or CONTRACTOR seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the OWNER and CONTRACTOR concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

*****12. *Contract Documents*--The Contract Documents establish the rights and obligations of the parties and include the Agreement, Addenda (which pertain to the Con- tract Documents), CONTRACTOR's Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders, and ENGINEER's written interpretations and clarifications issued on or after the Effective Date of the Agreement. Approved Shop Drawings and the reports and drawings of subsurface and physical conditions are not Contract Documents. Only printed or hard copies of the items listed in this paragraph are Contract Documents. Files in electronic media format of text, data, graphics, and the like that may be furnished by OWNER to CONTRACTOR are not Contract Documents.

13. *Contract Price*--The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Substantial Completion; and (ii) complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment.

15. *CONTRACTOR*--The individual or entity with whom OWNER has entered into the Agreement.

16. *Cost of the Work*--See paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by ENGINEER which graphically shows the scope, extent, and character of the Work to be performed by CONTRACTOR. Shop Drawings and other CONTRACTOR submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

*****19. *ENGINEER*--The individual or entity named as such in the Agreement.

*****20. *ENGINEER's Consultant*--An individual or entity having a contract with ENGINEER to furnish services as ENGINEER's independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

21. *Field Order*--A written order issued by ENGINEER which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

22. General Requirements--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

23. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

24. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

25. *Laws and Regulations; Laws or Regulations*-- Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

27. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

28. *Notice of Award*--The written notice by OWNER to the apparent successful bidder stating that upon timely compliance by the apparent successful bidder with the conditions precedent listed therein, OWNER will sign and deliver the Agreement.

29. *Notice to Proceed*--A written notice given by OWNER to CONTRACTOR fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform the Work under the Contract Documents.

**30. *OWNER*--The individual, entity, public body, or authority with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be performed.

31. *Partial Utilization*--Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

32. *PCBs*--Polychlorinated *biphenyls.*

33. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

34. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part as may be indicated elsewhere in the Contract Documents.

35. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

36. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

37. *Resident Project Representative*--The authorized representative of ENGINEER who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

40. *Site*--Lands or areas indicated in the Contract Documents as being furnished by OWNER upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by OWNER which are designated for the use of CONTRACTOR.

*41. *Specifications*~~--That part of the Contract Documents consisting of written technical descriptions of materials, equipment, systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.~~

42. *Subcontractor*--An individual or entity having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

**43. *Substantial Completion*--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

44. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

45. *Supplier*--A manufacturer, fabricator, supplier, distributor, material-man, or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

46. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

47. *Unit Price Work*--Work to be paid for on the basis of unit prices.

48. *Work*--The entire completed construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

49. *Work Change Directive*--A written statement to CONTRACTOR issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

50. *Written Amendment*--A written statement modifying the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the non-engineering or nontechnical rather than strictly construction-related aspects of the Contract Documents.

1.02 Terminology

A. Intent of Certain Terms or Adjectives

1. Whenever in the Contract Documents the terms "as allowed," "as approved," or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of ENGINEER as to the Work, it is intended that such action or determination will be solely to evaluate, in general, the completed Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise).

   The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

B. Day

1. The word "day" shall constitute a calendar day of 24 hours measured from midnight to the next midnight.

C. Defective

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.04 or 14.05).

D. Furnish, Install, Perform, Provide

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of CONTRACTOR, "provide" is implied.

E. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

2.01 Delivery of Bonds

A. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish.

2.02 Copies of Documents

A. OWNER shall furnish to CONTRACTOR up to ten copies of the Contract Documents. Additional copies will be furnished upon request at the cost of reproduction.

2.03 Commencement of Contract Times; Notice to Proceed *

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 Starting the Work

A. CONTRACTOR shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 Before Starting Construction

A. *CONTRACTOR's Review of Contract Documents:* Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error, ambiguity, or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless CONTRACTOR knew or reasonably should have known thereof.

B. *Preliminary Schedules:* Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for its timely review:

1. a preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary schedule of Shop Drawing and Sample submittals which will list each required submittal and the times for submitting, reviewing, and processing such submittal; and

3. a preliminary schedule of values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

*****C. *Evidence of Insurance:* ~~Before any Work at the Site is started, CONTRACTOR and OWNER shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which CONTRACTOR and OWNER respectively are required to purchase and maintain in accordance with Article 5.~~

2.06 Preconstruction Conference

A. Within 20 days after the Contract Times start to run, but before any Work at the Site is started, a conference attended by CONTRACTOR, ENGINEER, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.05.B, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 Initial Acceptance of Schedules

A. Unless otherwise provided in the Contract Documents, at least ten days before submission of the first Application for Payment a conference attended by CON- TRACTOR, ENGINEER, and others as appropriate will be held to review for acceptability to ENGINEER as provided below the schedules submitted in accordance with paragraph 2.05.B. CONTRACTOR shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to CONTRACTOR until acceptable schedules are submitted to ENGINEER.

1. The progress schedule will be acceptable to ENGINEER if it provides an orderly progression of the Work to completion within any specified Mile- stones and the Contract Times. Such acceptance will not impose on ENGINEER responsibility for the progress schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor.

2. CONTRACTOR's schedule of Shop Drawing and Sample submittals will be acceptable to ENGINEER if it provides a workable arrangement for reviewing and processing the required submittals.

3. CONTRACTOR's schedule of values will be acceptable to ENGINEER as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent

*****A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to OWNER.

C. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in Article 9.

3.02 Reference Standards

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of OWNER, CONTRACTOR, or ENGINEER, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to OWNER, ENGINEER, or any of ENGINEER's Consultants, agents, or employees any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 Reporting and Resolving Discrepancies

A. Reporting Discrepancies

1. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, CONTRACTOR shall report it to ENGINEER in writing at once. CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as required by paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in paragraph 3.04; provided, however, that CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity, or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways: (i) a Written Amendment; (ii) a Change Order; or (iii) a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways: (i) a Field Order; (ii) ENGINEER's approval of a Shop Drawing or Sample; or (iii) ENGINEER's written interpretation or clarification.

3.05 Reuse of Documents

A. CONTRACTOR and any Subcontractor or Supplier or other individual or entity performing or furnishing any of the Work under a direct or indirect contract with OWNER: (i) shall not have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, including electronic media editions; and (ii) shall not reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaption by ENGINEER. This prohibition will survive final payment, completion, and acceptance of the Work, or termination or completion of the Contract. Nothing herein shall preclude CONTRACTOR from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – AVAILABILITY OF LANDS, SUBSURFACE AND PHYSICAL CONDITIONS, REFERENCE POINTS REFERENCE POINTS

4.01 Availability of Lands

A. OWNER shall furnish the Site. OWNER shall notify CONTRACTOR of any encumbrances or restrictions not of general application but specifically related to use of the Site with which CONTRACTOR must comply in performing the Work. OWNER will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If CONTRACTOR and OWNER are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in OWNER's furnishing the Site, CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

B. Upon reasonable written request, OWNER shall furnish CONTRACTOR with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and OWNER's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 Subsurface and Physical Conditions

* A. Reports and Drawings: The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that ENGINEER has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that ENGINEER has used in preparing the Contract Documents.

B. *Limited Reliance by CONTRACTOR on Technical Data Authorized:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER, or any of ENGINEER's Consultants with respect to:

1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 Differing Subsurface or Physical Conditions

A. *Notice:* If CONTRACTOR believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which CONTRACTOR is entitled to rely as provided in paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents; then CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), notify OWNER and ENGINEER in writing about such condition. CONTRACTOR shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

** B. *ENGINEER's Review:* After receipt of written notice as required by paragraph 4.03.A, ENGINEER will promptly review the pertinent condition, determine the necessity of OWNER's obtaining additional exploration or tests with respect thereto, and advise OWNER in writing (with a copy to CONTRACTOR) of ENGINEER's findings and conclusions.

C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in CONTRACTOR's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in paragraph 4.03.A; and

b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of para- graphs 9.08 and 11.03.

2. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Contract Times if:

    a. CONTRACTOR knew of the existence of such conditions at the time CONTRACTOR made a final commitment to OWNER in respect of Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

    b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such final commitment; or

    c. CONTRACTOR failed to give the written notice within the time and as required by paragraph 4.03.A.

3. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in paragraph 10.05. However, OWNER, ENGINEER, and ENGINEER's Consultants shall not be liable to CONTRACTOR for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by CONTRACTOR on or in connection with any other project or anticipated project.

4.04 Underground Facilities

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities, including OWNER, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and CONTRACTOR shall have full responsibility for:

    a. reviewing and checking all such information and data,

    b. locating all Underground Facilities shown or indicated in the Contract Documents,

    c. coordination of the Work with the owners of such Underground Facilities, including OWNER, during construction, and

    d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. Not Shown or Indicated

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility.

2. If ENGINEER concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable *adjustment shall be made i n the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or *indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, OWNER or CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

4.05 Reference Points

A. OWNER shall provide engineering surveys to establish reference points for construction which in ENGINEER's judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.**

4.06 Hazardous Environmental Condition at Site

A. *Reports and Drawings:* Reference is made to the Supplementary Conditions for the identification of those** reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the ENGINEER in the preparation of the Contract Documents. *

B. *Limited Reliance by CONTRACTOR on Technical Data Authorized:* CONTRACTOR may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

1. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. CONTRACTOR shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. CONTRACTOR shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by CONTRACTOR, Subcontractors, Suppliers, or anyone else for whom CONTRACTOR is responsible.

D. If CONTRACTOR encounters a Hazardous Environmental Condition or if CONTRACTOR or anyone for whom CONTRACTOR is responsible creates a Hazardous Environmental Condition, CONTRACTOR shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by paragraph 6.16); and (iii) notify OWNER and ENGINEER (and promptly thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. CONTRACTOR shall not be required to resume Work in connection with such condition or in any affected area until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stop- page or such special conditions under which Work is agreed to be resumed by CONTRACTOR, either party may make a Claim therefor as provided in paragraph 10.05.

F. If after receipt of such written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in paragraph 10.05. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.E shall obligate OWNER to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, other consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by CONTRACTOR or by anyone for whom CONTRACTOR is responsible. Nothing in this paragraph 4.06.F shall obligate CONTRACTOR to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of paragraphs 4.02, 4.03, and 4.04 are not intended to apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

A. CONTRACTOR shall furnish performance and payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Contract Documents.*

B. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

C. If the surety on any Bond furnished by CON- TRACTOR is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.01.B, CONTRACTOR shall within 20 days thereafter substitute another Bond and surety, both of which shall comply with the requirements of paragraphs 5.01.B and 5.02.

5.02 Licensed Sureties and Insurers

A. All Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 Certificates of Insurance

A. CONTRACTOR shall deliver to OWNER, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by OWNER or any other additional insured) which CONTRACTOR is required to *****purchase and maintain. ~~OWNER shall deliver to CONTRACTOR, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by CONTRACTOR or any other additional insured) which OWNER is required to purchase and maintain.~~

5.04 CONTRACTOR's Liability Insurance

*****A. CONTRACTOR shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR's performance of the Work and CONTRACTOR's other obligations under the Contract Documents, whether it is to be performed by CONTRACTOR, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
2. claims for damages because of bodily injury, occupational sickness or disease, or death of CONTRACTOR's employees;
3. claims for damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees;
4. claims for damages insured by reasonably available personal injury liability coverage which are sustained: (i) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (ii) by any other person for any other reason;
5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance so required by this paragraph 5.04 to be purchased and maintained shall:

*1. with respect to insurance required by para- graphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) OWNER, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering CONTRACTOR's indemnity obligations under paragraphs 6.07, 6.11, and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the CONTRACTOR pursuant to paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when CONTRACTOR may be correcting, removing, or replacing defective Work in accordance with paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and CONTRACTOR shall furnish OWNER and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to OWNER and any such additional insured of continuation of such insurance at final payment and one year thereafter).*

~~*5.05 OWNER's Liability Insurance*~~

~~*~~A. In addition to the insurance required to be provided by CONTRACTOR under paragraph 5.04, OWNER, at OWNER's option, may purchase and maintain at OWNER's expense OWNER's own liability insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.~~

~~*5.06 Property Insurance*~~

~~*~~ A. Unless otherwise provided in the Supplementary Conditions, OWNER shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of OWNER, CON- TRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water dam- age, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER;

5. allow for partial utilization of the Work by OWNER;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and ENGINEER with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

~~*~~B. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and any other individuals or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

~~*~~ C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to OWNER and CONTRACTOR and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph *5.07*.

~~*~~D. OWNER shall not be responsible for purchasing and maintaining any property insurance specified in this paragraph 5.06 to protect the interests of CONTRACTOR, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by CONTRACTOR, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

*E. If CONTRACTOR requests in writing that other special insurance be included in the property insurance policies provided under paragraph 5.06, OWNER shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the Site, OWNER shall in writing advise CONTRACTOR whether or not such other insurance has been procured by OWNER.

5.07 Waiver of Rights

*A. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraph 5.06 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance * held by OWNER as trustee or otherwise payable under any policy so issued.

B. OWNER waives all rights against CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to OWNER's property or the Work caused by, arising out of, or resulting from fire or other peril whether or not insured by OWNER; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by OWNER during partial utilization pursuant to paragraph 14.05, after Substantial Completion pursuant to paragraph 14.04, or after final payment pursuant to paragraph 14.07.

C. Any insurance policy maintained by OWNER covering any loss, damage or consequential loss referred to in paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against CONTRACTOR, Subcontractors, ENGINEER, or ENGINEER's Consultants and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them.

5.08 Receipt and Application of Insurance Proceeds

*A. Any insured loss under the policies of insurance required by paragraph 5.06 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.08.B. OWNER shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order or Written Amendment.

*B. OWNER as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, OWNER as fiduciary shall give bond for the proper performance of such duties.

5.09 Acceptance of Bonds and Insurance; Option to Replace

*A. If either OWNER or CONTRACTOR has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by paragraph 2.05.C. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 Partial Utilization, Acknowledgment of Property Insurer

A. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 Supervision and Superintendence

A. CONTRACTOR shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of OWNER or ENGINEER in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents. CONTRACTOR shall be responsible to see that the completed Work complies accurately with the Contract Documents.

~~*B. At all times during the progress of the Work, CONTRACTOR shall assign a competent resident superintendent thereto who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR's representative at the Site and shall have authority to act on behalf of CONTRACTOR. All communications given to or received from the superintendent shall be binding on CONTRACTOR.~~

6.02 Labor; Working Hours

A. CONTRACTOR shall provide competent, suitably qualified personnel to survey, lay out, and construct the Work as required by the Contract Documents. CONTRACTOR shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday, or any legal holiday without OWNER's written consent (which will not be unreasonably withheld) given after prior written notice to ENGINEER.

6.03 Services, Materials, and Equipment

A. Unless otherwise specified in the General Requirements, CONTRACTOR shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Specifications shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 Progress Schedule

A. CONTRACTOR shall adhere to the progress schedule established in accordance with paragraph 2.07 as it may be adjusted from time to time as provided below.

1. CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.07) proposed adjustments in the progress schedule that will not result in changing the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of Article 12. Such adjustments may only be made by a Change Order or Written Amendment in accordance with Article 12.

**6.05 Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to ENGINEER for review under the circumstances described below.

1. "Or-Equal" Items: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

    a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is at least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;

    b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

    a. If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under paragraph 6.05.A.1, it will be considered a proposed substitute item.

    b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CON- TRACTOR.

    c. The procedure for review by ENGINEER will be as set forth in paragraph 6.05.A.2.d, as supplemented in the General Requirements and as ENGINEER may decide is appropriate under the circumstances.

    d. CONTRACTOR shall first make written application to ENGINEER for review of a proposed substitute item of material or equipment that CONTRACTOR seeks to furnish or use. The application shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item and whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.

B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CON- TRACTOR may furnish or utilize a substitute means, meth- od, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.05.A.2.

C. *Engineer's Evaluation:* ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.05.A and 6.05.B. ENGINEER will be the sole judge of accept- ability. No "or-equal" or substitute will be ordered, installed or utilized until ENGINEER's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." ENGINEER will advise CONTRACTOR in writing of any negative determination.

D. *Special Guarantee:* OWNER may require CON- TRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.

E. *ENGINEER's Cost Reimbursement:* ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.05.A.2 and 6.05.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluating each such proposed substitute.

F. *CONTRACTOR's Expense:* CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

6.06 Concerning Subcontractors, Suppliers, and Others

A. CONTRACTOR shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to OWNER as indicated in paragraph 6.06.B), whether initially or as a replacement, against whom OWNER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to OWNER in advance for acceptance by OWNER by a specified date prior to the Effective Date of the Agreement, and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation.

CONTRACTOR shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of OWNER or ENGINEER to reject defective Work.

C. CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other individual or entity, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR.

E. CONTRACTOR shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with ENGINEER through CONTRACTOR.

**F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.06, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same.

6.07 Patent Fees and Royalties

A. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees or agents, and other consultants of each and any of them

from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 Permits

******A. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto, such as plant investment fees.

6.09 Laws and Regulations

A. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws or Regulations.

B. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, CONTRACTOR shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work; however, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work may be the subject of an adjustment in Contract Price or Contract Times. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in paragraph 10.05.

*6.10 Taxes ***

A. CONTRACTOR shall pay all sales, consumer, use, and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

*6.11 Use of Site and Other Areas ***

A Limitation on Use of Site and Other Areas

1. CONTRACTOR shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultant, and the officers, directors, partners, employees, agents, and other consultants of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against OWNER, ENGINEER, or any other party indemnified hereunder to the extent caused by or based upon CONTRACTOR's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work CONTRACTOR shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work CONTRACTOR shall clean the Site and make it ready for utilization by OWNER. At the completion of the Work CONTRACTOR shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 Record Documents

A. CONTRACTOR shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to ENGINEER for OWNER.

6.13 Safety and Protection

A. CONTRACTOR shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Under- ground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. CONTRACTOR shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property. All damage, injury, or loss to any property referred to in paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or ENGINEER's Consultant, or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

CONTRACTOR's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 Safety Representative

A. CONTRACTOR shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 Hazard Communication Programs

A. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 Emergencies

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, CONTRACTOR is obligated to act to prevent threatened damage, injury, or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 Shop Drawings and Samples

A. CONTRACTOR shall submit Shop Drawings to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. All submittals will be identified as ENGINEER may require and in the number of copies specified in the General Requirements. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show ENGINEER the services, materials, and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.17.E.

B. CONTRACTOR shall also submit Samples to ENGINEER for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, and the use for which intended and otherwise as ENGINEER may require to enable ENGINEER to review the submittal for the limited purposes required by paragraph 6.17.E. The numbers of each Sample to be submitted will be as specified in the Specifications.

C. Where a Shop Drawing or Sample is required by the Contract Documents or the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER as required by paragraph 2.07, any related Work performed prior to ENGINEER's review and approval of the pertinent submittal will be at the sole expense and responsibility of CONTRACTOR.

D. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incident thereto; and

d. CONTRACTOR shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to CONTRACTOR's review and approval of that submittal.

3. At the time of each submittal, CONTRAC- TOR shall give ENGINEER specific written notice of such variations, if any, that the Shop Drawing or Sample submitted may have from the requirements of the Contract Documents, such notice to be in a written communication separate from the submittal; and, in addition, shall cause a specific notation to be made on each Shop Drawing and Sample submitted to ENGINEER for review and approval of each such variation.

E. ENGINEER's Review

*1. ENGINEER will ~~timely~~ review and approve Shop Drawings and Samples in accordance with the schedule of Shop Drawings and Sample submittals acceptable to ENGINEER. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. ENGINEER's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. ENGINEER's review and approval of Shop Drawings or Samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of each submittal as required by paragraph 6.17.D.3 and ENGINEER has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.17.D.1.

F. Resubmittal Procedures

1. CONTRACTOR shall make corrections required by ENGINEER and shall return the required number of corrected copies of Shop Drawings and submit as required new Samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.18 Continuing the Work

A. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.04 or as OWNER and CONTRACTOR may otherwise agree in writing.

6.19 CONTRACTOR's General Warranty and Guarantee

A. CONTRACTOR warrants and guarantees to OWNER, ENGINEER, and ENGINEER's Consultants that all Work will be in accordance with the Contract Documents and will not be defective. CONTRACTOR's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors, Suppliers, or any other individual or entity for whom CONTRACTOR is responsible; or

2. normal wear and tear under normal usage. B. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

a. observations by ENGINEER;
b. recommendation by ENGINEER or payment by OWNER of any progress or final payment;
c. the issuance of a certificate of Substantial Completion by ENGINEER or any payment related thereto by OWNER;
d. use or occupancy of the Work or any part thereof by OWNER;
e. any acceptance by OWNER or any failure to do so;
f. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by ENGINEER;
g. any inspection, test, or approval by others; or
h. any correction of defective Work by OWNER.

6.20 Indemnification

~~*A. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall indemnify and hold harmless OWNER, ENGINEER, ENGINEER's Consultants, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage:~~

~~1. is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom; and~~

~~2. is caused in whole or in part by any negligent act or omission of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such individual or entity.~~

B. In any and all claims against OWNER or ENGINEER or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of CONTRACTOR, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for CONTRACTOR or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

~~*C. The indemnification obligations of CONTRACTOR under paragraph 6.20.A shall not extend to the liability of ENGINEER and ENGINEER's Consultants or to the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them arising out of:~~

~~1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or~~ Specifications~~; or~~

~~2. giving directions or instructions, or failing to give them, if that is the primary cause of the~~ injury ~~or damage.~~

ARTICLE 7 - OTHER WORK

7.01 Related Work at Site

A. OWNER may perform other work related to the Project at the Site by OWNER's employees, or let other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to CONTRACTOR prior to starting any such other work; and

2. if OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in paragraph 10.05.

B. CONTRACTOR shall afford each other contractor who is a party to such a direct contract and each utility owner (and OWNER, if OWNER is performing the other work with OWNER's employees) proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

C. If the proper execution or results of any part of CONTRACTOR's Work depends upon work performed by others under this Article 7, CONTRACTOR shall inspect such other work and promptly report to ENGINEER in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure to so report will constitute an acceptance of such other work as fit and proper for integration with CONTRACTOR's Work except for latent defects and deficiencies in such other work.

7.02 Coordination

A. If OWNER intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
2. the specific matters to be covered by such authority and responsibility will be itemized; and
3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, OWNER shall have sole authority and responsibility for such coordination.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 Communications to Contractor

A. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.02 Replacement of ENGINEER

A. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer to whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.03 Furnish Data

A. OWNER shall promptly furnish the data required of OWNER under the Contract Documents.

8.04 Pay Promptly When Due

A. OWNER shall make payments to CONTRACTOR promptly when they are due as provided in paragraphs 14.02.C and 14.07.C.

8.05 Lands and Easements; Reports and Tests

A. OWNER's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.01 and 4.05. Paragraph 4.02 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by ENGINEER in preparing the Contract Documents.

8.06 Insurance

~~*A. OWNER's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.~~

8.07 Change Orders

A. OWNER is obligated to execute Change Orders as indicated in paragraph 10.03.

8.08 Inspections, Tests, and Approvals

A. OWNER's responsibility in respect to certain inspections, tests, and approvals is set forth in paragraph 13.03.B.

8.09 Limitations on OWNER's Responsibilities

A. The OWNER shall not supervise, direct, or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

8.10 Undisclosed Hazardous Environmental Condition

A. OWNER's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in paragraph 4.06.

8.11 Evidence of Financial Arrangements

A. If and to the extent OWNER has agreed to furnish CONTRACTOR reasonable evidence that financial arrangements have been made to satisfy OWNER's obligations under the Contract Documents, OWNER's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S Representative

A. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER's representative during construction are set forth in the Contract Documents and will not be changed without written consent of OWNER and ENGINEER.

**9.02 Visits to Site*

A. ENGINEER will make visits to the Site at intervals appropriate to the various stages of construction as ENGINEER deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of CONTRACTOR's executed Work. Based on information obtained during such visits and observations, ENGINEER, for the benefit of OWNER, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. ENGINEER's efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defective Work.

B. ENGINEER's visits and observations are subject to all the limitations on ENGINEER's authority and responsibility set forth in paragraph 9.10, and particularly, but without limitation, during or as a result of ENGINEER's visits or observations of CONTRACTOR's Work ENGINEER will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work.

9.03 Project Representative

A. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more extensive observation of the Work. The responsibilities and authority and limitations thereon of any such Resident Project Representative and assistants will be as provided in paragraph 9.10 and in the Supplementary Conditions. If OWNER designates another representative or agent to represent OWNER at the Site who is not ENGINEER's Consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 Clarifications and Interpretations

A. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents as ENGINEER may deter- mine necessary, which shall be consistent with the intent of and reasonably inferable from the Contract Documents. Such written clarifications and interpretations will be binding on OWNER and CONTRACTOR. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a written clarification or interpretation, a Claim may be made therefor as provided in paragraph 10.05.

***9.05 Authorized Variations in Work*

A. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER and also on CONTRACTOR, who shall perform the Work involved promptly. If OWNER and CONTRACTOR are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of a Field Order, a Claim may be made therefor as provided in paragraph 10.05.

9.06 Rejecting Defective Work

A. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be defective, or that ENGINEER believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. ENGINEER will also have authority to require special inspection or testing of the Work as provided in paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.07 Shop Drawings, Change Orders and Payments

A. In connection with ENGINEER's authority as to Shop Drawings and Samples, see paragraph 6.17.

B. In connection with ENGINEER's authority as to Change Orders, see Articles 10, 11, and 12.

C. In connection with ENGINEER's authority as to Applications for Payment, see Article 14.

9.08 Determinations for Unit Price Work

A. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of paragraph 10.05.

9.09 Decisions on Requirements of Contract Documents and Acceptability of Work

A. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. Claims, disputes and other matters relating to the acceptability of the Work, the quantities and classifications of Unit Price Work, the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, and Claims seeking changes in the Contract Price or Contract Times will be referred initially to ENGINEER in writing, in accordance with the provisions of paragraph 10.05, with a request for a formal decision.

B. When functioning as interpreter and judge under this paragraph 9.09, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to this paragraph 9.09 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.07) will be a condition precedent to any exercise by OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter.

9.10 Limitations on ENGINEER's Authority and Responsibilities

A. Neither ENGINEER's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by ENGINEER shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. ENGINEER will not supervise, direct, control, or have authority over or be responsible for CONTRACTOR's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

C. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. ENGINEER's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this paragraph 9.10 shall also apply to ENGINEER's Consultants, Resident Project Representative, and assistants.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 Authorized Changes in the Work

A. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Written Amendment, a Change Order, or a Work Change Directive. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If OWNER and CONTRACTOR are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in paragraph 10.05.

10.02 Unauthorized Changes in the Work

A. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in paragraph 3.04, except in the case of an emergency as provided in paragraph 6.16 or in the case of uncovering Work as provided in paragraph 13.04.B.

10.03 Execution of Change Orders

A. OWNER and CONTRACTOR shall execute appropriate Change Orders recommended by ENGINEER (or Written Amendments) covering:

1. changes in the Work which are: (i) ordered by OWNER pursuant to paragraph 10.01.A, (ii) required because of acceptance of defective Work under paragraph 13.08.A or OWNER's correction of defective Work under paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by ENGINEER pursuant to para- graph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.18.A.

10.04 Notification to Surety

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR's responsibility. The amount of each applicable Bond will be adjusted to reflect the effect of any such change.

10.05 Claims and Disputes

A. *Notice:* Written notice stating the general nature of each Claim, dispute, or other matter shall be delivered by the claimant to ENGINEER and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. Notice of the amount or extent of the Claim, dispute, or other matter with supporting data shall be delivered to the ENGINEER and the other party to the Contract within 60 days after the start of such event (unless ENGINEER allows additional time for claimant to submit additional or more accurate data in support of such Claim, dispute, or other matter). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to ENGINEER and the claimant within 30 days after receipt of the claimant's last submittal (unless ENGINEER allows additional time).

B. *ENGINEER's Decision:* ENGINEER will render a formal decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any. ENGINEER's written decision on such Claim, dispute, or other matter will be final and binding upon OWNER and CONTRACTOR unless:

1. an appeal from ENGINEER's decision is taken within the time limits and in accordance with the dispute resolution procedures set forth in Article 16; or

2. if no such dispute resolution procedures have been set forth in Article 16, a written notice of intention to appeal from ENGINEER's written decision is delivered by OWNER or CONTRACTOR to the other and to ENGINEER within 30 days after the date of such decision, and a formal proceeding is instituted by the appealing party in a forum of competent jurisdiction within 60 days after the date of such decision or within 60 days after Substantial Completion, whichever is later (unless otherwise agreed in writing by OWNER and CONTRACTOR), to exercise such rights or remedies as the appealing party may have with respect to such Claim, dispute, or other matter in accordance with applicable Laws and Regulations.

C. If ENGINEER does not render a formal decision in writing within the time stated in paragraph 10.05.B, a decision denying the Claim in its entirety shall be deemed to have been issued 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.

D. No Claim for an adjustment in Contract Price or Contract Times (or Milestones) will be valid if not submitted in accordance with this paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

***11.01 Cost of the Work*

~~A. *Costs Included:* The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to CONTRACTOR will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in paragraph 11.01.B.~~

~~1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include without limitation superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not~~

be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by OWNER.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

3. Payments made by CONTRACTOR to Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER, who will then determine, with the advice of ENGINEER, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in this paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

   a. The proportion of necessary transportation, travel, and subsistence expenses of CONTRACTOR's employees incurred in discharge of duties connected with the Work.

   b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of CONTRACTOR.

   c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

   d. Sales, consumer, use, and other similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

   e. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses within the deductible amounts of property insurance established in accordance with paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining CONTRACTOR's fee.

   f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance of the Work (except losses and damages

   g. The cost of utilities, fuel, and sanitary facilities at the Site.

   h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expressage, and similar petty cash items in connection with the Work.

   i. When the Cost of the Work is used to determine the value of a Change Order or of a Claim, the cost of premiums for additional Bonds and insurance required because of the changes in the Work or caused by the event giving rise to the Claim.

   j. When all the Work is performed on the basis of cost-plus, the costs of premiums for all Bonds and insurance CONTRACTOR is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnerships and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by CONTRACTOR, whether at the Site or in CONTRACTOR's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.01.A.1 or specifically covered by paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the CONTRACTOR's fee.

2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the Site.

3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

4. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraphs 11.01.A and 11.01.B.

C. *CONTRACTOR's Fee:* When all the Work is performed on the basis of cost-plus, CONTRACTOR's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, CONTRACTOR's fee shall be determined as set forth in paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to paragraphs 11.01.A and 11.01.B, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

11.02 Cash Allowances

A. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums as may be acceptable to OWNER and ENGINEER. CONTRACTOR agrees that:

1. the allowances include the cost to CON- TRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. CONTRACTOR's costs for unloading and handling on the Site, labor, installation costs, over- head, profit, and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

B. Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 Unit Price Work

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER subject to the provisions of paragraph 9.08.

B. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

*****C. OWNER or CONTRACTOR may make a Claim for an adjustment in the Contract Price in accordance with paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect any other item of Work; and

3. if CONTRACTOR believes that CONTRACTOR is entitled to an increase in Contract Price as a result of having incurred additional expense or OWNER believes that OWNER is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 Change of Contract Price

~~**A. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.~~

~~B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:~~

~~1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraph 11.03); or~~

~~2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 12.01.C.2); or~~

~~3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in paragraph 11.01) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 12.01.C).~~

~~C. *CONTRACTOR's Fee:* The CONTRACTOR's fee for overhead and profit shall be determined as follows:~~

~~1. mutually acceptable fixed fee; or~~

~~2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:~~

~~a. for costs incurred under paragraphs 11.01.A.1 and 11.01.A.2, the CONTRACTOR's fee shall be 15 percent;~~

~~b. for costs incurred under paragraph 11.01.A.3, the CONTRACTOR's fee shall be five percent;~~

~~c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and CONTRACTOR will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;~~

~~d. no fee shall be payable on the basis of costs itemized under paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;~~

~~e. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to five percent of such net decrease; and~~

~~f. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.~~

12.02 Change of Contract Times

A. The Contract Times (or Milestones) may only be changed by a Change Order or by a Written Amendment. Any Claim for an adjustment in the Contract Times (or Milestones) shall be based on written notice submitted by the party making the claim to the ENGINEER and the other party to the Contract in accordance with the provisions of paragraph 10.05.

B. Any adjustment of the Contract Times (or Milestones) covered by a Change Order or of any Claim for an adjustment in the Contract Times (or Milestones) will be determined in accordance with the provisions of this Article 12.

12.03 Delays Beyond CONTRACTOR's Control

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of CONTRACTOR, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in paragraph 12.02.A. Delays beyond the control of CONTRACTOR shall include, but not be limited to, acts or neglect by OWNER, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

12.04 Delays Within CONTRACTOR's Control

A. The Contract Times (or Milestones) will not be extended due to delays within the control of CONTRACTOR. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of CONTRACTOR.

12.05 Delays Beyond OWNER's and CONTRACTOR's Control

A. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay.

12.06 Delay Damages

A. In no event shall OWNER or ENGINEER be liable to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization, or to any surety for or employee or agent of any of them, for damages arising out of or resulting from:

1. delays caused by or within the control of CONTRACTOR; or

2. delays beyond the control of both OWNER and CONTRACTOR including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, or acts or neglect by utility owners or other contractors performing other work as contemplated by Article 7.

B. Nothing in this paragraph 12.06 bars a change in Contract Price pursuant to this Article 12 to compensate CONTRACTOR due to delay, interference, or disruption directly attributable to actions or inactions of OWNER or anyone for whom OWNER is responsible.

* ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 Notice of Defects

A. Prompt notice of all defective Work of which OWNER or ENGINEER has actual knowledge will be given to CONTRACTOR. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 Access to Work

A. OWNER, ENGINEER, ENGINEER's Consultants, other representatives and personnel of OWNER, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. CONTRACTOR shall provide them proper and safe conditions for such access and advise them of CONTRACTOR's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 Tests and Inspections

A. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. OWNER shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to paragraph 13.04.B shall be paid as provided in said paragraph 13.04.B; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, CONTRACTOR shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish ENGINEER the required certificates of inspection or approval.

D. CONTRACTOR shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for OWNER's and ENGINEER's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to OWNER and ENGINEER.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by CONTRACTOR without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation.

F. Uncovering Work as provided in paragraph 13.03.E shall be at CONTRACTOR's expense unless CON- TRACTOR has given ENGINEER timely notice of CONTRACTOR's intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

13.04 Uncovering Work

A. If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER's observation and replaced at CONTRACTOR's expense.

B. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. If it is found that such Work is defective, CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and OWNER shall be entitled to an appropriate decrease in the Contract Price.

If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefor as provided in paragraph 10.05. If, however, such Work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a Claim therefor as provided in paragraph 10.05.

13.05 OWNER May Stop the Work

A. If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 Correction or Removal of Defective Work

A. CONTRACTOR shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by ENGINEER, remove it from the Project and replace it with Work that is not defective. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

13.07 Correction Period

~~*A. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for CONTRACTOR's use by OWNER or permitted by Laws and Regulations as contemplated in paragraph 6.11.A is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) repair such defective land or areas, or (ii) correct such defective Work or, if the defective Work has been rejected by OWNER, remove it from the Project and replace it with Work that is not defective, and (iii) satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or repaired or may have the rejected Work removed and replaced, and all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR.~~

B. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

C. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

D. CONTRACTOR's obligations under this paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 Acceptance of Defective Work

A. If, instead of requiring correction or removal and replacement of defective Work, OWNER (and, prior to ENGINEER's recommendation of final payment, ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to OWNER's evaluation of and determination to accept such defective Work (such costs to be approved by ENGINEER as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by CONTRACTOR pursuant to this sentence. If any such acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and OWNER shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, OWNER may make a Claim therefor as provided in paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

13.09 OWNER May Correct Defective Work

*A. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct defective Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.06.A, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days written notice to CONTRACTOR, correct and remedy any such deficiency.

B. In exercising the rights and remedies under this paragraph, OWNER shall proceed expeditiously. In connection with such corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Site, take possession of all or part of the Work and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors, and ENGINEER and ENGINEER's Consultants access to the Site to enable OWNER to exercise the rights and remedies under this paragraph.

C. All Claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by OWNER in exercising the rights and remedies under this paragraph 13.09 will be charged against CON- TRACTOR, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, OWNER may make a Claim therefor as provided in paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of CONTRACTOR's defective Work.

D. CONTRACTOR shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by OWNER of OWNER's rights and remedies under this paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Schedule of Values

A. The schedule of values established as provided in paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 Progress Payments

A. Applications for Payments

1. At least 20 days before the date established for each progress payment (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that OWNER has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect OWNER's interest therein, all of which must be satisfactory to OWNER.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of CONTRACTOR stating that all previous progress payments received on account of the Work have been applied on account to discharge CONTRACTOR's legitimate obligations associated with prior Applications for Payment.

~~*3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.~~

B. Review of Applications

~~**1. ENGINEER will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER or return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application.~~

2. ENGINEER's recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWN- ER, based on ENGINEER's observations on the Site of the executed Work as an experienced and qualified design professional and on ENGINEER's review of the Application for Payment and the accompanying data and schedules, that to the best of ENGINEER's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.08, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

3. By recommending any such payment ENGINEER will not thereby be deemed to have represented that: (i) inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents; or (ii) that there may not be other matters or issues between the parties that might entitle CON- TRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

4. Neither ENGINEER's review of CONTRACTOR's Work for the purposes of recommending payments nor ENGINEER's recommendation of any payment, including final payment, will impose responsibility on ENGINEER to supervise, direct, or control the Work or for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for CONTRACTOR's failure to comply with Laws and Regulations applicable to CONTRACTOR's performance of the Work. Additionally, said review or recommendation will not impose responsibility on ENGINEER to make any examination to ascertain how or for what purposes CONTRACTOR has used the moneys paid on account of the Contract Price, or to determine that title to any of the Work, materials, or equipment has passed to OWNER free and clear of any Liens.

5. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make the representations to OWNER referred to in paragraph 14.02.B.2. ENGINEER may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. the Contract Price has been reduced b Written Amendment or Change Orders;

c. OWNER has been required to correct defective Work or complete Work in accordance with paragraph 13.09; or

d. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.A.

C. Payment Becomes Due

*1. Ten days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of paragraph 14.02.D) become due, and when due will be paid by OWNER to CONTRACTOR.

**D. Reduction *in Payment*

1. OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

a. claims have been made against OWN- ER on account of CONTRACTOR's performance or furnishing of the Work;

b. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific Bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens;

c. there are other items entitling OWNER to a set-off against the amount recommended; or

d. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.02.B.5.a through 14.02.B.5.c or paragraph 15.02.A.

2. If OWNER refuses to make payment of the full amount recommended by ENGINEER, OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR any amount remaining after deduction of the amount so withheld. OWNER shall promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects to OWNER's satisfaction the reasons for such action.

3. If it is subsequently determined that OWNER's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.02.C.1.

14.03 CONTRACTOR's Warranty of Title

* ~~A. CONTRACTOR warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.~~

14.04 Substantial Completion

A. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Promptly thereafter, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers the Work substantially complete, ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached list

   If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within 14 days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefor. If, after consideration of OWNER's objections, ENGINEER considers the Work substantially complete, ENGINEER will within said 14 days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER in writing prior to ENGINEER's issuing the definitive certificate of Substantial Completion, ENGINEER's aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

B. OWNER shall have the right to exclude CONTRACTOR from the Site after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

14.05 Partial Utilization

A. Use by OWNER at OWNER's option of any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which OWNER, ENGINEER, and CONTRACTOR agree constitutes a separately functioning and usable part of the Work that can be used by OWNER for its intended purpose without significant interference with CONTRACTOR's performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following conditions.

   1. OWNER at any time may request CON- TRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees that such part of the Work is substantially complete, CONTRACTOR will certify to OWNER and ENGINEER that such part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefor. If ENGINEER considers that part of the Work to be substantially complete, the provisions of para- graph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

   2. No occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of paragraph 5.10 regarding property insurance.

14.06 Final Inspection

A. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will promptly make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 Final Payment

A. Application for Payment

1. After CONTRACTOR has, in the opinion of ENGINEER, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in paragraph 6.12), and other documents, CONTRACTOR may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by subparagraph 5.04.B.7; (ii) consent of the surety, if any, to final payment; and (iii) complete and legally effective releases or waivers (satisfactory to OWNER) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in paragraph 14.07.A.2 and as approved by OWNER, CONTRACTOR may furnish receipts or releases in full and an affidavit of CONTRACTOR that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or OWNER's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

B. Review of Application and Acceptance

**1. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER's recommendation of payment and present the Application for Payment to OWNER for payment. At the same time ENGINEER will also give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.09. Otherwise, ENGINEER will return the Application for Payment to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due

1. Thirty days after the presentation to OWN- ER of the Application for Payment and accompanying documentation, the amount recommended by ENGINEER will become due and, when due, will be paid by OWNER to CONTRACTOR.

14.08 Final Completion Delayed

A. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed, and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 Waiver of Claims

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by OWNER against CONTRACTOR, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from CONTRACTOR's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by CONTRACTOR against OWNER other than those previously made in writing which are still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 OWNER May Suspend Work

**A. At any time and without cause, OWNER may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to CON- TRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if CONTRACTOR makes a Claim therefor as provided in paragraph 10.05.

15.02 OWNER May Terminate for Cause

A. The occurrence of any one or more of the following events will justify termination for cause:

1. CONTRACTOR's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.07 as adjusted from time to time pursuant to paragraph 6.04);

2. CONTRACTOR's disregard of Laws or Regulations of any public body having jurisdiction;

3. CONTRACTOR's disregard of the authority of ENGINEER; or

4. CONTRACTOR's violation in any substantial way of any provisions of the Contract Documents.

*B. If one or more of the events identified in paragraph 15.02.A occur, OWNER may, after giving CONTRACTOR (and the surety, if any) seven days written notice, terminate the services of CONTRACTOR, exclude CONTRACTOR from the Site, and take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by OWNER arising out of or relating to completing the Work, such excess will be paid to CONTRACTOR. If such claims, costs, losses, and damages exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses, and damages incurred by OWNER will be reviewed by ENGINEER as to their reasonableness and, when so approved by ENGINEER, incorporated in a Change Order. When exercising any rights or remedies under this paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

C. Where CONTRACTOR's services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.03 OWNER May Terminate For Convenience

A. Upon seven days written notice to CON- TRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy of OWNER, elect to terminate the Contract. In such case, CONTRACTOR shall be paid (without duplication of any items):

1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. for expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. for all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. for reasonable expenses directly attributable to termination.

B. CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 CONTRACTOR May Stop Work or Terminate

A. If, through no act or fault of CONTRACTOR, the Work is suspended for more than 90 consecutive days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within 30 days after it is submitted, or OWNER fails for 30 days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days written notice to OWNER and ENGINEER, and provided OWNER or ENGINEER do not remedy such suspension or failure within that time, terminate the Contract and recover from OWNER payment on the same terms as provided in paragraph 15.03. In lieu of terminating the Contract and without prejudice to any other right or remedy, if ENGINEER has failed to act on an Application for Payment within 30 days after it is submitted, or OWNER has failed for 30 days to pay CONTRACTOR any sum finally determined to be due, CONTRACTOR may, seven days after written notice to OWNER and ENGINEER, stop the Work until payment is made of all such amounts due CONTRACTOR, including interest thereon. The provisions of this paragraph 15.04 are not intended to preclude CON- TRACTOR from making a Claim under paragraph 10.05 for an adjustment in Contract Price or Contract Times or other- wise for expenses or damage directly attributable to CONTRACTOR's stopping the Work as permitted by this paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 Methods and Procedures

A. Dispute resolution methods and procedures, if any, shall be as set forth in the Supplementary Conditions. If no method and procedure has been set forth, and subject to the provisions of paragraphs 9.09 and 10.05, OWNER and CONTRACTOR may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 17 - MISCELLANEOUS

17.01 Giving Notice

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 Computation of Times

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 Cumulative Remedies

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 Survival of Obligations

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Agreement.

17.05 Controlling Law

A. This Contract is to be governed by the law of the state in which the Project is located.

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SECTION 00800

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (No. 1910-8, 1996 edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

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ARTICLE 1. DEFINITIONS AND TERMINOLOGY

Add the following language at the beginning of definition 1.01 A.12 entitled "Contract Documents" in the General Conditions: "The Advertisement for Bids, Instructions to Bidders, State Regulations,..."

Delete the words "The individual or entity named as such in the Agreement" in 1.01.A.19, “Engineer”, and insert the following in their place: "The individual or entity duly appointed by the Owner to undertake the duties and powers herein assigned to the Engineer, acting either directly or through duly appointed representatives."

Delete the words "and who is identified as such in the Supplementary Conditions" at the end of definition 1.01 A.20, entitled "ENGINEER'S Consultant."

Delete definition 1.01 A.41 entitled "Specifications" in the General Conditions in its entirety and insert the following in its place: "Sections included under Division 1 through Division 16 of the Contract Documents."

ARTICLE 2. PRELIMINARY MATTERS SC-2.02

Delete paragraph 2.02A of the General Conditions in its entirety.

SC-2.03

Add paragraph 2.03B:

Notwithstanding the time limitations provided in paragraph 2.03A, the OWNER may desire to commence the Contract Times later than the sixtieth day after the bid opening. The OWNER and CONTRACTOR, upon mutual agreement, may extend the commencement of the Contract Times to any date that they elect. OWNER must obtain CONTRACTOR's approval for extending the time beyond the dates/times stated in the Contract Documents.

SC-2.05

Delete paragraph 2.05C of the General Conditions in its entirety and insert the following in its place:

"C. Evidence of Insurance: CONTRACTOR shall deliver to OWNER, with a copy to the ENGINEER, Certificates of Insurance within 10 days after receipt of the notice of the acceptance of bid (and other evidence requested by OWNER) which CONTRACTOR is required to purchase and maintain in accordance with the requirements of Article 5."

ARTICLE 3. CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE SC-3.01

Add the following sentence at the end of Paragraph 3.01A of the General Conditions:

"...by all. Each and every provision of law and clause required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be physically amended to make such insertion."

ARTICLE 4. AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

SC-4.02

Delete the term "Supplementary Conditions" of paragraph 4.02 A of the General Conditions and replace it with "Contract Documents".

SC-4.04

Change "of" to "or" on line 6 of paragraph 4.04 B.2 of the General Conditions.

Delete the following words from lines 8 and 9 of paragraph 4.04 B.2 of the General Conditions: "...or not shown or indicated with reasonable accuracy..."

SC-4.05

Add a new paragraph immediately after paragraph 4.05A of the General Conditions which is to read as follows:

"B. ENGINEER may check the lines, elevations and reference marks set by CONTRACTOR, and CONTRACTOR shall correct any errors disclosed by such check. Such a check shall not be considered as approval of CONTRACTOR's work and shall not relieve CONTRACTOR of the responsibility for construction of the entire Work in accordance with the Contract Documents. CONTRACTOR shall furnish personnel to assist ENGINEER in checking lines and grades."

ARTICLE 5. BONDS AND INSURANCE NOTICE TO CONTRACTOR:

1. Proof of Insurance coverage shall be furnished to the OWNER in accordance with the schedule for submittal of Bonds and Agreements.

2. Additionally refer to Article 2. PRELIMINARY MATTERS, Paragraph SC-2.05.C

SC-5.01

Insert these sentences following SC-5.01.A:

"The Surety Company providing the bonds shall have a rating of A or better within the Best Key Rating Guide and be licensed by the Massachusetts Division of Insurance. The CONTRACTOR shall pay the premiums for such Bonds."

SC-5.03

Delete the second sentence in paragraph 5.03A of the General Conditions, which begins "OWNER shall deliver to...."

SC-5.04

The limits of liability for the insurance required by paragraph 5.04A of the General Conditions shall provide coverage for not less than the following amounts or greater where required by law:

5.04 A.1 and 5.04 A.2 Workers' Compensation.

(1) Worker's Compensation per Statutory Requirements

(2) Coverage B - Employer's Liability $100,000/$500,000/$100,000

5.04 A.3, 5.04 A.4 and 5.04 A.5 Commercial General Liability Limits shall include coverage for Independent Contractors (also known as Owners and Contractors Protective Liability), explosion, collapse and underground hazard coverage (XCU), broad form property damage, blanket contractual liability and products/completed operations. The general aggregate limits shall be endorsed so that they respond on a per project and per location basis.

Limits: $1,000,000 each occurrence

$2,000,000 general aggregate

$2,000,000 products/completed operations aggregate

5.04 A.6 Automobile Liability for owned, hired and non-owned vehicles:

(1)	Bodily injury:	$1,000,000	Combined single limit
(2)	Property damage	$1,000,000	Combined single limit

Revise the beginning of paragraph 5.04.B.1 to read as follows: "with respect to insurance required by paragraphs 5.04.A.3 through 5.04.A.5 inclusive and paragraph 5.04.C, include as additional insureds…"

Delete paragraph 5.04.B.5 in its entirety and insert the following in its place:

"5. Contains a provision that notice of cancellation of insurance be delivered in accordance with policy provisions. In addition, the CONTRACTOR and/or its insurance broker/agent shall immediately notify the OWNER and ENGINEER should any insurance coverage be cancelled. The CONTRACTOR shall immediately stop work on the Project and shall not resume work until the CONTRACTOR provides evidence, to the OWNER and ENGINEER, in the form of an acceptable insurance certificate, of new insurance coverage that replaces all cancelled coverage that is required for the Project."

Add two new paragraphs immediately after paragraph 5.04B of the General Conditions which are to read as follows:

"C. The CONTRACTOR shall also provide:

1. CONTRACTOR shall, as a minimum, purchase and maintain excess liability insurance in the umbrella form with a combined single limit of not less than $5,000,000 per occurrence and in the aggregate. Evidence of such excess liability shall be delivered to OWNER in accordance with paragraph 2.05C in the form of a certificate indicating the policy numbers and limits of liability of all underlying insurance.

2. General Liability, Workers' Compensation, Automobile Liability and Umbrella Liability Policies will contain waivers of subrogation in favor of the Engineer and Owner.

5) If the aggregate limits of liability indicated in CONTRACTOR' insurance provided in accordance with paragraphs 5.03 and 5.04 are not sufficient to cover all claims for damages arising from his operations under this Contract and from any other work performed by him or if the commercial general liability insurance policy of insurance does not provide that the general aggregate limits apply on a per project and per location basis, CONTRACTOR shall have the policy amended so that the aggregate limits of liability required by this Contract will be available to cover all claims for damages due to operations under this Contract."

6) The General Contractor shall carry the coverage for Subcontractors naming the Subcontractors, the Town of Orleans, and AECOM Technical Services, Inc. as additional insured in the limits specified herein. SECTION 05020A-3, INSURANCE REQUIREMENTS FOR INCLUSION IN ALL SPECIFICATIONS AND CONTRACTS are separate from the Owners and Contractors Protective Liability and shall name the Town of Orleans, and AECOM Technical Services, Inc. as additional insured.

SC-5.05

Delete paragraph 5.05 of the General Conditions in its entirety.

SC-5.06

Delete Paragraph 5.06A of the General Conditions in its entirety.

Delete paragraph 5.06B of the General Conditions in its entirety.

Delete Paragraph 5.06C of the General Conditions in its entirety.

Delete paragraph 5.06D of the General Conditions in its entirety.

Delete paragraph 5.06E of the General Conditions in its entirety.

SC-5.07

Amend the last sentence of paragraph 5.07A of the General Conditions by striking out the words "held by OWNER as trustee or." As so amended, paragraph 5.07A remains in effect.

SC-5.08

Delete paragraph 5.08A of the General Conditions in its entirety.

Delete paragraph 5.08B of the General Conditions in its entirety.

SC-5.09

Delete paragraph 5.09A of the General Conditions in its entirety and insert the following in its place:

"A. If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with this Article 5 on the basis of its not complying with the Contract Documents, OWNER will notify CONTRACTOR in writing thereof within thirty days of the date of delivery of such certificates to OWNER in accordance with paragraph 2.05C. CONTRACTOR will provide such additional information in respect of insurance provided by him as OWNER may reasonably request."

ARTICLE 6. CONTRACTOR'S RESPONSIBILITIES SC-6.01

Delete paragraph 6.01B of the General Conditions in its entirety and replace with the following:

"B. At the site of the Work the CONTRACTOR shall employ a full-time construction superintendent or foreman who shall have full authority to act for the CONTRACTOR. It is understood that such representative shall be acceptable to the ENGINEER and shall be one who will be continued in the capacity for the particular job involved unless the representative ceases to be on the CONTRACTOR's payroll. If at any time during the Work the representative is deemed by the ENGINEER to be no longer acceptable, the representative shall be promptly replaced by the CONTRACTOR. All communications to the superintendent or foreman shall be as binding as if given to the CONTRACTOR."

SC-6.04

Add the following paragraph after paragraph 6.04A.2 of the General Conditions:

"B. The CONTRACTOR's resident superintendent shall attend monthly progress meetings at the site of the work with the ENGINEER and others as appropriate to review schedule status and such other pertinent subjects as may be listed on the agenda by the ENGINEER."

SC-6.05

Revise the second sentence of Paragraph A to read as follows:

"Unless the specification indicates that a proprietary item is called for, other items of material or equipment or material or equipment of other suppliers may be submitted to ENGINEER for review under the circumstances described below, and in accordance with MGL c.30, s.39M."

SC-6.17

In paragraph 6.17 E.1 of the General Conditions, delete the word "timely" from the first line.

SC-6.20

Delete paragraph 6.20A of the General Conditions in its entirety and replace with the following:

"A. To the fullest extent permitted by law, the CONTRACTOR shall indemnify and hold harmless the OWNER, the ENGINEER, ENGINEER's consultants, and any of their officers, directors, employees, agents, affiliates, subsidiaries and partners from and against all claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from the performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, but only to the extent caused in whole or in part by acts or omissions of the CONTRACTOR, a subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall apply to any such claims, damages, losses and expenses which arise and/or are incurred by any person or entity either during the performance of the Work and/or after completion of construction. Nothing in this paragraph shall be construed to negate, abridge, or reduce other rights or obligations of indemnity or contribution which would otherwise exist as to a party or person indemnified hereunder. CONTRACTOR hereby assumes the responsibility and liability for injury to or death of any and all persons, including the CONTRACTOR's employees, and for any and all damage to property caused by, resulting from, or arising out of any act, omission or neglect on the part of the CONTRACTOR, or of any Subcontractor or of anyone directly or indirectly employed by any of them or of anyone for whose acts, any of them may be liable. The Contractor hereby acknowledges its obligation under the foregoing paragraph to indemnify the Engineer and Owner against judgments suffered because of the contractor's work and to assume the cost of defending the Engineer and Owner against claims as described in the foregoing paragraph."

Delete paragraph 6.20C of the General Conditions in its entirety.

ARTICLE 8. OWNER'S RESPONSIBILITIES

SC-8.02

Delete the phrase "to whom the CONTRACTOR makes no reasonable objection."

SC-8.06

Delete paragraph 8.06A of the General Conditions in its entirety.

SC-8.09

Insert the following after the first sentence:

"However, the OWNER shall have the right to direct the CONTRACTOR to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto."

ARTICLE 9. ENGINEER'S STATUS DURING CONSTRUCTION SC-9.01

Add a new paragraph 9.01B after paragraph 9.01A of the General Conditions, which is to read as follows:

"B. Nothing contained in the Contract Documents shall be construed to create a contractual relationship of any kind (1) between the ENGINEER and CONTRACTOR, (2) between the OWNER and a Subcontractor or Subcontractors, or (3) between any person or entities other than the OWNER and CONTRACTOR. The ENGINEER shall, however, be entitled to performance and enforcement of obligations under the CONTRACT DOCUMENTS intended to facilitate performance of the ENGINEER'S duties."

SC-9.10

Insert the following after the first sentence on paragraph 9.10B:

"However, the ENGINEER shall have the right to direct the CONTRACTOR to perform the Work according to any sequence schedule set forth in the Contract Documents or established pursuant thereto."

ARTICLE 11. COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

Delete Article 11 of the General Conditions in its entirety and replace with the following:

"A. The unit price of an item of Unit Price work shall be subject to reevaluation and adjustment under the following conditions:

(1) If the total extended bid price [Estimated Quantity times the Bid Unit Price] of a particular item of Unit Price Work amounts to 5 percent or more of the Original Contract Price and the variation in the quantity of the particular item of Unit Price Work performed by CONTRACTOR differs by more than 15 percent from the estimated quantity of such item indicated in the Agreement; and

(2) If there is no corresponding adjustment with respect to any other item of work; and

(3) If CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof, CONTRACTOR may make a claim for an adjustment in the Contract Price in accordance with Article 11 if the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work performed. If OWNER believes that the quantity variation entitles OWNER to an adjustment in the unit price, OWNER shall be entitled to an adjustment in the unit price in an amount determined by the ENGINEER. ENGINEER shall not be liable in connection with any determination relating to adjustments which is rendered in good faith."

ARTICLE 12. CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

SC-12.01

Delete paragraph 12.01 in its entirety.

SC-12.06

Add the following new paragraphs after paragraph 12.06 of the General Conditions: "12.07 Liquidated Damages:

"A. If the CONTRACTOR shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the OWNER, then the CONTRACTOR does hereby agree, as a part consideration for the awarding of this Contract, to pay to the OWNER the amount specified in the Contract, not as a penalty but as liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the Contract shall be in default after the time stipulated in the Contract for completing the work. Such damages may be retained from time to time by the OWNER from progress payments or any amounts owing to the CONTRACTOR, or otherwise collected.

B. The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would in such event sustain, and said amount is agreed to be the amount of damages which the OWNER would sustain and said amount shall be retained from time to time by the OWNER from current periodical estimates.

C. It is further agreed that time is of the essence of each and every portion of this Contract and of the specifications wherein as definite and certain length of times if fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this Contract. Provided that the CONTRACTOR shall not be charged with liquidated damages of any excess cost when the OWNER determines that the CONTRACTOR is without fault and the CONTRACTOR's reasons for the time extension are acceptable to the OWNER; Provided, further, that the CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the work is due:

1) to any preference, priority or allocation order duly issued by the Government;

2) to unforeseeable cause beyond the control and without the fault or negligence of the CONTRACTOR, including, but not restricted to, acts of God, or of the public enemy, acts of the OWNER, acts of another CONTRACTOR in the performance of a contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and severe weather; and

3) to any delays of subcontractors or suppliers occasioned by any of the causes specified in subsections C (1) and C (2) above;

D. Provided, further, that the CONTRACTOR shall, within thirty (30) days from the beginning of such delay, unless the OWNER shall grant a further period of time prior to the date of final settlement of the Contract, notify the OWNER, in writing, of the causes of the delay, who shall ascertain the facts and extent of the delay and notify the CONTRACTOR within a reasonable time of its decision in the matter."

ARTICLE 13. TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

SC-13.07

Delete paragraph 13.07A of the General Conditions and insert the following in its place:

"A. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions: (i) correct such defective work, or, if it has been rejected by OWNER, remove it from the site and replace it with work that is not defective, and (ii) satisfactorily correct or remove and replace any damage to other work or the work of others therefrom. If CONTRACTOR does not begin the repairs within ten (10) days of receipt of written notification and promptly comply with the terms of OWNER's written instructions, or in an emergency where delay would cause serious risk, loss or damage, OWNER may have the defective work corrected or the rejected work removed and replaced, and all claims, costs, losses and damages caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by CONTRACTOR."

SC-13.09

Revise paragraph 13.09A of the General Conditions

"A. Delete the word "seven" and replace it with the word "ten" so that it reads "after ten days written notice to CONTRACTOR."

ARTICLE 14. PAYMENTS TO CONTRACTOR AND COMPLETION

SC-14.02

Delete paragraph 14.02A.3 and insert the following in its place:

"3. Retainage with respect to progress payments will be five percent or, if stipulated, the maximum allowed by law."

Add Paragraph 4. to read as follows:

"4. The CONTRACTOR shall submit Weekly Payroll Records Report and Statement of Compliance verifying compliance with the Minimum Prevailing Wage Law, MGL ch. 149, Sections 26-27H. These Statements of Compliance shall be submitted as a condition of payment for work performed during the period the reports apply."

SC-14.03

Delete paragraph 14.03A in its entirety and insert the following in its place:

"A. CONTRACTOR warrants and guarantees that title to all work, material and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than at the time of Application for Payment free and clear of all liens. CONTRACTOR shall provide written transfer of title and a certified paid invoice provided by the supplier."

ARTICLE 15. SUSPENSION OF WORK AND TERMINATION

SC-15.02

Add a new paragraph immediately after paragraph 15.02 A.4 of the General Conditions which is to read as follows:

"5. If the Work to be done under this Contract shall be abandoned, or if this Contract or any part thereof shall be sublet, without the previous written consent of OWNER, or if the contract or any claim thereunder shall be assigned by CONTRACTOR otherwise than as herein specified;"

ARTICLE 17. MISCELLANEOUS

SC-17.06, 17.07, 17.08, 17.09

Add the following new paragraphs after paragraph 17.05 of the General Conditions:

"17.06 Assignment:

The CONTRACTOR shall not assign the whole or any part of this Contract or any moneys due or to become due hereunder until thirty (30) days prior notice in writing has been given to the OWNER of the intention to assign, which notice shall state the identity and address of the prospective assignee. No assignment shall be made without the OWNER's prior written consent. Such consent shall not be unreasonably withheld. In case the CONTRACTOR assigns all or any part of the moneys due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any moneys due or to become due to the CONTRACTOR shall be subject to prior claims of all persons, firms and corporations of services rendered or materials supplied for the performance of the work called for in this Contract.

17.07 Liability

It is understood and agreed that members of the OWNER or the ENGINEER or any agent or employees of the OWNER signing this Agreement shall not be personally liable hereunder for any action incurred in connection with this Agreement.

17.08 State Statutes and Regulations

See Section 00830 for further modifications of the General Conditions due to state statutes and regulations.

17.09 Severability

If any provision of this Agreement shall be invalid or unenforceable to any extent or in any application, then the remainder of this Agreement and of such terms and conditions, except to such extent or in such application, shall not be affected thereby, and each and every term and condition of this Agreement shall be valid and enforced to the fullest extent and in the broadest application permitted by law."

END OF DOCUMENT

SECTION 00830

STATE STATUTES AND REGULATIONS

COMMONWEALTH OF MASSACHUSETTS

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ATTACHMENT D - Change Orders

A. REVISIONS TO GENERAL CONDITIONS

1. Definitions

The term "AWARDING AUTHORITY," as used herein, shall be considered to be synonymous with the term "OWNER," described in definition 1.01 A.30.

Delete definition 1.01 A.43 entitled "Substantial Completion" in the General Conditions in its entirety and insert the following in its place:

"Substantial Completion shall be interpreted in accordance with Massachusetts General Law

Chapter 30, Section 39G or 39K as appropriate."

2. Subsurface Conditions Found Different

Add the following sentence to the end of paragraph 4.03A of the General Conditions:

"...to do so. Adjustments resulting from subsurface or latent physical conditions will be in accordance with Massachusetts General Law Chapter 30, Section 39N."

3. Subcontracting

Add the following language at the end of paragraph 6.06F of the General Conditions:

"Except as required otherwise by Massachusetts General Law Chapter 149, Section 44F, for

Work governed by Chapter 149, sections 44A through 44H.

4. Permits

Delete paragraph 6.08A of the General Conditions in its entirety and insert the following in its place:

"A. Unless otherwise provided for in Section 00890 PERMITS, the AWARDING AUTHORITY shall be responsible for identifying and obtaining all federal, state, and local permits required by the nature and location of construction, including but not limited to railroad permits, building construction permits, and permits for street and highway cuts and openings. CONTRACTOR shall be responsible for obtaining all permits required of its equipment, work force, or particular operations in the performance of the Work and not otherwise specified to be obtained by the AWARDING AUTHORITY. These permit fees shall be paid by CONTRACTOR. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of bids, or, if there are no Bids, on the Effective Date of the Agreement. Town of Orleans building permit fees are waived."

5. Contractor Records

Add a new paragraph immediately after paragraph 6.09C of the General Conditions, which is to read as follows:

"D. The CONTRACTOR shall comply with all applicable provisions Chapter 30, Section 39R of the Massachusetts General Laws regarding, CONTRACTOR's records."

6. Massachusetts Sales and Use Tax

Add the following paragraph after paragraph 6.10A of the General Conditions:

"B. The materials and supplies to be used by the CONTRACTOR in the Work of this Contract are exempt from the Sales and Use Tax of the Commonwealth of Massachusetts. The AWARDING AUTHORITY tax exemption certificate number will be furnished to the CONTRACTOR."

7. Clarifications and Interpretations

Add the following language at the end of paragraph 9.04A of the General Conditions:

"The ENGINEER'S interpretation will be made in accordance with the requirements of Massachusetts General Law Chapter 30, Section 39P."

8. Change of Contract Price

Delete paragraphs 11.01, 11.02 and 12.01 of the General Conditions, having to do with Change of Contract Price. Changes in contract price will be governed by the section called "Change Orders," in Attachment D, Section 00830 and Article 11 in the Supplementary Conditions.

9. Payments

Delete paragraph 14.02B.1 of the General Conditions in its entirety and insert the following in its place:

"1. Progress Payments will be made in accordance with Massachusetts General Law Chapter 30, Section 39G, or 39K, as applicable."

Add the following new paragraph following paragraph 14.02C.1 of the General Conditions:

"2. The CONTRACTOR shall make payments to Subcontractors in accordance with the requirements of Massachusetts General Law Chapter 30, Section 39F."

Delete paragraph 14.07B of the General Conditions in its entirety and insert the following in its place:

"1. If, on the basis of the ENGINEER's observation of the Work during construction and final inspection and, upon the ENGINEER's review of the final Application for Payment and accompanying documentation, the ENGINEER is satisfied that the Work has been completed and that the CONTRACTOR's other obligations under the Contract Documents have been fulfilled, the ENGINEER will indicate in writing its recommendation of payment and present the Application to the AWARDING AUTHORITY for payment. Thereupon the ENGINEER will give written notice to the AWARDING AUTHORITY and the CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.15. Otherwise, the ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment. In such case the CONTRACTOR shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, the AWARDING AUTHORITY shall in accordance with the applicable provisions of the Massachusetts General Laws, make payment to the CONTRACTOR."

10. Suspension of Work and Termination

Delete paragraph 15.01A of the General Conditions in its entirety and insert the following in its place:

"A. The AWARDING AUTHORITY may order, at any time and without cause, the CONTRACTOR to suspend or delay the Work in accordance with Massachusetts General Law Chapter 30, Section 39O."

11. Labor Classifications and Minimum Wage Rates

Add the following paragraphs under the heading "Wage Rates" after paragraph 17.09 of the

Supplementary Conditions: "17.11 Wage Rates

A. Minimum Wage Rates as determined by the Commissioner of the Division of Occupational Safety of the Executive Office of Labor and Workforce Development under the provisions of Massachusetts General Laws Chapter 149, Sections 26-27D apply to this project. A copy of the wage schedule is included in Attachment A of Section 00830. If, after the Notice of Award, it becomes necessary to employ any person in a trade or occupation not classified in the wage determinations, such person shall be paid at not less than such rates as shall be determined by the Commissioner. Such approved minimum rate shall be retroactive to the time of the initial employment of such person in such trade or occupation. The CONTRACTOR shall notify the AWARDING AUTHORITY of its intention to employ persons in trades or occupations not classified in the wage determinations as soon as possible in order to allow sufficient time for the AWARDING AUTHORITY to obtain approved rates for such trades or occupations.

B. The schedule of wages referred to above are minimum rates only, and the AWARDING AUTHORITY will not consider any claims for additional compensation made by CONTRACTOR because of payment by the CONTRACTOR of any wage rate in excess of the applicable rate contained in the Contract.

C. The said schedule of wages shall continue to be the minimum rates to be paid during the life of this Agreement, except in the case of the duration of this Agreement exceeding one year, when the Contractor will be responsible for requesting and obtaining updated minimum wage rates from the Owner before the one-year anniversary of the project's start date, and a legible copy of said schedule shall be kept posted in a conspicuous place at the site of the Work.

D. CONTRACTOR and subcontractors shall submit a copy of weekly payroll records to the AWARDING AUTHORITY and the AWARDING AUTHORITY shall retain the records for a minimum of three years."

B. OTHER REGULATORY REQUIREMENTS:

1. Working Hours

No laborer, workman, mechanic, foreman, or inspector, working within the Commonwealth, in the employ of the CONTRACTOR, subcontractor, or other person doing or contracting to do the whole or a part of the work contemplated by this contract, shall be required or permitted to work more than eight hours in any one day or more than forty-eight hours in any one week, or more than six days in any one week, except in cases of emergency or required for this Project.

2. Commonwealth of Massachusetts Supplemental Equal Employment Opportunity, Non-Discrimination and Affirmative Action Program.

The Contractor shall abide by the Commonwealth of Massachusetts Supplemental Equal Employment Opportunity, Non-Discrimination and Affirmative Action Program, which is attached in its entirety on pages 00830-C.

3. MassDEP Community Sound Level Criteria

The Community Sound Level Criteria as established by the Commonwealth of Massachusetts' Department of Environmental Protection (MassDEP) must be conformed to prior to the AWARDING AUTHORITY's acceptance of the structure. The following sound level criteria must be met at the construction site:

A. The increase in the broadband noise level shall not be in excess of ten (10) dB(A) above ambient at the station boundary. The ambient level is defined as the A-weighted noise level that is exceeded ninety (90) percent of the time measured during the period in question.

B. The primary noise source(s) shall not produce a puretone condition. Puretone is any given octave band center frequency that exceeds the two adjacent center frequencies by three (3) or more decibels.

4. OSHA 10 Hour Certification Requirements

All employees of the Contractor who work at the jobsite must have received OSHA 10 Hour safety training, and have proof, at the jobsite, of being certified by OSHA as having received the training. The Contractor must provide written proof (copy of OSHA card each employee is required to carry is preferred) of this certification for every employee with submission of the first certified payroll report for each employee.

END OF DOCUMENT

SECTION 00830

ATTACHMENT A

MINIMUM WAGE RATES

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"General Decision Number: MA20230008 03/03/2023

Superseded General Decision Number: MA20220008

State: Massachusetts

Construction Types: Heavy (Heavy and Marine)

Counties: Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth and Suffolk Counties in Massachusetts.

HEAVY AND MARINE CONTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number Publication Date

0	01/06/2023
1	01/27/2023
2	02/03/2023
3	03/03/2023

BOIL0029-001 01/01/2021

	Rates	Fringes
BOILERMAKER	$ 45.87	29.02

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* BRMA0001-011 02/01/2023

FOXBORO CHAPTER

BRISTOL (Attleboro, Berkley, Dighton, Mansfield, North Attleboro, Norton, Raynham, Rehoboth, Seekonk, Taunton); NORFOLK, (Bellingham, Canton, Dedham, Foxboro, Franklin, Norfolk, Norwood, Plainville, Sharon, Walpole, Westrwood, Wrentham); and PLYMOUTH (Lakeville)

	Rates	Fringes
Bricklayer/Cement Mason	$ 60.35	34.40

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* BRMA0001-012 02/01/2023

LOWELL CHAPTER

MIDDLESEX (Acton, Ashby, Ayer, Bedford, Billerica, Boxboro, Carlisle, Chemsford, Dracut, Dunstabale, Ft Devens, Groton, Littleton, Lowell, North Acton, Pepperell, Shirley, South Acton, Tewksbury, Townsend, Tyngsboro, West Acton, Westford, Wilmington)

	Rates	Fringes
BRICKLAYER	$ 58.21	33.71

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* BRMA0001-013 02/01/2023

LOWELL CHAPTER
MIDDLESEX (Ashland, Framingham, Holliston, Hopkinton, Hudson, Maynard, Natick, Sherbvorn, Stow); and NORFOLK (Medfield, Medway, Millis)

	Rates	Fringes
BRICKLAYER	$ 60.35	34.40

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* BRMA0003-001 02/01/2023

	Rates	Fringes
Marble & Tile Finisher	$ 46.25	32.43
Marble, Tile & Terrazzo Workers	$ 60.37	34.37
TERRAZZO FINISHER	$ 59.29	34.21

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* BRMA0003-003 02/01/2023

BOSTON CHAPTER

MIDDLESEX (Arlington, Cambridge, Everett, Malden, Medford, Melrose, Somerville); NORFOLK (Brookline, Milton); and SUFFOLK

	Rates	Fringes
BRICKLAYER	$ 60.35	34.40

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* BRMA0003-011 02/01/2023

LYNN CHAPTER

ESSEX (Amesbury, Andover, Beverly, Boxford, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence, Lynn, Lynnfield, Manchester, Marblehead, Merrimac, Methuen, Middleton, Nahant, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salisbury, Salem, Saugus, Swampscott, Topsfield, Wakefield, Wenham, West Newbury); and MIDDLESEX (North Reading, Reading, Wakefield)

	Rates	Fringes
Bricklayer/Cement Mason	$ 60.35	34.40

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* BRMA0003-012 02/01/2023

	Rates	Fringes
BRICKLAYER WALTHAM CHAPTER - MIDDLESEX (Belmont, Burlington, Concord, Lexington, Lincoln, Stoneham, Sudbury, Waltham, Watertown, Wayland, Weston, Winchester, Woburn)	$ 60.35	34.40

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* BRMA0003-014 02/01/2023

QUINCY CHAPTER

PLYMOUTH COUNTY (Abington, Bridgewater, Brockton, Carver, Duxbury, East Bridgewater, Halifax, Hanover, Hanson, Hingham, Hull, Kingston, Marshfield, Middleboro, Norwell, Pembroke, Plymouth, Rockland, Scituate, West Bridgewater, Whitman)

	Rates	Fringes
Bricklayer/Cement Mason	$ 60.35	34.40

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* BRMA0003-025 02/01/2023

NEW BEDFORD CHAPTER

BARNSTABLE; BRISTOL (Acushnet, Darmouth, Fairhaven, Fall River, Freetown, New Bedford, Somerset, Swansea, Westport); DUKES; NANTUCKET; PLYMOUTH (Marion, Mattapoisett, Rochester, Wareham)

	Rates	Fringes
Bricklayer/Cement Mason	$ 60.35	34.40

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* BRMA0003-033 02/01/2023

NEWTON CHAPTER
MIDDLESEX (Newton); NORFOLK (Dover, Needham, Wellesley)

	Rates	Fringes
Bricklayer, Plasterer	$ 60.35	34.40

CARP0056-001 08/01/2022

All of SUFFOLK COUNTY; and those areas of BARNSTABLE, BRISTOL, ESSEX, MIDDLESEX, NORFOLK, and PLYMOUTH COUNTIES situated INSIDE Boston Beltway (I-495) and North of Cape Cod Canal. ALL of DUKES and NANTUCKET COUNTIES

	Rates	Fringes
PILEDRIVERMAN	$ 52.15	34.10

CARP0056-002 08/01/2022

The areas of BARNSTABLE, BRISTOL, PLYMOUTH, and NORFOLK COUNTIES situated OUTSIDE Boston Beltway (I-495) and South of Cape Cod Canal

	Rates	Fringes
PILEDRIVERMAN	$ 48.34	34.10

CARP0056-003 08/01/2022

Those areas of ESSEX and MIDDLESEX COUNTIES situated OUTSIDE Boston Beltway (I-495)

	Rates	Fringes
PILEDRIVERMAN	$ 45.74	34.10

CARP0056-004 08/01/2022

	Rates	Fringes
DIVER TENDER	$ 52.15	34.10
DIVER	$ 68.70	35.57

CARP0327-002 03/01/2022

MIDDLESEX (Belmont, Cambridge, Everett, Malden, Medford, Somerville); NORFOLK (Brookline, Dedham, Milton); AND SUFFOLK COUNTIES

	Rates	Fringes
CARPENTER	$ 53.87	29.62

CARP0339-002 03/01/2022

BRISTOL (Attleborough, North Attleborough); ESSEX; MIDDLESEX

(Except Belmont, Cambridge, Everett, Malden, Medford, Somerville); AND NORFOLK (Bellingham, Braintree, Canton, Cohassett, Foxboro, Franklin, Medfield, Medway, Millis, Needham, Norfolk, Norwood, Plainville, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth, Wrentham) COUNTIES

	Rates	Fringes
CARPENTER	$ 44.53	29.52

CARP0346-001 09/01/2021

NORFOLK (Braintree, Quincy, Cohasset, Weymouth, etc.) PLYMOUTH (Duxbury, Hanover, Hull, Hingham, Marshfield, Norwell, Pembroke Rockland, Scituate)

	Rates	Fringes
CARPENTER	$ 44.18	29.27

CARP0624-002 09/01/2017

DUKES; NANTUCKET

	Rates	Fringes
CARPENTER	$ 46.43	28.35

CARP0624-006 09/01/2017

BARNSTABLE; BRISTOL (Except Attleboro & North Attleboro); NORFOLK (Avon, Holbrook, Randolph, Stoughton); PLYMOUTH (Bridgewater, Kingston, Lakeville, Middleboro, Plymouth, S. Hanover, Whitman)

	Rates	Fringes
CARPENTER	$ 39.28	27.90

CARP1121-001 01/02/2023

SUFFOLK COUNTY

	Rates	Fringes
MILLWRIGHT	$ 46.29	31.18

CARP1121-005 01/02/2023

BARNSTABLE, BRISTOL, DUKES, ESSEX, MIDDLESEX, NANTUCKET, NORFOLK and PLYMOUTH COUNTIES

	Rates	Fringes
MILLWRIGHT	$ 40.94	31.18

ELEC0096-001 09/04/2022

MIDDLESEX (Ashby, Ashland, Ayer, Ft. Devens, Groton, Hopkinton, Hudson, Marlboro, Pepperell, Shirley, Stow, Townsend)

	Rates	Fringes
ELECTRICIAN	$ 45.59	30.92
Teledata System Installer	$ 34.19	29.33

ELEC0099-001 06/01/2021

BRISTOL (Attleboro, North Attleboro, Seekonk)

	Rates	Fringes
ELECTRICIAN	$ 43.61	54.71%
Teledata System Installer	$ 31.21	13.1%+14.93

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* ELEC0103-002 03/01/2023

ESSEX (Amesbury, Andover, Boxford, Georgetown, Groveland, Haverhill, Lawrence, Merrimac, Methuen, Newbury, Newburyport, North Andover, Rowley, Salisbury, West Newbury); MIDDLESEX (Bedford, Billerica, Boxboro, Burlington, Carlisle, Chelmsford, Dracut, Dunstable littleton, Lowell, North Reading, Tewksbury, Tyngsboro, Westford, Wilmington)

	Rates	Fringes
ELECTRICIAN	$ 59.23	35.52

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* ELEC0103-004 03/01/2023

ESSEX (Beverly, Danvers, Essex, Gloucester, Hamilton, Ipswich, Manchester, Marblehead, Middleton, Peabody, Rockport, Salem, Topsfield, Wenham)

	Rates	Fringes
ELECTRICIAN	$ 59.23	35.52

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* ELEC0103-005 03/01/2023

ESSEX (Lynn, Lynnfield, Nahant, Saugus, Swampscott); MIDDLESEX (Acton, Arlington, Belmont, Cambridge, Concord, Everett, Framingham, Holliston, Lexington, Lincoln, Malden, Maynard, Medford, Melrose, Natick, Newton, Reading, Sherborn, Somerville, Stoneham, Sudbury, Wakefield, Waltham, Watertown, Wayland, Weston, Winchester, Woburn); NORFOLK (Bellingham, Braintree, Brookline, Canton, Cohasset, Dedham, Dover, Foxboro, Frankloin, Medfield, Medway, Millis, Milton, Needham, Norfolk, Norwood, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth, Wrentham); PLYMOUTH (Hingham and Hull);SUFFOLK

	Rates	Fringes
ELECTRICIAN	$ 59.23	35.52

ELEC0104-001 08/29/2022

	Rates	Fringes
Line Construction:		
Cableman	$ 53.06	28.49+A
Equipment Operator	$ 45.10	25.20+A

Groundman	$ 29.18	12.10+A
Lineman	$ 53.06	28.49+A

A. PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Christmas Day and Columbus Day, provided the employee has been employed 5 working days prior to any one of the listed holidays.

ELEC0223-002 09/01/2022

BARNSTABLE, BRISTOL (Except Attleboro, North Attleboro, Seekonk); DUKES; NANTUCKET; PLYMOUTH (Except Hingham and Hull Twps); NORFOLK (Avon, Halbrook, Randolph, Sloughton)

	Rates	Fringes
ELECTRICIAN	$ 46.35	31.18%+14.50

ENGI0004-009 12/01/2021

	Rates	Fringes
Power equipment operators:		
Group 1	$ 51.38	30.10
Group 2	$ 50.83	30.10
Group 3	$ 33.69	30.10
Group 4	$ 41.76	30.10
Group 5	$ 23.48	30.10
Group 6	$ 28.44	30.10

HOURLY PREMIUM FOR BOOM LENGTHS (Including Jib):
Over 150 ft. +2.18
Over 185 ft. +3.84
Over 210 ft. +5.39
Over 250 ft. +8.16
Over 295 ft. +11.29
Over 350 ft. +13.14

FOOTNOTE FOR POWER EQUIPMENT OPERATORS:
A. PAID HOLIDAYS: New Year's Day, Washington,s Birthday, Labor Day, Memorial Day, Independence Day, Patriot's Day, Columbus Day, Veteran's Day, Thanksgiving Day, Christmas Day

POWER EQUIPMENT OPERATORS CLASSIFICATIONS [HEAVY CONSTRUCTION]
GROUP 1: Power shovel; crane; truck crane; derrick; pile driver; trenching machine; mechanical hoist pavement breaker; cement concrete paver; dragline; hoisting engine; three drum machine; pumpcrete machine; loaders; shovel dozer; front end loader; mucking machine; shaft hoist; steam engine; backhoe; gradall; cable way; fork lift; cherry picker; boring machine; rotary drill; post hole hammer; post hole digger; asphalt plant on job site; concrete batching and/or mixing plant on job site; crusher plant on job site; paving concrete mixer; timber jack
GROUP 2: Sonic or vibratory hammer; grader; scraper; tandem scraper; bulldozer; tractor; mechanic - maintenance; York rake; mulching machine; paving screed machine;stationary steam boiler; paving concrete finishing machine; grout pump; portable steam boiler; portable steam generator; roller; spreader; asphalt paver; locomotives or machines used in place thereof; tamper (self propelled or

tractor-draw); cal tracks; ballast regulator;rail anchor machine; switch tamper; tire truck
GROUP 3: Pumps (1-3 grouped); compressor; welding machines (1-3 grouped); generator; sighting plant; heaters (power driven, 1- 5); syphon-pulsometer; concrete mixer; valves controlling permanent plant air steam, conveyor, wellpoint system (operating)
GROUP 4: Assitant engineer (fireman)
GROUP 5: Oiler (other than truck cranes and gradalls)
GROUP 6: Oiler (on truck cranes and gradalls)

IRON0007-001 03/16/2022

AREA 1: BRISTOL (Easton); ESSEX (Beverly,Gloucester,Lynn, Lynnfield, Manchester,Marblehead, Nahant, Rockport, Salem, Saugus, Swampscott); MIDDLESEX (Arlington, Bedford, Belmont, Burlington, Cambridge, Carlisle, Concord, Dunstable, Everett, Framingham, Lexington, Lincoln, Malden, Maynard, Medford, Melrose, Natick, Newton, Reading, Sherborn, Somerville, Stoneham, Sudbury, Wakefield, Waltham, Watertown, Wayland, Weston, Winchester, Woburn); NORFOLK (Except Medway); PLYMOUTH (Abington, Bridgewater, Brocton, Duxbury, East Bridgewater, Halifax, Hanover, Hanson, Hingham, Hull, Kingston, Marshfield, Norwell, Pembroke, Plymouth, Plympton, Rockland, Scituate, West Bridgewater, Whitman); SUFFOLK

AREA 2: ESSEX (Amesbury, Andover, Boxford, Danvers, Essex, Georgetown, Hamilton, Haverhill, Ipswich, Lawrence, Merrimac, Methuen, Newbury, Newburyport, North Andover, Rowley, Salisbury, Topsfield, Wenham, West Newbury); MIDDLESEX (Action,Billerica, Chelmsford, Dracut, Groton, Groveland, Littleton, Lowell, Middleton, North Reading, Pepperell, Tewksbury, Tyngsboro, Westford, Wilminton)

	Rates	Fringes
IRONWORKER		
AREA 1	$ 50.60	34.81
AREA 2	$ 46.19	39.20

IRON0007-010 09/16/2022

MIDDLESEX (Ashby, Ashland, Ayer, Boxboro, Holliston, Hopkinton, Hudson, Marlboro, Shirley, Stow, Townsend); NORFOLK (Medway)

	Rates	Fringes
IRONWORKER	$ 51.29	35.84

IRON0037-002 09/16/2022

BARNSTABLE; BRISTOL (Acushnet, Attleboro, Berkley, Dartmouth, Dighton, Fairhaven, Fall River, Freetown, Mansfield, New Bedford, North Attleboro, Norton, Raynham, Rehoboth, Seekonk, Somerset, Swansea, Taunton, Westport); DUKES; NANTUCKET; NORFOLK (Billingham, Franklin, Plainville, Wrentham); PLYMOUTH (Lakeville, Marion, Mattapoisett, Middleboro, Rochester, Wareham)

	Rates	Fringes

IRONWORKER.....$ 39.01 31.58

LABO0022-006 12/01/2021

SUFFOLK COUNTY (Boston, Chelsea, Revere, Winthrop, Deer & Nut Islands); MIDDLESEX COUNTY (Arlington, Belmont, Burlington, Cambridge, Everett, Malden, Medford, Melrose, Reading, Somerville, Stoneham, Wakefield, Winchester, Winthrop and Woburn only); NORFOLK COUNTY (Brookline, Dedham, and Milton only)

	Rates	Fringes
Laborers:		
GROUP 1	$ 41.18	27.52
GROUP 2	$ 41.43	27.52
GROUP 3	$ 41.93	27.52
GROUP 4	$ 42.18	27.52
GROUP 5	$ 24.50	27.52
GROUP 6	$ 43.18	27.52

LABORERS CLASSIFICATIONS

GROUP 1: Laborers; carpenter tenders; cement finisher tenders

GROUP 2: Asphalt raker; fence and guard rail erector; laser beam operator; mason tender; pipelayer; pneumatic drill operator; pneumatic tool operator; wagon drill operator

GROUP 3: Air track operator; block paver; rammer; curb setter

GROUP 4: Blaster; powderman

GROUP 5: Flagger

GROUP 6: Asbestos Abatement; Toxic and Hazardous Waste Laborers

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LABO0022-012 12/01/2021

Counties of BARNSTABLE; BRISTOL; DUKES; ESSEX; NANTUCKET; PLYMOUTH; MIDDLESEX (With the exception of Arlington, Belmont, Burlington, Cambridge, Everett, Malden, Melrose, Reading, Somerville, Stoneham, Wakefield, Winchester, Winthrop and Woburn); NORFOLK (With the exception of Brookline, Dedham, and Milton)

	Rates	Fringes
Laborers:		
GROUP 1	$ 35.41	26.59
GROUP 2	$ 35.66	26.59
GROUP 3	$ 36.16	26.59
GROUP 4	$ 36.41	26.59
GROUP 5	$ 24.50	26.59
GROUP 6	$ 37.41	26.59

LABORERS CLASSIFICATIONS

GROUP 1: Laborers; carpenter tenders; cement finisher

tenders

GROUP 2: Asphalt raker; fence and guard rail erector; laser beam operator; mason tender; pipelayer; pneumatic drill operator; pneumatic tool operator; wagon drillperator

GROUP 3: Air track operator; block paver; rammer; curb setter; hydraulic & similar self powere drills

GROUP 4: Blaster; powderman

GROUP 5: Flagger

GROUP 6: Asbestos Abatement; Toxic and Hazardous Waste Laborers

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LABO0022-013 12/01/2021

	Rates	Fringes
Laborers:		
(FREE AIR OPERATION): SHIELD DRIVEN AND LINER PLATE IN FREE AIR)		
GROUP 1	$ 45.48	28.02
GROUP 2	$ 45.48	28.02
(OPEN AIR CASSONS, UNDERPINNING AND TEST BORING INDUSTRIES):		
TEST BORING & WELL DRILLING		
Driller	$ 42.58	27.67
Laborer	$ 41.18	27.67
(OPEN AIR CASSONS, UNDERPINNING AND TEST BORING INDUSTRIES):		
OPEN AIR CASSON, UNDERPINNING WORK & BORING CREW		
Bottom man	$ 42.33	27.67
Laborers; Top man	$ 41.18	27.67
(TUNNELS, CAISSON & CYLINDER WORK IN COMPRESSED AIR)		
GROUP 1	$ 42.93	28.02
GROUP 2	$ 53.41	28.02
GROUP 3	$ 53.41	28.02
GROUP 4	$ 53.41	28.02
GROUP 5	$ 53.41	28.02
GROUP 6	$ 55.41	28.02
CLEANING CONCRETE AND CAULKING TUNNEL (Both New & Existing)		
GROUP 1	$ 45.48	28.02
GROUP 2	$ 45.48	28.02
ROCK SHAFT, CONCRETE LINING OF SAME AND TUNNEL IN FREE AIR		
GROUP 1	$ 42.93	28.02
GROUP 2	$ 45.48	28.02
GROUP 3	$ 45.48	28.02
GROUP 4	$ 45.48	28.02
GROUP 5	$ 47.48	28.02

LABORERS CLASSIFICATIONS for TUNNELS, CAISSON & CYLINDER WORK IN COMPRESSED AIR

GROUP 1: Powder watchman; Top man on iron bolt; change house attendant

GROUP 2: Brakeman; trackman; groutman; tunnel laborer; outside lock tender; lock tender; guage tender

GROUP 3: Motorman, miner

GROUP 4: Blaster

GROUP 5: Mucking machine operator

GROUP 6: Hazardous Waste work within the ""HOT"" zone. (A premium of two dollars $2.00 per hour over the basic wage rate.

LABORERS CLASSIFICATIONS for (FREE AIR OPERATION): SHIELD DRIVEN AND LINER PLATE IN FREE AIR

GROUP 1: Miner; miner welder; conveyor operator; motorman; mucking machine operator; nozzle man; grout man-; pumps, shaft and tunnel steel and rodman; shield and erector arm operators, mole nipper, outside motorman, burner, TBM operator, safety miner; laborer topside; heading motormen; erecting operators; top signal men

GROUP 2: Brakeman; trackman

LABORERS CLASSIFICATIONS FOR CLEANING CONCRETE AND CAULKING TUNNEL (Both New & Existing)

GROUP 1: Concrete workers; strippers and form movers (wood & steel), cement finisher

GROUP 2: Form erector (wood & steel and all accessories)

LABORERS CLASSIFICATIONS for ROCK SHAFT, CONCRETE LINING OF SAME AND TUNNE IN FREE AIR

GROUP 1: Change house attendants

GROUP 2: Laborers, topside, bottom men (when heading is 50 ft. from shaft) and all other laborers

GROUP 3: Brakeman; trackman; tunnel laborers; shaft laborers

GROUP 4: Miner; cage tender; bellman

GROUP 5: Hazardous Waste work within the ""HOT"" zone. (A premium of two dollars $2.00 per hour over the basic wage rate)

FOOTNOTE FOR LABORERS:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday,

Patriot's Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veteran's Day, Thanksgiving Day, and Christmas Day

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LABO1421-001 12/01/2021

WRECKING LABORERS:

	Rates	Fringes
Laborers: (Wrecking)		
Group 1	$ 41.33	27.37
Group 2	$ 42.08	27.37
Group 3	$ 42.33	27.37
Group 4	$ 37.33	27.37
Group 5	$ 40.43	27.37
Group 6	$ 41.33	27.37

Group 1: Adzeman, Wrecking Laborer.
Group 2: Burners, Jackhammers.
Group 3: Small Backhoes, Loaders on tracks, Bobcat Type Loaders, Hydraulic ""Brock"" Type Hammer Operators, Concrete Cutting Saws.
Group 4: Yardman (Salvage Yard Only).
Group 5: Yardman, Burners, Sawyers.
Group 6: Asbestos, Lead Paint, Toxic and Hazardous Waste.

PAIN0035-001 07/01/2019

BARNSTABLE BRISTOL; DUKES; ESSEX; NANTUCKET; PLYMOUTH (Remainder of NORFOLK; MIDDLESEX AND SUFFOLK COUNTIES)

	Rates	Fringes
PAINTER		
NEW CONSTRUCTION:		
Bridge	$ 50.36	30.25
Brush, Taper	$ 39.86	30.25
Spray, Sandblast	$ 41.26	30.25
REPAINT:		
Bridge	$ 50.66	30.90
Brush, Taper	$ 37.92	30.25
Spray, Sandblast	$ 39.32	30.25

PAIN0035-015 07/01/2019

MIDDLESEX (Cambridge, Everett, Malden, Medford, Sommerville) SUFFOLK COUNTY (Boston, Chelsea) NORFOLK COUNTY (Brookline)

	Rates	Fringes
PAINTER		
NEW CONSTRUCTION:		
Brush, Taper	$ 45.65	30.25
Spray, Sandblast	$ 47.05	30.25
REPAINT:		
Bridge	$ 50.66	30.90
Brush, Taper	$ 43.71	30.25
Spray, Sandblast	$ 45.11	30.25

PLAS0534-001 01/01/2020

ESSEX; MIDDLESEX; NORFOLK AND SUFFOLK COUNTY

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 43.00	37.66

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* PLUM0004-001 03/01/2023

MIDDLESEX (Ashby, Ayer-West of Greenville branch of Boston and Maine Railroad, Ft. Devens, Groton, Shirley, Townsend)

	Rates	Fringes
Plumbers and Pipefitters	$ 51.50	28.07

PLUM0012-001 02/27/2022

ESSEX (Ames, Andover, Beverly, Boxford, Byfield, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence,Manchester, Marblehead, Merrimac, Methuem, Middleton, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salem, Salisbury, Topsfieild, Wenham, West Newbury)

	Rates	Fringes
PLUMBER	$ 63.39	30.83

PLUM0012-003 02/27/2022

ESSEX (Ames, Andover, Beverly, Boxford, Byfield, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence, Manchester, Marblehead, Merrimac, Methuen, Middleton, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salem, Salisbury, Topsfield, Wenham, West Newbury)

	Rates	Fringes
Plumber, Pipefitter, Steamfitter	$ 63.39	30.83

PLUM0012-006 02/27/2022

ESSEX (Lynn, Lynnfield, Nahant, Saugus, and Swampscott); MIDDLESEX (Acton, Arlington, Ashland, Ayer - except W. of Greenville Branch of Boston & Maine RR, Bedford, Belmont, Billerica, Boxboro, Burlington, Cambridge, Carlisle, Chelmsford, Concord, Dracut, Dunstable, Everett, Framingham, Hudson, Holliston, Hopkinton, Lexington, Lincoln, Littleton, Lowell, Malden, Marlboro, Maynard, Medford, Melrose, Natick, Newton, North Reading, Pepperell, Reading, Sherborn, Somerville, Stoneham, Stow, Sudbury, Tewksbury, Tyngsboro, Wakefield, Waltham, Watertown, Wayland, Westford, Wilmington, Winchester, Woburn); NORFOLK (Bellingham, Braintree, Brookline, Canton, Cohasset, Dedham, Dover,Foxboro, Franklin, Medfield, Medway, Millis, Milton, Needham, Norfolk, Norwood, Plainville, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth, Wrentham); PLYMOUTH (Hingham, Hull, Scituate); SUFFOLK

	Rates	Fringes
PLUMBER	$ 63.39	30.83

PLUM0051-005 09/01/2018

BARNSTABLE; BRISTOL; DUKES; NANTUCKET; NORFOLK (Avon, Holbrook, Randolph, Stoughton) PLYMOUTH(Remainder of County)

	Rates	Fringes
Plumbers and Pipefitters	$ 42.04	29.91

PLUM0537-001 03/01/2022

MIDDLESEX (Arlington, Cambridge, Everett, Malden, Medford, Melrose, Reading, Wakefield, Winchester and Woburn); NORFOLK (Bellingham, Braintree, Brookline, Canton Cashasset, Dedham, Foxboro, Franklin, Millis, Milton, Sharon, Walpole, Westwood, and Wrenthan); PLYMOUTH (Hingham, Hull, Scituate); ESSEX (Ames, Andover, Beverly, Boxford, Byfield, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence,Lynn, Lynnfield, Manchester, Marblehead, Merrimac, Methuem, Middleton, Nahant, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salem, Salisbury, Saugus, Swampscott, Topsfieild, Wenham, West Newbury)

	Rates	Fringes
PIPEFITTER	$ 60.28	32.48

TEAM0379-001 08/01/2022

	Rates	Fringes
Truck drivers:		
Group 1	$ 34.98	31.36+a+b
Group 2	$ 35.15	31.36+a+b
Group 3	$ 35.22	31.36+a+b
Group 4	$ 34.44	31.36+a+b
Group 5	$ 35.44	31.36+a+b
Group 6	$ 35.73	31.36+a+b
Group 7	$ 36.02	31.36+a+b

POWER TRUCKS $.25 DIFFERENTIAL BY AXLE
TUNNEL WORK (UNDERGROUND ONLY) $.40 DIFFERENTIAL BY AXLE
HAZARDOUS MATERIALS (IN HOT ZONE ONLY) $2.00 PREMIUM

TRUCK DRIVERS CLASSIFICATIONS

Group 1: Station wagons; panel trucks; and pickup trucks

Group 2: Two axle equipment; & forklift operator

Group 3: Three axle equipment and tireman

Group 4: Four and Five Axle equipment

Group 5: Specialized earth moving equipment under 35 tons other than conventional type trucks; low bed; vachual; mechanics, paving restoration equipment

Group 6: Specialized earth moving equipment over 35 tons

Group 7: Trailers for earth moving equipment (double hookup)

FOOTNOTES:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Patriot's Day, Columbus Day, Veteran's Day, Thanksgiving Day and Christmas Day

B. PAID VACATION: Employees with 4 months to 1 year of service receive 1/2 day's pay per month; 1 week vacation for 1 - 5 years of service; 2 weeks vacation for 5 - 10 years of service; and 3 weeks vacation for more than 10 years of service

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination

* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
DEPARTMENT OF LABOR STANDARDS

Prevailing Wage Rates

As determined by the Director under the provisions of the Massachusetts General Laws, Chapter 149, Sections 26 to 27H

CHARLES D. BAKER
Governor

KARYN E. POLITO
Lt. Governor

ROSALIN ACOSTA
Secretary

MICHAEL FLANAGAN
Director

Awarding Authority: Town of Orleans

Contract Number: 2022-01 **City/Town:** ORLEANS

Description of Work: 15,750 lf of 8", 10" and 12" PVC gravity sewer, approximately 7,500 lf of 6" and 8" PVC force main approximately 20,750 lf of 1.5", 2" and 3" low pressure sewer and 1 Submersible Pumping Station

Job Location: 19 School Road

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- **The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor.** For multi-year CM AT RISK projects, the awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. The annual update requirement is not applicable to 27F "rental of equipment" contracts. **The updated wage schedule must be provided to all contractors, including general and sub-contractors, working on the construction project.**
- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the "Wage Request Number" on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule if it has not opened bids or selected a contractor within 90 days of the date of issuance of the wage schedule. For CM AT RISK projects (bid pursuant to G.L. c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27. The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or a sub-contractor.
- Apprentices working on the project are required to be registered with the Massachusetts Division of Apprentice Standards (DAS). Apprentices must keep their apprentice identification card on their persons during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. **Any apprentice not registered with DAS regardless of whether they are registered with another federal, state, local, or private agency must be paid the journeyworker's rate.**
- Every contractor or subcontractor working on the construction project must submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee's name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. For a sample payroll reporting form go to http://www.mass.gov/dols/pw.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Contractors must obtain the wage schedules from awarding authorities. Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and criminal penalties.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may file a complaint with the Fair Labor Division of the office of the Attorney General at (617) 727-3465.

Issue Date: 01/05/2023 **Wage Request Number:** 20230105-008

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
Construction						
(2 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2021	$35.95	$13.41	$16.01	$0.00	$65.37
(3 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2021	$36.02	$13.41	$16.01	$0.00	$65.44
(4 & 5 AXLE) DRIVER - EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2021	$36.14	$13.41	$16.01	$0.00	$65.56
ADS/SUBMERSIBLE PILOT *PILE DRIVER LOCAL 56 (ZONE 2)*	08/01/2020	$103.05	$9.40	$23.12	$0.00	$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR *LABORERS - ZONE 2*	12/01/2022	$37.91	$9.10	$16.64	$0.00	$63.65
	06/01/2023	$38.81	$9.10	$16.64	$0.00	$64.55
	12/01/2023	$39.71	$9.10	$16.64	$0.00	$65.45
For apprentice rates see "Apprentice- LABORER"						
AIR TRACK OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$37.31	$9.35	$16.89	$0.00	$63.55
	06/01/2023	$38.21	$9.35	$16.89	$0.00	$64.45
	12/01/2023	$39.11	$9.35	$16.89	$0.00	$65.35
	06/01/2024	$40.44	$9.35	$16.89	$0.00	$66.68
	12/01/2024	$41.77	$9.35	$16.89	$0.00	$68.01
	06/01/2025	$43.16	$9.35	$16.89	$0.00	$69.40
	12/01/2025	$44.54	$9.35	$16.89	$0.00	$70.78
	06/01/2026	$45.98	$9.35	$16.89	$0.00	$72.22
	12/01/2026	$47.42	$9.35	$16.89	$0.00	$73.66
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
ASBESTOS REMOVER - PIPE / MECH. EQUIPT. *HEAT & FROST INSULATORS LOCAL 6 (BOSTON)*	12/01/2020	$38.10	$12.80	$9.45	$0.00	$60.35
ASPHALT RAKER *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
ASPHALT RAKER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.81	$9.35	$16.89	$0.00	$63.05
	06/01/2023	$37.71	$9.35	$16.89	$0.00	$63.95
	12/01/2023	$38.61	$9.35	$16.89	$0.00	$64.85
	06/01/2024	$39.94	$9.35	$16.89	$0.00	$66.18
	12/01/2024	$41.27	$9.35	$16.89	$0.00	$67.51
	06/01/2025	$42.66	$9.35	$16.89	$0.00	$68.90
	12/01/2025	$44.04	$9.35	$16.89	$0.00	$70.28
	06/01/2026	$45.48	$9.35	$16.89	$0.00	$71.72
	12/01/2026	$46.92	$9.35	$16.89	$0.00	$73.16
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.63	$14.25	$16.05	$0.00	$83.93
	06/01/2023	$54.88	$14.25	$16.05	$0.00	$85.18
	12/01/2023	$56.13	$14.25	$16.05	$0.00	$86.43
	06/01/2024	$57.43	$14.25	$16.05	$0.00	$87.73
	12/01/2024	$58.88	$14.25	$16.05	$0.00	$89.18
	06/01/2025	$60.18	$14.25	$16.05	$0.00	$90.48
	12/01/2025	$61.63	$14.25	$16.05	$0.00	$91.93
	06/01/2026	$62.93	$14.25	$16.05	$0.00	$93.23
	12/01/2026	$64.38	$14.25	$16.05	$0.00	$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.63	$14.25	$16.05	$0.00	$83.93
	06/01/2023	$54.88	$14.25	$16.05	$0.00	$85.18
	12/01/2023	$56.13	$14.25	$16.05	$0.00	$86.43
	06/01/2024	$57.43	$14.25	$16.05	$0.00	$87.73
	12/01/2024	$58.88	$14.25	$16.05	$0.00	$89.18
	06/01/2025	$60.18	$14.25	$16.05	$0.00	$90.48
	12/01/2025	$61.63	$14.25	$16.05	$0.00	$91.93
	06/01/2026	$62.93	$14.25	$16.05	$0.00	$93.23
	12/01/2026	$64.38	$14.25	$16.05	$0.00	$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BARCO-TYPE JUMPING TAMPER *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER *LABORERS - ZONE 2*	12/01/2022	$37.91	$9.10	$16.64	$0.00	$63.65
	06/01/2023	$38.81	$9.10	$16.64	$0.00	$64.55
	12/01/2023	$39.71	$9.10	$16.64	$0.00	$65.45
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$37.31	$9.35	$16.89	$0.00	$63.55
	06/01/2023	$38.21	$9.35	$16.89	$0.00	$64.45
	12/01/2023	$39.11	$9.35	$16.89	$0.00	$65.35
	06/01/2024	$40.44	$9.35	$16.89	$0.00	$66.68
	12/01/2024	$41.77	$9.35	$16.89	$0.00	$68.01
	06/01/2025	$43.16	$9.35	$16.89	$0.00	$69.40
	12/01/2025	$44.54	$9.35	$16.89	$0.00	$70.78
	06/01/2026	$45.98	$9.35	$16.89	$0.00	$72.22
	12/01/2026	$47.42	$9.35	$16.89	$0.00	$73.66
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
BOILER MAKER *BOILERMAKERS LOCAL 29*	01/01/2023	$47.12	$7.07	$20.31	$0.00	$74.50
	01/01/2024	$48.12	$7.07	$20.60	$0.00	$75.79

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *BOILERMAKER - Local 29*

Effective Date - 01/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	$30.63	$7.07	$13.22	$0.00	$50.92
2	65	$30.63	$7.07	$13.22	$0.00	$50.92
3	70	$32.98	$7.07	$14.23	$0.00	$54.28
4	75	$35.34	$7.07	$15.24	$0.00	$57.65
5	80	$37.70	$7.07	$16.25	$0.00	$61.02
6	85	$40.05	$7.07	$17.28	$0.00	$64.40
7	90	$42.41	$7.07	$18.28	$0.00	$67.76
8	95	$44.76	$7.07	$19.32	$0.00	$71.15

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	$31.28	$7.07	$13.22	$0.00	$51.57
2	65	$31.28	$7.07	$13.22	$0.00	$51.57
3	70	$33.68	$7.07	$14.23	$0.00	$54.98
4	75	$36.09	$7.07	$15.24	$0.00	$58.40
5	80	$38.50	$7.07	$16.25	$0.00	$61.82
6	85	$40.90	$7.07	$17.28	$0.00	$65.25
7	90	$43.31	$7.07	$18.28	$0.00	$68.66
8	95	$45.71	$7.07	$19.32	$0.00	$72.10

Notes:

Apprentice to Journeyworker Ratio:1:4

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING) *BRICKLAYERS LOCAL 3 (NEW BEDFORD)*	08/01/2022	$59.15	$11.49	$22.34	$0.00	$92.98
	02/01/2023	$60.35	$11.49	$22.34	$0.00	$94.18
	08/01/2023	$62.40	$11.49	$22.34	$0.00	$96.23
	02/01/2024	$63.65	$11.49	$22.34	$0.00	$97.48
	08/01/2024	$65.75	$11.49	$22.34	$0.00	$99.58
	02/01/2025	$67.05	$11.49	$22.34	$0.00	$100.88
	08/01/2025	$69.20	$11.49	$22.34	$0.00	$103.03
	02/01/2026	$70.55	$11.49	$22.34	$0.00	$104.38
	08/01/2026	$72.75	$11.49	$22.34	$0.00	$106.58
	02/01/2027	$74.15	$11.49	$22.34	$0.00	$107.98

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *BRICK/PLASTER/CEMENT MASON - Local 3 New Bedford*

Effective Date - 08/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$29.58	$11.49	$22.34	$0.00	$63.41
2	60	$35.49	$11.49	$22.34	$0.00	$69.32
3	70	$41.41	$11.49	$22.34	$0.00	$75.24
4	80	$47.32	$11.49	$22.34	$0.00	$81.15
5	90	$53.24	$11.49	$22.34	$0.00	$87.07

Effective Date - 02/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$30.18	$11.49	$22.34	$0.00	$64.01
2	60	$36.21	$11.49	$22.34	$0.00	$70.04
3	70	$42.25	$11.49	$22.34	$0.00	$76.08
4	80	$48.28	$11.49	$22.34	$0.00	$82.11
5	90	$54.32	$11.49	$22.34	$0.00	$88.15

Notes:

Apprentice to Journeyworker Ratio:1:5

BULLDOZER/GRADER/SCRAPER *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
CAISSON & UNDERPINNING BOTTOM MAN *LABORERS - FOUNDATION AND MARINE*	12/01/2021	$42.33	$9.10	$17.72	$0.00	$69.15
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING LABORER *LABORERS - FOUNDATION AND MARINE*	12/01/2021	$41.18	$9.10	$17.72	$0.00	$68.00
For apprentice rates see "Apprentice- LABORER"						
CAISSON & UNDERPINNING TOP MAN *LABORERS - FOUNDATION AND MARINE*	12/01/2021	$41.18	$9.10	$17.72	$0.00	$68.00
For apprentice rates see "Apprentice- LABORER"						
CARBIDE CORE DRILL OPERATOR *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
CARPENTER *CARPENTERS -ZONE 2 (Eastern Massachusetts)*	09/01/2022	$45.18	$8.68	$19.97	$0.00	$73.83
	03/01/2023	$45.78	$8.68	$19.97	$0.00	$74.43

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *CARPENTER - Zone 2 Eastern MA*

Effective Date - 09/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$22.59	$8.68	$1.73	$0.00	$33.00
2	60	$27.11	$8.68	$1.73	$0.00	$37.52
3	70	$31.63	$8.68	$14.78	$0.00	$55.09
4	75	$33.89	$8.68	$14.78	$0.00	$57.35
5	80	$36.14	$8.68	$16.51	$0.00	$61.33
6	80	$36.14	$8.68	$16.51	$0.00	$61.33
7	90	$40.66	$8.68	$18.24	$0.00	$67.58
8	90	$40.66	$8.68	$18.24	$0.00	$67.58

Effective Date - 03/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$22.89	$8.68	$1.73	$0.00	$33.30
2	60	$27.47	$8.68	$1.73	$0.00	$37.88
3	70	$32.05	$8.68	$14.78	$0.00	$55.51
4	75	$34.34	$8.68	$14.78	$0.00	$57.80
5	80	$36.62	$8.68	$16.51	$0.00	$61.81
6	80	$36.62	$8.68	$16.51	$0.00	$61.81
7	90	$41.20	$8.68	$18.24	$0.00	$68.12
8	90	$41.20	$8.68	$18.24	$0.00	$68.12

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 $31.01/ 3&4 $48.64/ 5&6 $57.24/ 7&8 $63.54

Apprentice to Journeyworker Ratio:1:5

CARPENTER WOOD FRAME *CARPENTERS-ZONE 3 (Wood Frame)*	04/01/2022	$23.66	$7.21	$4.80	$0.00	$35.67
	04/01/2023	$24.16	$7.21	$4.80	$0.00	$36.17

All Aspects of New Wood Frame Work

Apprentice - *CARPENTER (Wood Frame) - Zone 3*

Effective Date - 04/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$14.20	$7.21	$0.00	$0.00	$21.41
2	60	$14.20	$7.21	$0.00	$0.00	$21.41
3	65	$15.38	$7.21	$0.00	$0.00	$22.59
4	70	$16.56	$7.21	$0.00	$0.00	$23.77
5	75	$17.75	$7.21	$3.80	$0.00	$28.76
6	80	$18.93	$7.21	$3.80	$0.00	$29.94
7	85	$20.11	$7.21	$3.80	$0.00	$31.12
8	90	$21.29	$7.21	$3.80	$0.00	$32.30

Effective Date - 04/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$14.50	$7.21	$0.00	$0.00	$21.71
2	60	$14.50	$7.21	$0.00	$0.00	$21.71
3	65	$15.70	$7.21	$0.00	$0.00	$22.91
4	70	$16.91	$7.21	$0.00	$0.00	$24.12
5	75	$18.12	$7.21	$3.80	$0.00	$29.13
6	80	$19.33	$7.21	$3.80	$0.00	$30.34
7	85	$20.54	$7.21	$3.80	$0.00	$31.55
8	90	$21.74	$7.21	$3.80	$0.00	$32.75

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 $17.86/ 3&4 $20.22/ 5&6 $27.57/ 7&8 $29.94

Apprentice to Journeyworker Ratio:1:5

CEMENT MASONRY/PLASTERING *BRICKLAYERS LOCAL 3 (NEW BEDFORD)*	01/01/2020	$49.07	$12.75	$22.41	$0.62	$84.85

Apprentice - *CEMENT MASONRY/PLASTERING - Eastern Mass (New Bedford)*

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$24.54	$12.75	$15.41	$0.00	$52.70
2	60	$29.44	$12.75	$17.41	$0.62	$60.22
3	65	$31.90	$12.75	$18.41	$0.62	$63.68
4	70	$34.35	$12.75	$19.41	$0.62	$67.13
5	75	$36.80	$12.75	$20.41	$0.62	$70.58
6	80	$39.26	$12.75	$21.41	$0.62	$74.04
7	90	$44.16	$12.75	$22.41	$0.62	$79.94

Notes:

Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CHAIN SAW OPERATOR *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$54.68	$14.25	$16.05	$0.00	$84.98
	06/01/2023	$55.95	$14.25	$16.05	$0.00	$86.25
	12/01/2023	$57.23	$14.25	$16.05	$0.00	$87.53
	06/01/2024	$58.55	$14.25	$16.05	$0.00	$88.85
	12/01/2024	$60.03	$14.25	$16.05	$0.00	$90.33
	06/01/2025	$61.36	$14.25	$16.05	$0.00	$91.66
	12/01/2025	$62.83	$14.25	$16.05	$0.00	$93.13
	06/01/2026	$64.16	$14.25	$16.05	$0.00	$94.46
	12/01/2026	$65.64	$14.25	$16.05	$0.00	$95.94
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
COMPRESSOR OPERATOR *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$35.08	$14.25	$16.05	$0.00	$65.38
	06/01/2023	$35.90	$14.25	$16.05	$0.00	$66.20
	12/01/2023	$36.72	$14.25	$16.05	$0.00	$67.02
	06/01/2024	$37.57	$14.25	$16.05	$0.00	$67.87
	12/01/2024	$38.52	$14.25	$16.05	$0.00	$68.82
	06/01/2025	$39.37	$14.25	$16.05	$0.00	$69.67
	12/01/2025	$40.32	$14.25	$16.05	$0.00	$70.62
	06/01/2026	$41.18	$14.25	$16.05	$0.00	$71.48
	12/01/2026	$42.13	$14.25	$16.05	$0.00	$72.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DELEADER (BRIDGE) *PAINTERS LOCAL 35 - ZONE 2*	01/01/2023	$56.06	$8.65	$23.05	$0.00	$87.76
	07/01/2023	$57.26	$8.65	$23.05	$0.00	$88.96
	01/01/2024	$58.46	$8.65	$23.05	$0.00	$90.16
	07/01/2024	$59.66	$8.65	$23.05	$0.00	$91.36
	01/01/2025	$60.86	$8.65	$23.05	$0.00	$92.56

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 - BRIDGES/TANKS*

Effective Date - 01/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$28.03	$8.65	$0.00	$0.00	$36.68
2	55	$30.83	$8.65	$6.27	$0.00	$45.75
3	60	$33.64	$8.65	$6.84	$0.00	$49.13
4	65	$36.44	$8.65	$7.41	$0.00	$52.50
5	70	$39.24	$8.65	$19.63	$0.00	$67.52
6	75	$42.05	$8.65	$20.20	$0.00	$70.90
7	80	$44.85	$8.65	$20.77	$0.00	$74.27
8	90	$50.45	$8.65	$21.91	$0.00	$81.01

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$28.63	$8.65	$0.00	$0.00	$37.28
2	55	$31.49	$8.65	$6.27	$0.00	$46.41
3	60	$34.36	$8.65	$6.84	$0.00	$49.85
4	65	$37.22	$8.65	$7.41	$0.00	$53.28
5	70	$40.08	$8.65	$19.63	$0.00	$68.36
6	75	$42.95	$8.65	$20.20	$0.00	$71.80
7	80	$45.81	$8.65	$20.77	$0.00	$75.23
8	90	$51.53	$8.65	$21.91	$0.00	$82.09

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

DEMO: ADZEMAN *LABORERS - ZONE 2*	12/01/2022	$43.33	$9.10	$17.57	$0.00	$70.00
	06/01/2023	$44.33	$9.10	$17.57	$0.00	$71.00
	12/01/2023	$45.58	$9.10	$17.57	$0.00	$72.25
For apprentice rates see "Apprentice- LABORER"						
DEMO: BACKHOE/LOADER/HAMMER OPERATOR *LABORERS - ZONE 2*	12/01/2022	$44.33	$9.10	$17.57	$0.00	$71.00
	06/01/2023	$45.33	$9.10	$17.57	$0.00	$72.00
	12/01/2023	$46.58	$9.10	$17.57	$0.00	$73.25
For apprentice rates see "Apprentice- LABORER"						
DEMO: BURNERS *LABORERS - ZONE 2*	12/01/2022	$44.08	$9.10	$17.57	$0.00	$70.75
	06/01/2023	$45.08	$9.10	$17.57	$0.00	$71.75
	12/01/2023	$46.33	$9.10	$17.57	$0.00	$73.00
For apprentice rates see "Apprentice- LABORER"						
DEMO: CONCRETE CUTTER/SAWYER *LABORERS - ZONE 2*	12/01/2022	$44.33	$9.10	$17.57	$0.00	$71.00
	06/01/2023	$45.33	$9.10	$17.57	$0.00	$72.00
	12/01/2023	$46.58	$9.10	$17.57	$0.00	$73.25
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DEMO: JACKHAMMER OPERATOR *LABORERS - ZONE 2*	12/01/2022	$44.08	$9.10	$17.57	$0.00	$70.75
	06/01/2023	$45.08	$9.10	$17.57	$0.00	$71.75
	12/01/2023	$46.33	$9.10	$17.57	$0.00	$73.00
For apprentice rates see "Apprentice- LABORER"						
DEMO: WRECKING LABORER *LABORERS - ZONE 2*	12/01/2022	$43.33	$9.10	$17.57	$0.00	$70.00
	06/01/2023	$44.33	$9.10	$17.57	$0.00	$71.00
	12/01/2023	$45.58	$9.10	$17.57	$0.00	$72.25
For apprentice rates see "Apprentice- LABORER"						
DIRECTIONAL DRILL MACHINE OPERATOR *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DIVER *PILE DRIVER LOCAL 56 (ZONE 2)*	08/01/2020	$68.70	$9.40	$23.12	$0.00	$101.22
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER *PILE DRIVER LOCAL 56 (ZONE 2)*	08/01/2020	$49.07	$9.40	$23.12	$0.00	$81.59
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER (EFFLUENT) *PILE DRIVER LOCAL 56 (ZONE 2)*	08/01/2020	$73.60	$9.40	$23.12	$0.00	$106.12
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER/SLURRY (EFFLUENT) *PILE DRIVER LOCAL 56 (ZONE 2)*	08/01/2020	$103.05	$9.40	$23.12	$0.00	$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
DRAWBRIDGE OPERATOR (Construction) *DRAWBRIDGE - SEIU LOCAL 888*	07/01/2020	$26.77	$6.67	$3.93	$0.16	$37.53
ELECTRICIAN *ELECTRICIANS LOCAL 223*	09/01/2022	$46.35	$11.50	$16.18	$0.00	$74.03
	09/01/2023	$47.87	$11.75	$16.86	$0.00	$76.48

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *ELECTRICIAN - Local 223*

Effective Date - 09/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$18.54	$11.50	$0.56	$0.00	$30.60
2	45	$20.86	$11.50	$0.63	$0.00	$32.99
3	50	$23.18	$11.50	$0.70	$0.00	$35.38
4	55	$25.49	$11.50	$7.35	$0.00	$44.34
5	60	$27.81	$11.50	$7.86	$0.00	$47.17
6	65	$30.13	$11.50	$8.37	$0.00	$50.00
7	70	$32.45	$11.50	$8.89	$0.00	$52.84
8	75	$34.76	$11.50	$9.40	$0.00	$55.66

Effective Date - 09/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$19.15	$11.75	$0.57	$0.00	$31.47
2	45	$21.54	$11.75	$0.65	$0.00	$33.94
3	50	$23.94	$11.75	$0.72	$0.00	$36.41
4	55	$26.33	$11.75	$7.79	$0.00	$45.87
5	60	$28.72	$11.75	$8.31	$0.00	$48.78
6	65	$31.12	$11.75	$8.65	$0.00	$51.52
7	70	$33.51	$11.75	$9.38	$0.00	$54.64
8	75	$35.90	$11.75	$9.90	$0.00	$57.55

Notes:

Apprentice to Journeyworker Ratio:2:3***

ELEVATOR CONSTRUCTOR *ELEVATOR CONSTRUCTORS LOCAL 4*	01/01/2022	$65.62	$16.03	$20.21	$0.00	$101.86

Apprentice - *ELEVATOR CONSTRUCTOR - Local 4*

Effective Date - 01/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$32.81	$16.03	$0.00	$0.00	$48.84
2	55	$36.09	$16.03	$20.21	$0.00	$72.33
3	65	$42.65	$16.03	$20.21	$0.00	$78.89
4	70	$45.93	$16.03	$20.21	$0.00	$82.17
5	80	$52.50	$16.03	$20.21	$0.00	$88.74

Notes:

Steps 1-2 are 6 mos.; Steps 3-5 are 1 year

Apprentice to Journeyworker Ratio:1:1

ELEVATOR CONSTRUCTOR HELPER *ELEVATOR CONSTRUCTORS LOCAL 4*	01/01/2022	$45.93	$16.03	$20.21	$0.00	$82.17

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"						
FENCE & GUARD RAIL ERECTOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.81	$9.35	$16.89	$0.00	$63.05
	06/01/2023	$37.71	$9.35	$16.89	$0.00	$63.95
	12/01/2023	$38.61	$9.35	$16.89	$0.00	$64.85
	06/01/2024	$39.94	$9.35	$16.89	$0.00	$66.18
	12/01/2024	$41.27	$9.35	$16.89	$0.00	$67.51
	06/01/2025	$42.66	$9.35	$16.89	$0.00	$68.90
	12/01/2025	$44.04	$9.35	$16.89	$0.00	$70.28
	06/01/2026	$45.48	$9.35	$16.89	$0.00	$71.72
	12/01/2026	$46.92	$9.35	$16.89	$0.00	$73.16
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 4*	11/05/2022	$48.67	$14.25	$16.05	$0.00	$78.97
	05/01/2023	$49.91	$14.25	$16.05	$0.00	$80.21
	11/01/2023	$51.15	$14.25	$16.05	$0.00	$81.45
	05/01/2024	$52.39	$14.25	$16.05	$0.00	$82.69
	11/01/2024	$53.68	$14.25	$16.05	$0.00	$83.98
	05/01/2025	$55.12	$14.25	$16.05	$0.00	$85.42
	11/01/2025	$56.41	$14.25	$16.05	$0.00	$86.71
	05/01/2026	$57.85	$14.25	$16.05	$0.00	$88.15
	11/01/2026	$59.14	$14.25	$16.05	$0.00	$89.44
	05/01/2027	$60.57	$14.25	$16.05	$0.00	$90.87
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 4*	11/01/2022	$50.22	$14.25	$16.05	$0.00	$80.52
	05/01/2023	$51.47	$14.25	$16.05	$0.00	$81.77
	11/01/2023	$52.72	$14.25	$16.05	$0.00	$83.02
	05/01/2024	$53.97	$14.25	$16.05	$0.00	$84.27
	11/01/2024	$55.27	$14.25	$16.05	$0.00	$85.57
	05/01/2025	$56.72	$14.25	$16.05	$0.00	$87.02
	11/01/2025	$58.02	$14.25	$16.05	$0.00	$88.32
	05/01/2026	$59.47	$14.25	$16.05	$0.00	$89.77
	11/01/2026	$60.77	$14.25	$16.05	$0.00	$91.07
	05/01/2027	$62.22	$14.25	$16.05	$0.00	$92.52
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY *OPERATING ENGINEERS LOCAL 4*	11/01/2022	$24.31	$14.25	$16.05	$0.00	$54.61
	05/01/2023	$25.05	$14.25	$16.05	$0.00	$55.35
	11/01/2023	$25.78	$14.25	$16.05	$0.00	$56.08
	05/01/2024	$26.51	$14.25	$16.05	$0.00	$56.81
	11/01/2024	$27.27	$14.25	$16.05	$0.00	$57.57
	05/01/2025	$28.12	$14.25	$16.05	$0.00	$58.42
	11/01/2025	$28.88	$14.25	$16.05	$0.00	$59.18
	05/01/2026	$29.73	$14.25	$16.05	$0.00	$60.03
	11/01/2026	$30.49	$14.25	$16.05	$0.00	$60.79
	05/01/2027	$31.34	$14.25	$16.05	$0.00	$61.64
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIRE ALARM INSTALLER *ELECTRICIANS LOCAL 223*	09/01/2020	$43.66	$10.90	$14.66	$0.00	$69.22
For apprentice rates see "Apprentice- ELECTRICIAN"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FIRE ALARM REPAIR / MAINTENANCE / COMMISSIONING *ELECTRICIANS*	09/01/2020	$36.86	$10.90	$12.45	$0.00	$60.21
LOCAL 223						
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"						
FIREMAN (ASST. ENGINEER)	12/01/2022	$43.54	$14.25	$16.05	$0.00	$73.84
OPERATING ENGINEERS LOCAL 4	06/01/2023	$44.56	$14.25	$16.05	$0.00	$74.86
	12/01/2023	$45.57	$14.25	$16.05	$0.00	$75.87
	06/01/2024	$46.63	$14.25	$16.05	$0.00	$76.93
	12/01/2024	$47.81	$14.25	$16.05	$0.00	$78.11
	06/01/2025	$48.87	$14.25	$16.05	$0.00	$79.17
	12/01/2025	$50.04	$14.25	$16.05	$0.00	$80.34
	06/01/2026	$51.10	$14.25	$16.05	$0.00	$81.40
	12/01/2026	$52.28	$14.25	$16.05	$0.00	$82.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FLAGGER & SIGNALER (HEAVY & HIGHWAY)	12/01/2022	$25.23	$9.35	$16.89	$0.00	$51.47
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	06/01/2023	$25.98	$9.35	$16.89	$0.00	$52.22
	12/01/2023	$25.98	$9.35	$16.89	$0.00	$52.22
	06/01/2024	$27.01	$9.35	$16.89	$0.00	$53.25
	12/01/2024	$27.01	$9.35	$16.89	$0.00	$53.25
	06/01/2025	$28.09	$9.35	$16.89	$0.00	$54.33
	12/01/2025	$28.09	$9.35	$16.89	$0.00	$54.33
	06/01/2026	$29.21	$9.35	$16.89	$0.00	$55.45
	12/01/2026	$29.21	$9.35	$16.89	$0.00	$55.45
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
FLOORCOVERER	03/01/2022	$47.62	$8.68	$20.27	$0.00	$76.57
FLOORCOVERERS LOCAL 2168 ZONE II						

Apprentice - *FLOORCOVERER - Local 2168 Zone II*

Effective Date - 03/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.81	$8.68	$1.79	$0.00	$34.28
2	55	$26.19	$8.68	$1.79	$0.00	$36.66
3	60	$28.57	$8.68	$14.90	$0.00	$52.15
4	65	$30.95	$8.68	$14.90	$0.00	$54.53
5	70	$33.33	$8.68	$16.69	$0.00	$58.70
6	75	$35.72	$8.68	$16.69	$0.00	$61.09
7	80	$38.10	$8.68	$18.48	$0.00	$65.26
8	85	$40.48	$8.68	$18.48	$0.00	$67.64

Notes: Steps are 750 hrs.
% After 10/1/17; 45/45/55/55/70/70/80/80 (1500hr Steps)
Step 1&2 $31.90/ 3&4 $38.39/ 5&6 $58.70/ 7&8 $65.26

Apprentice to Journeyworker Ratio:1:1

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FORK LIFT/CHERRY PICKER *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.63	$14.25	$16.05	$0.00	$83.93
	06/01/2023	$54.88	$14.25	$16.05	$0.00	$85.18
	12/01/2023	$56.13	$14.25	$16.05	$0.00	$86.43
	06/01/2024	$57.43	$14.25	$16.05	$0.00	$87.73
	12/01/2024	$58.88	$14.25	$16.05	$0.00	$89.18
	06/01/2025	$60.18	$14.25	$16.05	$0.00	$90.48
	12/01/2025	$61.63	$14.25	$16.05	$0.00	$91.93
	06/01/2026	$62.93	$14.25	$16.05	$0.00	$93.23
	12/01/2026	$64.38	$14.25	$16.05	$0.00	$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GENERATOR/LIGHTING PLANT/HEATERS *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$35.08	$14.25	$16.05	$0.00	$65.38
	06/01/2023	$35.90	$14.25	$16.05	$0.00	$66.20
	12/01/2023	$36.72	$14.25	$16.05	$0.00	$67.02
	06/01/2024	$37.57	$14.25	$16.05	$0.00	$67.87
	12/01/2024	$38.52	$14.25	$16.05	$0.00	$68.82
	06/01/2025	$39.37	$14.25	$16.05	$0.00	$69.67
	12/01/2025	$40.32	$14.25	$16.05	$0.00	$70.62
	06/01/2026	$41.18	$14.25	$16.05	$0.00	$71.48
	12/01/2026	$42.13	$14.25	$16.05	$0.00	$72.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) *GLAZIERS LOCAL 1333*	06/01/2020	$39.18	$10.80	$10.45	$0.00	$60.43

Apprentice - *GLAZIER - Local 1333*

Effective Date - 06/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$19.59	$10.80	$1.80	$0.00	$32.19
2	56	$22.04	$10.80	$1.80	$0.00	$34.64
3	63	$24.49	$10.80	$2.45	$0.00	$37.74
4	69	$26.94	$10.80	$2.45	$0.00	$40.19
5	75	$29.39	$10.80	$3.15	$0.00	$43.34
6	81	$31.83	$10.80	$3.15	$0.00	$45.78
7	88	$34.28	$10.80	$10.45	$0.00	$55.53
8	94	$36.73	$10.80	$10.45	$0.00	$57.98

Notes:

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
HOISTING ENGINEER/CRANES/GRADALLS *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.63	$14.25	$16.05	$0.00	$83.93
	06/01/2023	$54.88	$14.25	$16.05	$0.00	$85.18
	12/01/2023	$56.13	$14.25	$16.05	$0.00	$86.43
	06/01/2024	$57.43	$14.25	$16.05	$0.00	$87.73
	12/01/2024	$58.88	$14.25	$16.05	$0.00	$89.18
	06/01/2025	$60.18	$14.25	$16.05	$0.00	$90.48
	12/01/2025	$61.63	$14.25	$16.05	$0.00	$91.93
	06/01/2026	$62.93	$14.25	$16.05	$0.00	$93.23
	12/01/2026	$64.38	$14.25	$16.05	$0.00	$94.68

Apprentice - *OPERATING ENGINEERS - Local 4*

Effective Date - 12/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	$29.50	$14.25	$0.00	$0.00	$43.75
2	60	$32.18	$14.25	$16.05	$0.00	$62.48
3	65	$34.86	$14.25	$16.05	$0.00	$65.16
4	70	$37.54	$14.25	$16.05	$0.00	$67.84
5	75	$40.22	$14.25	$16.05	$0.00	$70.52
6	80	$42.90	$14.25	$16.05	$0.00	$73.20
7	85	$45.59	$14.25	$16.05	$0.00	$75.89
8	90	$48.27	$14.25	$16.05	$0.00	$78.57

Effective Date - 06/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	$30.18	$14.25	$0.00	$0.00	$44.43
2	60	$32.93	$14.25	$16.05	$0.00	$63.23
3	65	$35.67	$14.25	$16.05	$0.00	$65.97
4	70	$38.42	$14.25	$16.05	$0.00	$68.72
5	75	$41.16	$14.25	$16.05	$0.00	$71.46
6	80	$43.90	$14.25	$16.05	$0.00	$74.20
7	85	$46.65	$14.25	$16.05	$0.00	$76.95
8	90	$49.39	$14.25	$16.05	$0.00	$79.69

Notes:

Apprentice to Journeyworker Ratio:1:6

HVAC (DUCTWORK) *SHEETMETAL WORKERS LOCAL 17 - B*	04/01/2022	$38.91	$13.65	$17.15	$2.09	$71.80
For apprentice rates see "Apprentice- SHEET METAL WORKER"						
HVAC (ELECTRICAL CONTROLS) *ELECTRICIANS LOCAL 223*	09/01/2020	$43.66	$10.90	$14.66	$0.00	$69.22
For apprentice rates see "Apprentice- ELECTRICIAN"						
HVAC (TESTING AND BALANCING - AIR) *SHEETMETAL WORKERS LOCAL 17 - B*	04/01/2022	$38.91	$13.65	$17.15	$2.09	$71.80
For apprentice rates see "Apprentice- SHEET METAL WORKER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
HVAC (TESTING AND BALANCING -WATER) *PLUMBERS & PIPEFITTERS LOCAL 51* For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"	08/30/2021	$46.49	$10.15	$19.95	$0.00	$76.59
HVAC MECHANIC *PLUMBERS & PIPEFITTERS LOCAL 51* For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"	08/30/2021	$46.49	$10.15	$19.95	$0.00	$76.59
HYDRAULIC DRILLS *LABORERS - ZONE 2*	12/01/2022	$37.91	$9.10	$16.64	$0.00	$63.65
	06/01/2023	$38.81	$9.10	$16.64	$0.00	$64.55
	12/01/2023	$39.71	$9.10	$16.64	$0.00	$65.45
For apprentice rates see "Apprentice- LABORER"						
HYDRAULIC DRILLS (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$37.31	$9.35	$16.89	$0.00	$63.55
	06/01/2023	$38.21	$9.35	$16.89	$0.00	$64.45
	12/01/2023	$39.11	$9.35	$16.89	$0.00	$65.35
	06/01/2024	$40.44	$9.35	$16.89	$0.00	$66.68
	12/01/2024	$41.77	$9.35	$16.89	$0.00	$68.01
	06/01/2025	$43.16	$9.35	$16.89	$0.00	$69.40
	12/01/2025	$44.54	$9.35	$16.89	$0.00	$70.78
	06/01/2026	$45.98	$9.35	$16.89	$0.00	$72.22
	12/01/2026	$47.42	$9.35	$16.89	$0.00	$73.66
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
INSULATOR (PIPES & TANKS) *HEAT & FROST INSULATORS LOCAL 6 (BOSTON)*	09/01/2022	$53.85	$13.80	$17.14	$0.00	$84.79

Apprentice - *ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Boston*

Effective Date - 09/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$26.93	$13.80	$12.42	$0.00	$53.15
2	60	$32.31	$13.80	$13.36	$0.00	$59.47
3	70	$37.70	$13.80	$14.31	$0.00	$65.81
4	80	$43.08	$13.80	$15.25	$0.00	$72.13

Notes:
Steps are 1 year

Apprentice to Journeyworker Ratio:1:4

IRONWORKER/WELDER *IRONWORKERS LOCAL 37*	03/16/2021	$42.46	$7.70	$17.10	$0.00	$67.26

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *IRONWORKER - Local 37*

Effective Date - 03/16/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	70	$29.72	$7.70	$17.10	$0.00	$54.52
2	75	$31.85	$7.70	$17.10	$0.00	$56.65
3	80	$33.97	$7.70	$17.10	$0.00	$58.77
4	85	$36.09	$7.70	$17.10	$0.00	$60.89
5	90	$38.21	$7.70	$17.10	$0.00	$63.01
6	95	$40.34	$7.70	$17.10	$0.00	$65.14

Notes:

Apprentice to Journeyworker Ratio:1:4

JACKHAMMER & PAVING BREAKER OPERATOR *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
LABORER *LABORERS - ZONE 2*	12/01/2022	$37.16	$9.10	$16.64	$0.00	$62.90
	06/01/2023	$38.06	$9.10	$16.64	$0.00	$63.80
	12/01/2023	$38.96	$9.10	$16.64	$0.00	$64.70

Apprentice - *LABORER - Zone 2*

Effective Date - 12/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$22.30	$9.10	$16.64	$0.00	$48.04
2	70	$26.01	$9.10	$16.64	$0.00	$51.75
3	80	$29.73	$9.10	$16.64	$0.00	$55.47
4	90	$33.44	$9.10	$16.64	$0.00	$59.18

Effective Date - 06/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$22.84	$9.10	$16.64	$0.00	$48.58
2	70	$26.64	$9.10	$16.64	$0.00	$52.38
3	80	$30.45	$9.10	$16.64	$0.00	$56.19
4	90	$34.25	$9.10	$16.64	$0.00	$59.99

Notes:

Apprentice to Journeyworker Ratio:1:5

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LABORER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.56	$9.35	$16.89	$0.00	$62.80
	06/01/2023	$37.46	$9.35	$16.89	$0.00	$63.70
	12/01/2023	$38.36	$9.35	$16.89	$0.00	$64.60
	06/01/2024	$39.69	$9.35	$16.89	$0.00	$65.93
	12/01/2024	$41.02	$9.35	$16.89	$0.00	$67.26
	06/01/2025	$42.41	$9.35	$16.89	$0.00	$68.65
	12/01/2025	$43.79	$9.35	$16.89	$0.00	$70.03
	06/01/2026	$45.23	$9.35	$16.89	$0.00	$71.47
	12/01/2026	$46.67	$9.35	$16.89	$0.00	$72.91

Apprentice - *LABORER (Heavy & Highway) - Zone 2*

Effective Date - 12/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$21.94	$9.35	$16.89	$0.00	$48.18
2	70	$25.59	$9.35	$16.89	$0.00	$51.83
3	80	$29.25	$9.35	$16.89	$0.00	$55.49
4	90	$32.90	$9.35	$16.89	$0.00	$59.14

Effective Date - 06/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	$22.48	$9.35	$16.89	$0.00	$48.72
2	70	$26.22	$9.35	$16.89	$0.00	$52.46
3	80	$29.97	$9.35	$16.89	$0.00	$56.21
4	90	$33.71	$9.35	$16.89	$0.00	$59.95

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER: CARPENTER TENDER *LABORERS - ZONE 2*	12/01/2022	$37.16	$9.10	$16.64	$0.00	$62.90
	06/01/2023	$38.06	$9.10	$16.64	$0.00	$63.80
	12/01/2023	$38.96	$9.10	$16.64	$0.00	$64.70
For apprentice rates see "Apprentice- LABORER"						
LABORER: CEMENT FINISHER TENDER *LABORERS - ZONE 2*	12/01/2022	$37.16	$9.10	$16.64	$0.00	$62.90
	06/01/2023	$38.06	$9.10	$16.64	$0.00	$63.80
	12/01/2023	$38.96	$9.10	$16.64	$0.00	$64.70
For apprentice rates see "Apprentice- LABORER"						
LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER *LABORERS - ZONE 2*	12/01/2022	$37.25	$9.10	$16.70	$0.00	$63.05
	06/01/2023	$38.15	$9.10	$16.70	$0.00	$63.95
	12/01/2023	$39.05	$9.10	$16.70	$0.00	$64.85
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LABORER: MASON TENDER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.81	$9.35	$16.89	$0.00	$63.05
	06/01/2023	$37.71	$9.35	$16.89	$0.00	$63.95
	12/01/2023	$38.61	$9.35	$16.89	$0.00	$64.85
	06/01/2024	$39.94	$9.35	$16.89	$0.00	$66.18
	12/01/2024	$41.27	$9.35	$16.89	$0.00	$67.51
	06/01/2025	$42.66	$9.35	$16.89	$0.00	$68.90
	12/01/2025	$44.04	$9.35	$16.89	$0.00	$70.28
	06/01/2026	$45.48	$9.35	$16.89	$0.00	$71.72
	12/01/2026	$46.92	$9.35	$16.89	$0.00	$73.16
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
LABORER: MULTI-TRADE TENDER *LABORERS - ZONE 2*	12/01/2022	$37.16	$9.10	$16.64	$0.00	$62.90
	06/01/2023	$38.06	$9.10	$16.64	$0.00	$63.80
	12/01/2023	$38.96	$9.10	$16.64	$0.00	$64.70
For apprentice rates see "Apprentice- LABORER"						
LABORER: TREE REMOVER *LABORERS - ZONE 2*	12/01/2022	$37.16	$9.10	$16.64	$0.00	$62.90
	06/01/2023	$38.06	$9.10	$16.64	$0.00	$63.80
	12/01/2023	$38.96	$9.10	$16.64	$0.00	$64.70
This classification applies to the removal of standing trees, and the trimming and removal of branches and limbs when related to public works construction or site clearance incidental to construction . For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.81	$9.35	$16.89	$0.00	$63.05
	06/01/2023	$37.71	$9.35	$16.89	$0.00	$63.95
	12/01/2023	$38.61	$9.35	$16.89	$0.00	$64.85
	06/01/2024	$39.94	$9.35	$16.89	$0.00	$66.18
	12/01/2024	$41.27	$9.35	$16.89	$0.00	$67.51
	06/01/2025	$42.66	$9.35	$16.89	$0.00	$68.90
	12/01/2025	$44.04	$9.35	$16.89	$0.00	$70.28
	06/01/2026	$45.48	$9.35	$16.89	$0.00	$71.72
	12/01/2026	$46.92	$9.35	$16.89	$0.00	$73.16
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
MARBLE & TILE FINISHERS *BRICKLAYERS LOCAL 3 - MARBLE & TILE*	08/01/2022	$45.29	$11.49	$20.37	$0.00	$77.15
	02/01/2023	$46.25	$11.49	$20.37	$0.00	$78.11
	08/01/2023	$47.89	$11.49	$20.37	$0.00	$79.75
	02/01/2024	$48.89	$11.49	$20.37	$0.00	$80.75
	08/01/2024	$50.57	$11.49	$20.37	$0.00	$82.43
	02/01/2025	$51.61	$11.49	$20.37	$0.00	$83.47
	08/01/2025	$53.33	$11.49	$20.37	$0.00	$85.19
	02/01/2026	$54.41	$11.49	$20.37	$0.00	$86.27
	08/01/2026	$56.17	$11.49	$20.37	$0.00	$88.03
	02/01/2027	$57.29	$11.49	$20.37	$0.00	$89.15

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *MARBLE & TILE FINISHER - Local 3 Marble & Tile*

Effective Date - 08/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$22.65	$11.49	$20.37	$0.00	$54.51
2	60	$27.17	$11.49	$20.37	$0.00	$59.03
3	70	$31.70	$11.49	$20.37	$0.00	$63.56
4	80	$36.23	$11.49	$20.37	$0.00	$68.09
5	90	$40.76	$11.49	$20.37	$0.00	$72.62

Effective Date - 02/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.13	$11.49	$20.37	$0.00	$54.99
2	60	$27.75	$11.49	$20.37	$0.00	$59.61
3	70	$32.38	$11.49	$20.37	$0.00	$64.24
4	80	$37.00	$11.49	$20.37	$0.00	$68.86
5	90	$41.63	$11.49	$20.37	$0.00	$73.49

Notes:

Apprentice to Journeyworker Ratio:1:3

MARBLE MASONS,TILELAYERS & TERRAZZO MECH *BRICKLAYERS LOCAL 3 - MARBLE & TILE*	08/01/2022	$59.17	$11.49	$22.31	$0.00	$92.97
	02/01/2023	$60.37	$11.49	$22.31	$0.00	$94.17
	08/01/2023	$62.42	$11.49	$22.31	$0.00	$96.22
	02/01/2024	$63.67	$11.49	$22.31	$0.00	$97.47
	08/01/2024	$65.77	$11.49	$22.31	$0.00	$99.57
	02/01/2025	$67.07	$11.49	$22.31	$0.00	$100.87
	08/01/2025	$69.22	$11.49	$22.31	$0.00	$103.02
	02/01/2026	$70.57	$11.49	$22.31	$0.00	$104.37
	08/01/2026	$72.77	$11.49	$22.31	$0.00	$106.57
	02/01/2027	$74.17	$11.49	$22.31	$0.00	$107.97

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *MARBLE-TILE-TERRAZZO MECHANIC - Local 3 Marble & Tile*

Effective Date - 08/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$29.59	$11.49	$22.31	$0.00	$63.39
2	60	$35.50	$11.49	$22.31	$0.00	$69.30
3	70	$41.42	$11.49	$22.31	$0.00	$75.22
4	80	$47.34	$11.49	$22.31	$0.00	$81.14
5	90	$53.25	$11.49	$22.31	$0.00	$87.05

Effective Date - 02/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$30.19	$11.49	$22.31	$0.00	$63.99
2	60	$36.22	$11.49	$22.31	$0.00	$70.02
3	70	$42.26	$11.49	$22.31	$0.00	$76.06
4	80	$48.30	$11.49	$22.31	$0.00	$82.10
5	90	$54.33	$11.49	$22.31	$0.00	$88.13

Notes:

Apprentice to Journeyworker Ratio:1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES) *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
MECHANICS MAINTENANCE *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
MILLWRIGHT (Zone 2) *MILLWRIGHTS LOCAL 1121 - Zone 2*	01/02/2023	$41.92	$8.58	$21.57	$0.00	$72.07

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *MILLWRIGHT - Local 1121 Zone 2*

Effective Date - 01/02/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	$23.06	$8.58	$5.72	$0.00	$37.36
2	65	$27.25	$8.58	$17.93	$0.00	$53.76
3	75	$31.44	$8.58	$18.98	$0.00	$59.00
4	85	$35.63	$8.58	$20.01	$0.00	$64.22

Notes: Step 1&2 Appr. indentured after 1/6/2020 receive no pension, but do receive annuity. (Step 1 $5.72, Step 2 $6.66)
Steps are 2,000 hours

Apprentice to Journeyworker Ratio:1:4

MORTAR MIXER *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
OILER (OTHER THAN TRUCK CRANES,GRADALLS) *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$24.37	$14.25	$16.05	$0.00	$54.67
	06/01/2023	$24.94	$14.25	$16.05	$0.00	$55.24
	12/01/2023	$25.51	$14.25	$16.05	$0.00	$55.81
	06/01/2024	$26.11	$14.25	$16.05	$0.00	$56.41
	12/01/2024	$26.77	$14.25	$16.05	$0.00	$57.07
	06/01/2025	$27.37	$14.25	$16.05	$0.00	$57.67
	12/01/2025	$28.03	$14.25	$16.05	$0.00	$58.33
	06/01/2026	$28.62	$14.25	$16.05	$0.00	$58.92
	12/01/2026	$29.29	$14.25	$16.05	$0.00	$59.59
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
OILER (TRUCK CRANES, GRADALLS) *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$29.57	$14.25	$16.05	$0.00	$59.87
	06/01/2023	$30.27	$14.25	$16.05	$0.00	$60.57
	12/01/2023	$30.96	$14.25	$16.05	$0.00	$61.26
	06/01/2024	$31.68	$14.25	$16.05	$0.00	$61.98
	12/01/2024	$32.48	$14.25	$16.05	$0.00	$62.78
	06/01/2025	$33.20	$14.25	$16.05	$0.00	$63.50
	12/01/2025	$34.00	$14.25	$16.05	$0.00	$64.30
	06/01/2026	$34.72	$14.25	$16.05	$0.00	$65.02
	12/01/2026	$35.52	$14.25	$16.05	$0.00	$65.82
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
OTHER POWER DRIVEN EQUIPMENT - CLASS II *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PAINTER (BRIDGES/TANKS) *PAINTERS LOCAL 35 - ZONE 2*	01/01/2023	$56.06	$8.65	$23.05	$0.00	$87.76
	07/01/2023	$57.26	$8.65	$23.05	$0.00	$88.96
	01/01/2024	$58.46	$8.65	$23.05	$0.00	$90.16
	07/01/2024	$59.66	$8.65	$23.05	$0.00	$91.36
	01/01/2025	$60.86	$8.65	$23.05	$0.00	$92.56

Apprentice - *PAINTER Local 35 - BRIDGES/TANKS*

Effective Date - 01/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$28.03	$8.65	$0.00	$0.00	$36.68
2	55	$30.83	$8.65	$6.27	$0.00	$45.75
3	60	$33.64	$8.65	$6.84	$0.00	$49.13
4	65	$36.44	$8.65	$7.41	$0.00	$52.50
5	70	$39.24	$8.65	$19.63	$0.00	$67.52
6	75	$42.05	$8.65	$20.20	$0.00	$70.90
7	80	$44.85	$8.65	$20.77	$0.00	$74.27
8	90	$50.45	$8.65	$21.91	$0.00	$81.01

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$28.63	$8.65	$0.00	$0.00	$37.28
2	55	$31.49	$8.65	$6.27	$0.00	$46.41
3	60	$34.36	$8.65	$6.84	$0.00	$49.85
4	65	$37.22	$8.65	$7.41	$0.00	$53.28
5	70	$40.08	$8.65	$19.63	$0.00	$68.36
6	75	$42.95	$8.65	$20.20	$0.00	$71.80
7	80	$45.81	$8.65	$20.77	$0.00	$75.23
8	90	$51.53	$8.65	$21.91	$0.00	$82.09

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, NEW) * * If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 2*	01/01/2023	$46.96	$8.65	$23.05	$0.00	$78.66
	07/01/2023	$48.16	$8.65	$23.05	$0.00	$79.86
	01/01/2024	$49.36	$8.65	$23.05	$0.00	$81.06
	07/01/2024	$50.56	$8.65	$23.05	$0.00	$82.26
	01/01/2025	$51.76	$8.65	$23.05	$0.00	$83.46

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 Zone 2 - Spray/Sandblast - New*

Effective Date - 01/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.48	$8.65	$0.00	$0.00	$32.13
2	55	$25.83	$8.65	$6.27	$0.00	$40.75
3	60	$28.18	$8.65	$6.84	$0.00	$43.67
4	65	$30.52	$8.65	$7.41	$0.00	$46.58
5	70	$32.87	$8.65	$19.63	$0.00	$61.15
6	75	$35.22	$8.65	$20.20	$0.00	$64.07
7	80	$37.57	$8.65	$20.77	$0.00	$66.99
8	90	$42.26	$8.65	$21.91	$0.00	$72.82

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$24.08	$8.65	$0.00	$0.00	$32.73
2	55	$26.49	$8.65	$6.27	$0.00	$41.41
3	60	$28.90	$8.65	$6.84	$0.00	$44.39
4	65	$31.30	$8.65	$7.41	$0.00	$47.36
5	70	$33.71	$8.65	$19.63	$0.00	$61.99
6	75	$36.12	$8.65	$20.20	$0.00	$64.97
7	80	$38.53	$8.65	$20.77	$0.00	$67.95
8	90	$43.34	$8.65	$21.91	$0.00	$73.90

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT) *PAINTERS LOCAL 35 - ZONE 2*	01/01/2023	$45.02	$8.65	$23.05	$0.00	$76.72
	07/01/2023	$46.22	$8.65	$23.05	$0.00	$77.92
	01/01/2024	$47.42	$8.65	$23.05	$0.00	$79.12
	07/01/2024	$48.62	$8.65	$23.05	$0.00	$80.32
	01/01/2025	$49.82	$8.65	$23.05	$0.00	$81.52

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint*

Effective Date - 01/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$22.51	$8.65	$0.00	$0.00	$31.16
2	55	$24.76	$8.65	$6.27	$0.00	$39.68
3	60	$27.01	$8.65	$6.84	$0.00	$42.50
4	65	$29.26	$8.65	$7.41	$0.00	$45.32
5	70	$31.51	$8.65	$19.63	$0.00	$59.79
6	75	$33.77	$8.65	$20.20	$0.00	$62.62
7	80	$36.02	$8.65	$20.77	$0.00	$65.44
8	90	$40.52	$8.65	$21.91	$0.00	$71.08

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.11	$8.65	$0.00	$0.00	$31.76
2	55	$25.42	$8.65	$6.27	$0.00	$40.34
3	60	$27.73	$8.65	$6.84	$0.00	$43.22
4	65	$30.04	$8.65	$19.06	$0.00	$57.75
5	70	$32.35	$8.65	$19.63	$0.00	$60.63
6	75	$34.67	$8.65	$20.20	$0.00	$63.52
7	80	$36.98	$8.65	$20.77	$0.00	$66.40
8	90	$41.60	$8.65	$21.91	$0.00	$72.16

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, NEW) *	01/01/2023	$45.56	$8.65	$23.05	$0.00	$77.26
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.*PAINTERS LOCAL 35 - ZONE 2*	07/01/2023	$46.76	$8.65	$23.05	$0.00	$78.46
	01/01/2024	$47.96	$8.65	$23.05	$0.00	$79.66
	07/01/2024	$49.16	$8.65	$23.05	$0.00	$80.86
	01/01/2025	$50.36	$8.65	$23.05	$0.00	$82.06

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER - Local 35 Zone 2 - BRUSH NEW*

Effective Date - 01/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$22.78	$8.65	$0.00	$0.00	$31.43
2	55	$25.06	$8.65	$6.27	$0.00	$39.98
3	60	$27.34	$8.65	$6.84	$0.00	$42.83
4	65	$29.61	$8.65	$7.41	$0.00	$45.67
5	70	$31.89	$8.65	$19.63	$0.00	$60.17
6	75	$34.17	$8.65	$20.20	$0.00	$63.02
7	80	$36.45	$8.65	$20.77	$0.00	$65.87
8	90	$41.00	$8.65	$21.91	$0.00	$71.56

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$23.38	$8.65	$0.00	$0.00	$32.03
2	55	$25.72	$8.65	$6.27	$0.00	$40.64
3	60	$28.06	$8.65	$6.84	$0.00	$43.55
4	65	$30.39	$8.65	$7.41	$0.00	$46.45
5	70	$32.73	$8.65	$19.63	$0.00	$61.01
6	75	$35.07	$8.65	$20.20	$0.00	$63.92
7	80	$37.41	$8.65	$20.77	$0.00	$66.83
8	90	$42.08	$8.65	$21.91	$0.00	$72.64

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, REPAINT) *PAINTERS LOCAL 35 - ZONE 2*	01/01/2023	$43.62	$8.65	$23.05	$0.00	$75.32
	07/01/2023	$44.82	$8.65	$23.05	$0.00	$76.52
	01/01/2024	$46.02	$8.65	$23.05	$0.00	$77.72
	07/01/2024	$47.22	$8.65	$23.05	$0.00	$78.92
	01/01/2025	$48.42	$8.65	$23.05	$0.00	$80.12

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PAINTER Local 35 Zone 2 - BRUSH REPAINT*

Effective Date - 01/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$21.81	$8.65	$0.00	$0.00	$30.46
2	55	$23.99	$8.65	$6.27	$0.00	$38.91
3	60	$26.17	$8.65	$6.84	$0.00	$41.66
4	65	$28.35	$8.65	$7.41	$0.00	$44.41
5	70	$30.53	$8.65	$19.63	$0.00	$58.81
6	75	$32.72	$8.65	$20.20	$0.00	$61.57
7	80	$34.90	$8.65	$20.77	$0.00	$64.32
8	90	$39.26	$8.65	$21.91	$0.00	$69.82

Effective Date - 07/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$22.41	$8.65	$0.00	$0.00	$31.06
2	55	$24.65	$8.65	$6.27	$0.00	$39.57
3	60	$26.89	$8.65	$6.84	$0.00	$42.38
4	65	$29.13	$8.65	$7.41	$0.00	$45.19
5	70	$31.37	$8.65	$19.63	$0.00	$59.65
6	75	$33.62	$8.65	$20.20	$0.00	$62.47
7	80	$35.86	$8.65	$20.77	$0.00	$65.28
8	90	$40.34	$8.65	$21.91	$0.00	$70.90

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER TRAFFIC MARKINGS (HEAVY/HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.56	$9.35	$16.89	$0.00	$62.80
	06/01/2023	$37.46	$9.35	$16.89	$0.00	$63.70
	12/01/2023	$38.36	$9.35	$16.89	$0.00	$64.60
	06/01/2024	$39.69	$9.35	$16.89	$0.00	$65.93
	12/01/2024	$41.02	$9.35	$16.89	$0.00	$67.26
	06/01/2025	$42.41	$9.35	$16.89	$0.00	$68.65
	12/01/2025	$43.79	$9.35	$16.89	$0.00	$70.03
	06/01/2026	$45.23	$9.35	$16.89	$0.00	$71.47
	12/01/2026	$46.67	$9.35	$16.89	$0.00	$72.91
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
PANEL & PICKUP TRUCKS DRIVER *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2021	$35.78	$13.41	$16.01	$0.00	$65.20
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) *PILE DRIVER LOCAL 56 (ZONE 2)* For apprentice rates see "Apprentice- PILE DRIVER"	08/01/2020	$46.11	$9.40	$23.12	$0.00	$78.63
PILE DRIVER *PILE DRIVER LOCAL 56 (ZONE 2)*	08/01/2020	$46.11	$9.40	$23.12	$0.00	$78.63

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *PILE DRIVER - Local 56 Zone 2*

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	0	$0.00	$0.00	$0.00	$0.00	$0.00

Notes: Apprentice wages shall be no less than the following Steps;
(Same as set in Zone 1)
1$57.06/2$61.96/3$66.87/4$69.32/5$71.78/6$71.78/7$76.68/8$76.68

Apprentice to Journeyworker Ratio:1:5

PIPELAYER *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
PIPELAYER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.81	$9.35	$16.89	$0.00	$63.05
	06/01/2023	$37.71	$9.35	$16.89	$0.00	$63.95
	12/01/2023	$38.61	$9.35	$16.89	$0.00	$64.85
	06/01/2024	$39.94	$9.35	$16.89	$0.00	$66.18
	12/01/2024	$41.27	$9.35	$16.89	$0.00	$67.51
	06/01/2025	$42.66	$9.35	$16.89	$0.00	$68.90
	12/01/2025	$44.04	$9.35	$16.89	$0.00	$70.28
	06/01/2026	$45.48	$9.35	$16.89	$0.00	$71.72
	12/01/2026	$46.92	$9.35	$16.89	$0.00	$73.16
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
PLUMBER & PIPEFITTER *PLUMBERS & PIPEFITTERS LOCAL 51*	08/30/2021	$46.49	$10.15	$19.95	$0.00	$76.59

Apprentice - *PLUMBER/PIPEFITTER - Local 51*

Effective Date - 08/30/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$18.60	$10.15	$2.50	$0.00	$31.25
2	50	$23.25	$10.15	$2.50	$0.00	$35.90
3	60	$27.89	$10.15	$8.80	$0.00	$46.84
4	70	$32.54	$10.15	$14.08	$0.00	$56.77
5	80	$37.19	$10.15	$17.60	$0.00	$64.94

Notes:
Steps 2000hrs. Prior 9/1/05; 40/40/45/50/55/60/65/75/80/85

Apprentice to Journeyworker Ratio:1:3

PNEUMATIC CONTROLS (TEMP.) *PLUMBERS & PIPEFITTERS LOCAL 51*	08/30/2021	$46.49	$10.15	$19.95	$0.00	$76.59
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
PNEUMATIC DRILL/TOOL OPERATOR *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PNEUMATIC DRILL/TOOL OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.81	$9.35	$16.89	$0.00	$63.05
	06/01/2023	$37.71	$9.35	$16.89	$0.00	$63.95
	12/01/2023	$38.61	$9.35	$16.89	$0.00	$64.85
	06/01/2024	$39.94	$9.35	$16.89	$0.00	$66.18
	12/01/2024	$41.27	$9.35	$16.89	$0.00	$67.51
	06/01/2025	$42.66	$9.35	$16.89	$0.00	$68.90
	12/01/2025	$44.04	$9.35	$16.89	$0.00	$70.28
	06/01/2026	$45.48	$9.35	$16.89	$0.00	$71.72
	12/01/2026	$46.92	$9.35	$16.89	$0.00	$73.16
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
POWDERMAN & BLASTER *LABORERS - ZONE 2*	12/01/2022	$38.16	$9.10	$16.64	$0.00	$63.90
	06/01/2023	$39.06	$9.10	$16.64	$0.00	$64.80
	12/01/2023	$39.96	$9.10	$16.64	$0.00	$65.70
For apprentice rates see "Apprentice- LABORER"						
POWDERMAN & BLASTER (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$37.56	$9.35	$16.89	$0.00	$63.80
	06/01/2023	$38.46	$9.35	$16.89	$0.00	$64.70
	12/01/2023	$39.36	$9.35	$16.89	$0.00	$65.60
	06/01/2024	$40.69	$9.35	$16.89	$0.00	$66.93
	12/01/2024	$42.02	$9.35	$16.89	$0.00	$68.26
	06/01/2025	$43.41	$9.35	$16.89	$0.00	$69.65
	12/01/2025	$44.79	$9.35	$16.89	$0.00	$71.03
	06/01/2026	$46.23	$9.35	$16.89	$0.00	$72.47
	12/01/2026	$47.67	$9.35	$16.89	$0.00	$73.91
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
POWER SHOVEL/DERRICK/TRENCHING MACHINE *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.63	$14.25	$16.05	$0.00	$83.93
	06/01/2023	$54.88	$14.25	$16.05	$0.00	$85.18
	12/01/2023	$56.13	$14.25	$16.05	$0.00	$86.43
	06/01/2024	$57.43	$14.25	$16.05	$0.00	$87.73
	12/01/2024	$58.88	$14.25	$16.05	$0.00	$89.18
	06/01/2025	$60.18	$14.25	$16.05	$0.00	$90.48
	12/01/2025	$61.63	$14.25	$16.05	$0.00	$91.93
	06/01/2026	$62.93	$14.25	$16.05	$0.00	$93.23
	12/01/2026	$64.38	$14.25	$16.05	$0.00	$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (CONCRETE) *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.63	$14.25	$16.05	$0.00	$83.93
	06/01/2023	$54.88	$14.25	$16.05	$0.00	$85.18
	12/01/2023	$56.13	$14.25	$16.05	$0.00	$86.43
	06/01/2024	$57.43	$14.25	$16.05	$0.00	$87.73
	12/01/2024	$58.88	$14.25	$16.05	$0.00	$89.18
	06/01/2025	$60.18	$14.25	$16.05	$0.00	$90.48
	12/01/2025	$61.63	$14.25	$16.05	$0.00	$91.93
	06/01/2026	$62.93	$14.25	$16.05	$0.00	$93.23
	12/01/2026	$64.38	$14.25	$16.05	$0.00	$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PUMP OPERATOR (DEWATERING, OTHER) *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$35.08	$14.25	$16.05	$0.00	$65.38
	06/01/2023	$35.90	$14.25	$16.05	$0.00	$66.20
	12/01/2023	$36.72	$14.25	$16.05	$0.00	$67.02
	06/01/2024	$37.57	$14.25	$16.05	$0.00	$67.87
	12/01/2024	$38.52	$14.25	$16.05	$0.00	$68.82
	06/01/2025	$39.37	$14.25	$16.05	$0.00	$69.67
	12/01/2025	$40.32	$14.25	$16.05	$0.00	$70.62
	06/01/2026	$41.18	$14.25	$16.05	$0.00	$71.48
	12/01/2026	$42.13	$14.25	$16.05	$0.00	$72.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
READY-MIX CONCRETE DRIVER *TEAMSTERS 653 - Southeastern Concrete (Weymouth)*	08/01/2022	$24.50	$13.41	$6.90	$0.00	$44.81
	05/01/2023	$25.00	$13.41	$6.90	$0.00	$45.31
	08/01/2023	$25.00	$13.91	$6.90	$0.00	$45.81
RECLAIMERS *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
RIDE-ON MOTORIZED BUGGY OPERATOR *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						
ROLLER/SPREADER/MULCHING MACHINE *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg) *ROOFERS LOCAL 33*	08/01/2022	$48.53	$12.28	$19.45	$0.00	$80.26
	02/01/2023	$49.78	$12.28	$19.45	$0.00	$81.51
	08/01/2023	$51.28	$12.28	$19.45	$0.00	$83.01
	02/01/2024	$52.53	$12.28	$19.45	$0.00	$84.26
	08/01/2024	$54.03	$12.28	$19.45	$0.00	$85.76
	02/01/2025	$55.28	$12.28	$19.45	$0.00	$87.01
	08/01/2025	$56.78	$12.28	$19.45	$0.00	$88.51
	02/01/2026	$58.03	$12.28	$19.45	$0.00	$89.76

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *ROOFER - Local 33*

Effective Date - 08/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$24.27	$12.28	$5.21	$0.00	$41.76
2	60	$29.12	$12.28	$19.45	$0.00	$60.85
3	65	$31.54	$12.28	$19.45	$0.00	$63.27
4	75	$36.40	$12.28	$19.45	$0.00	$68.13
5	85	$41.25	$12.28	$19.45	$0.00	$72.98

Effective Date - 02/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$24.89	$12.28	$5.21	$0.00	$42.38
2	60	$29.87	$12.28	$19.45	$0.00	$61.60
3	65	$32.36	$12.28	$19.45	$0.00	$64.09
4	75	$37.34	$12.28	$19.45	$0.00	$69.07
5	85	$42.31	$12.28	$19.45	$0.00	$74.04

Notes: ** 1:5, 2:6-10, the 1:10; Reroofing: 1:4, then 1:1
Step 1 is 2000 hrs.; Steps 2-5 are 1000 hrs.
(Hot Pitch Mechanics' receive $1.00 hr. above ROOFER)

Apprentice to Journeyworker Ratio:**

ROOFER SLATE / TILE / PRECAST CONCRETE *ROOFERS LOCAL 33*	08/01/2022	$48.78	$12.28	$19.45	$0.00	$80.51
	02/01/2023	$50.03	$12.28	$19.45	$0.00	$81.76
	08/01/2023	$51.53	$12.28	$19.45	$0.00	$83.26
	02/01/2024	$52.78	$12.28	$19.45	$0.00	$84.51
	08/01/2024	$54.28	$12.28	$19.45	$0.00	$86.01
	02/01/2025	$55.53	$12.28	$19.45	$0.00	$87.26
	08/01/2025	$57.03	$12.28	$19.45	$0.00	$88.76
	02/01/2026	$58.28	$12.28	$19.45	$0.00	$90.01
For apprentice rates see "Apprentice- ROOFER"						
SHEETMETAL WORKER *SHEETMETAL WORKERS LOCAL 17 - B*	04/01/2022	$37.41	$13.95	$17.85	$2.08	$71.29

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *SHEET METAL WORKER - Local 17-B*

Effective Date - 04/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	$14.96	$13.95	$4.10	$1.02	$34.03
2	45	$16.83	$13.95	$4.61	$1.09	$36.48
3	50	$18.71	$13.95	$11.26	$1.35	$45.27
4	55	$20.58	$13.95	$11.26	$1.41	$47.20
5	60	$22.45	$13.95	$14.60	$1.53	$52.53
6	65	$24.32	$13.95	$14.88	$1.59	$54.74
7	70	$26.19	$13.95	$15.16	$1.66	$56.96
8	75	$28.06	$13.95	$15.44	$1.72	$59.17
9	80	$29.93	$13.95	$15.72	$1.79	$61.39
10	85	$31.80	$13.95	$15.57	$1.85	$63.17

Notes:

Apprentice to Journeyworker Ratio:1:3

SPECIALIZED EARTH MOVING EQUIP < 35 TONS *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2021	$36.24	$13.41	$16.01	$0.00	$65.66
SPECIALIZED EARTH MOVING EQUIP > 35 TONS *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2021	$36.53	$13.41	$16.01	$0.00	$65.95
SPRINKLER FITTER *SPRINKLER FITTERS LOCAL 550 - (Section B) Zone 2*	10/01/2022	$59.00	$10.44	$22.60	$0.00	$92.04
	03/01/2023	$60.53	$10.44	$22.60	$0.00	$93.57
	10/01/2023	$62.11	$10.44	$22.60	$0.00	$95.15
	03/01/2024	$63.73	$10.44	$22.60	$0.00	$96.77
	10/01/2024	$65.35	$10.44	$22.60	$0.00	$98.39
	03/01/2025	$66.97	$10.44	$22.60	$0.00	$100.01

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *SPRINKLER FITTER - Local 550 (Section B) Zone 2*

Effective Date - 10/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	$20.65	$10.44	$9.10	$0.00	$40.19
2	40	$23.60	$10.44	$9.10	$0.00	$43.14
3	45	$26.55	$10.44	$9.10	$0.00	$46.09
4	50	$29.50	$10.44	$9.10	$0.00	$49.04
5	55	$32.45	$10.44	$9.10	$0.00	$51.99
6	60	$35.40	$10.44	$11.10	$0.00	$56.94
7	65	$38.35	$10.44	$11.10	$0.00	$59.89
8	70	$41.30	$10.44	$11.10	$0.00	$62.84
9	75	$44.25	$10.44	$11.10	$0.00	$65.79
10	80	$47.20	$10.44	$11.10	$0.00	$68.74

Effective Date - 03/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	$21.19	$10.44	$9.10	$0.00	$40.73
2	40	$24.21	$10.44	$9.10	$0.00	$43.75
3	45	$27.24	$10.44	$9.10	$0.00	$46.78
4	50	$30.27	$10.44	$9.10	$0.00	$49.81
5	55	$33.29	$10.44	$9.10	$0.00	$52.83
6	60	$36.32	$10.44	$11.10	$0.00	$57.86
7	65	$39.34	$10.44	$11.10	$0.00	$60.88
8	70	$42.37	$10.44	$11.10	$0.00	$63.91
9	75	$45.40	$10.44	$11.10	$0.00	$66.94
10	80	$48.42	$10.44	$11.10	$0.00	$69.96

Notes: Apprentice entered prior 9/30/10:
40/45/50/55/60/65/70/75/80/85
Steps are 850 hours

Apprentice to Journeyworker Ratio:1:3

STEAM BOILER OPERATOR *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TELECOMMUNICATION TECHNICIAN *ELECTRICIANS LOCAL 223*	09/01/2022	$38.16	$11.25	$13.31	$0.00	$62.72
	09/01/2023	$39.40	$11.50	$13.91	$0.00	$64.81
	09/01/2024	$40.69	$11.75	$14.53	$0.00	$66.97

Apprentice - *TELECOMMUNICATION TECHNICIAN - Local 223*

Effective Date - 09/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	0	$0.00	$0.00	$0.00	$0.00	$0.00

Notes: See Electrician Apprentice Wages

Telecom Apprentice Wages shall be the same as the Electrician Apprentice Wages

Apprentice to Journeyworker Ratio:2:3***

TERRAZZO FINISHERS *BRICKLAYERS LOCAL 3 - MARBLE & TILE*	08/01/2022	$58.09	$11.49	$22.34	$0.00	$91.92
	02/01/2023	$59.29	$11.49	$22.34	$0.00	$93.12
	08/01/2023	$61.34	$11.49	$22.34	$0.00	$95.17
	02/01/2024	$62.59	$11.49	$22.34	$0.00	$96.42
	08/01/2024	$64.69	$11.49	$22.34	$0.00	$98.52
	02/01/2025	$65.99	$11.49	$22.34	$0.00	$99.82
	08/01/2025	$68.14	$11.49	$22.34	$0.00	$101.97
	02/01/2026	$69.49	$11.49	$22.34	$0.00	$103.32
	08/01/2026	$71.69	$11.49	$22.34	$0.00	$105.52
	02/01/2027	$73.09	$11.49	$22.34	$0.00	$106.92

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate

Apprentice - *TERRAZZO FINISHER - Local 3 Marble & Tile*

Effective Date - 08/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$29.05	$11.49	$22.34	$0.00	$62.88
2	60	$34.85	$11.49	$22.34	$0.00	$68.68
3	70	$40.66	$11.49	$22.34	$0.00	$74.49
4	80	$46.47	$11.49	$22.34	$0.00	$80.30
5	90	$52.28	$11.49	$22.34	$0.00	$86.11

Effective Date - 02/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	$29.65	$11.49	$22.34	$0.00	$63.48
2	60	$35.57	$11.49	$22.34	$0.00	$69.40
3	70	$41.50	$11.49	$22.34	$0.00	$75.33
4	80	$47.43	$11.49	$22.34	$0.00	$81.26
5	90	$53.36	$11.49	$22.34	$0.00	$87.19

Notes:

Apprentice to Journeyworker Ratio:1:3

TEST BORING DRILLER *LABORERS - FOUNDATION AND MARINE*	12/01/2021	$42.58	$9.10	$17.72	$0.00	$69.40
For apprentice rates see "Apprentice- LABORER"						
TEST BORING DRILLER HELPER *LABORERS - FOUNDATION AND MARINE*	12/01/2021	$41.30	$9.10	$17.72	$0.00	$68.12
For apprentice rates see "Apprentice- LABORER"						
TEST BORING LABORER *LABORERS - FOUNDATION AND MARINE*	12/01/2021	$41.18	$9.10	$17.72	$0.00	$68.00
For apprentice rates see "Apprentice- LABORER"						
TRACTORS/PORTABLE STEAM GENERATORS *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.05	$14.25	$16.05	$0.00	$83.35
	06/01/2023	$54.29	$14.25	$16.05	$0.00	$84.59
	12/01/2023	$55.53	$14.25	$16.05	$0.00	$85.83
	06/01/2024	$56.81	$14.25	$16.05	$0.00	$87.11
	12/01/2024	$58.25	$14.25	$16.05	$0.00	$88.55
	06/01/2025	$59.53	$14.25	$16.05	$0.00	$89.83
	12/01/2025	$60.97	$14.25	$16.05	$0.00	$91.27
	06/01/2026	$62.25	$14.25	$16.05	$0.00	$92.55
	12/01/2026	$63.69	$14.25	$16.05	$0.00	$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TRAILERS FOR EARTH MOVING EQUIPMENT *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2021	$36.82	$13.41	$16.01	$0.00	$66.24

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TUNNEL WORK - COMPRESSED AIR *LABORERS (COMPRESSED AIR)*	12/01/2022	$54.81	$9.35	$18.42	$0.00	$82.58
	06/01/2023	$55.81	$9.35	$18.42	$0.00	$83.58
	12/01/2023	$57.06	$9.35	$18.42	$0.00	$84.83
	06/01/2024	$58.54	$9.35	$18.42	$0.00	$86.31
	12/01/2024	$60.01	$9.35	$18.42	$0.00	$87.78
	06/01/2025	$61.51	$9.35	$18.42	$0.00	$89.28
	12/01/2025	$63.01	$9.35	$18.42	$0.00	$90.78
	06/01/2026	$64.56	$9.35	$18.42	$0.00	$92.33
	12/01/2026	$66.06	$9.35	$18.42	$0.00	$93.83
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) *LABORERS (COMPRESSED AIR)*	12/01/2022	$56.81	$9.35	$18.42	$0.00	$84.58
	06/01/2023	$57.81	$9.35	$18.42	$0.00	$85.58
	12/01/2023	$59.06	$9.35	$18.42	$0.00	$86.83
	06/01/2024	$60.54	$9.35	$18.42	$0.00	$88.31
	12/01/2024	$62.01	$9.35	$18.42	$0.00	$89.78
	06/01/2025	$63.51	$9.35	$18.42	$0.00	$91.28
	12/01/2025	$65.01	$9.35	$18.42	$0.00	$92.78
	06/01/2026	$66.56	$9.35	$18.42	$0.00	$94.33
	12/01/2026	$68.06	$9.35	$18.42	$0.00	$95.83
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR *LABORERS (FREE AIR TUNNEL)*	12/01/2022	$46.88	$9.35	$18.42	$0.00	$74.65
	06/01/2023	$47.88	$9.35	$18.42	$0.00	$75.65
	12/01/2023	$49.13	$9.35	$18.42	$0.00	$76.90
	06/01/2024	$50.61	$9.35	$18.42	$0.00	$78.38
	12/01/2024	$52.08	$9.35	$18.42	$0.00	$79.85
	06/01/2025	$53.58	$9.35	$18.42	$0.00	$81.35
	12/01/2025	$55.08	$9.35	$18.42	$0.00	$82.85
	06/01/2026	$56.63	$9.35	$18.42	$0.00	$84.40
	12/01/2026	$58.13	$9.35	$18.42	$0.00	$85.90
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR (HAZ. WASTE) *LABORERS (FREE AIR TUNNEL)*	12/01/2022	$48.88	$9.35	$18.42	$0.00	$76.65
	06/01/2023	$49.88	$9.35	$18.42	$0.00	$77.65
	12/01/2023	$51.13	$9.35	$18.42	$0.00	$78.90
	06/01/2024	$52.61	$9.35	$18.42	$0.00	$80.38
	12/01/2024	$54.08	$9.35	$18.42	$0.00	$81.85
	06/01/2025	$55.58	$9.35	$18.42	$0.00	$83.35
	12/01/2025	$57.08	$9.35	$18.42	$0.00	$84.85
	06/01/2026	$58.63	$9.35	$18.42	$0.00	$86.40
	12/01/2026	$60.13	$9.35	$18.42	$0.00	$87.90
For apprentice rates see "Apprentice- LABORER"						
VAC-HAUL *TEAMSTERS JOINT COUNCIL NO. 10 ZONE B*	12/01/2021	$36.24	$13.41	$16.01	$0.00	$65.66
WAGON DRILL OPERATOR *LABORERS - ZONE 2*	12/01/2022	$37.41	$9.10	$16.64	$0.00	$63.15
	06/01/2023	$38.31	$9.10	$16.64	$0.00	$64.05
	12/01/2023	$39.21	$9.10	$16.64	$0.00	$64.95
For apprentice rates see "Apprentice- LABORER"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
WAGON DRILL OPERATOR (HEAVY & HIGHWAY) *LABORERS - ZONE 2 (HEAVY & HIGHWAY)*	12/01/2022	$36.81	$9.35	$16.89	$0.00	$63.05
	06/01/2023	$37.71	$9.35	$16.89	$0.00	$63.95
	12/01/2023	$38.61	$9.35	$16.89	$0.00	$64.85
	06/01/2024	$39.94	$9.35	$16.89	$0.00	$66.18
	12/01/2024	$41.27	$9.35	$16.89	$0.00	$67.51
	06/01/2025	$42.66	$9.35	$16.89	$0.00	$68.90
	12/01/2025	$44.04	$9.35	$16.89	$0.00	$70.28
	06/01/2026	$45.48	$9.35	$16.89	$0.00	$71.72
	12/01/2026	$46.92	$9.35	$16.89	$0.00	$73.16
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
WASTE WATER PUMP OPERATOR *OPERATING ENGINEERS LOCAL 4*	12/01/2022	$53.63	$14.25	$16.05	$0.00	$83.93
	06/01/2023	$54.88	$14.25	$16.05	$0.00	$85.18
	12/01/2023	$56.13	$14.25	$16.05	$0.00	$86.43
	06/01/2024	$57.43	$14.25	$16.05	$0.00	$87.73
	12/01/2024	$58.88	$14.25	$16.05	$0.00	$89.18
	06/01/2025	$60.18	$14.25	$16.05	$0.00	$90.48
	12/01/2025	$61.63	$14.25	$16.05	$0.00	$91.93
	06/01/2026	$62.93	$14.25	$16.05	$0.00	$93.23
	12/01/2026	$64.38	$14.25	$16.05	$0.00	$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
WATER METER INSTALLER *PLUMBERS & PIPEFITTERS LOCAL 51*	08/30/2021	$46.49	$10.15	$19.95	$0.00	$76.59
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						

Additional Apprentice Information:

Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the pre-determined hourly wage rate established by the Commissioner under the provisions of the M.G.L. c. 149, ss. 26-27D. Apprentice ratios are established by the Division of Apprenticeship Training pursuant to M.G.L. c. 23, ss. 11E-11L.

All apprentices must be registered with the Division of Apprenticeship Training in accordance with M.G.L. c. 23, ss. 11E-11L.

All steps are six months (1000 hours.)
Ratios are expressed in allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified.

** Multiple ratios are listed in the comment field.
*** APP to JM; 1:1, 2:2, 2:3, 3:4, 4:4, 4:5, 4:6, 5:7, 6:7, 6:8, 6:9, 7:10, 8:10, 8:11, 8:12, 9:13, 10:13, 10:14, etc.
**** APP to JM; 1:1, 1:2, 2:3, 2:4, 3:5, 4:6, 4:7, 5:8, 6:9, 6:10, 7:11, 8:12, 8:13, 9:14, 10:15, 10:16, etc.

SECTION 00830

ATTACHMENT B

Excerpts from Chapters 30, Section 39F of the Massachusetts General Laws

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***NOTICE** - These are **NOT** the official versions of the Massachusetts General Laws (MGL). While reasonable efforts have been made to assure the accuracy of the excerpts provided, do not rely on this information without first checking an official edition of the MGL. If you are in need of legal advice or counsel, consult a lawyer.*

Certain excerpts from the Massachusetts General Laws are applicable to Construction contracts. Attention is directed to the following Sections of Chapter 30 as amended.

Chapter 30: Section 39F. Construction contracts; assignment and subrogation; subcontractor defined; enforcement of claim for direct payment; deposit, reduction of disputed amounts

Section 39F. (1) Every contract awarded pursuant to sections forty-four A to L, inclusive, of chapter one hundred and forty-nine shall contain the following subparagraphs (a) through (i) and every contract awarded pursuant to section thirty-nine M of chapter thirty shall contain the following subparagraphs (a) through (h) and in each case those subparagraphs shall be binding between the general contractor and each subcontractor.

(a) Forthwith after the general contractor receives payment on account of a periodic estimate, the general contractor shall pay to each subcontractor the amount paid for the labor performed and the materials furnished by that subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(b) Not later than the sixty-fifth day after each subcontractor substantially completes his work in accordance with the plans and specifications, the entire balance due under the subcontract less amounts retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, shall be due the subcontractor; and the awarding authority shall pay that amount to the general contractor. The general contractor shall forthwith pay to the subcontractor the full amount received from the awarding authority less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(c) Each payment made by the awarding authority to the general contractor pursuant to subparagraphs (a) and (b) of this paragraph for the labor performed and the materials furnished by a subcontractor shall be made to the general contractor for the account of that subcontractor; and the awarding authority shall take reasonable steps to compel the general contractor to make each such payment to each such subcontractor. If the awarding authority has received a demand for direct payment from a subcontractor for any amount which has already been included in a payment to the general contractor or which is to be included in a payment to the general contractor for payment to the subcontractor as provided in subparagraphs (a) and (b), the awarding authority shall act upon the demand as provided in this section.

(d) If, within seventy days after the subcontractor has substantially completed the subcontract work, the subcontractor has not received from the general contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, the subcontractor may demand direct payment of that balance

from the awarding authority. The demand shall be by a sworn statement delivered to or sent by certified mail to the awarding authority, and a copy shall be delivered to or sent by certified mail to the general contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the seventieth day after the subcontractor has substantially completed the subcontract work. Within ten days after the subcontractor has delivered or so mailed the demand to the awarding authority and delivered or so mailed a copy to the general contractor, the general contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the awarding authority and a copy shall be delivered to or sent by certified mail to the subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor and of the amount due for each claim made by the general contractor against the subcontractor.

(e) Within fifteen days after receipt of the demand by the awarding authority, but in no event prior to the seventieth day after substantial completion of the subcontract work, the awarding authority shall make direct payment to the subcontractor of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount (i) retained by the awarding authority as the estimated cost of completing the incomplete or unsatisfactory items of work, (ii) specified in any court proceedings barring such payment, or (iii) disputed by the general contractor in the sworn reply; provided, that the awarding authority shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (d). The awarding authority shall make further direct payments to the subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

(f) The awarding authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (e) in an interest-bearing joint account in the names of the general contractor and the subcontractor in a bank in Massachusetts selected by the awarding authority or agreed upon by the general contractor and the subcontractor and shall notify the general contractor and the subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the general contractor and the subcontractor or as determined by decree of a court of competent jurisdiction.

(g) All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to subparagraph (f) shall be made out of amounts payable to the general contractor at the time of receipt of a demand for direct payment from a subcontractor and out of amounts which later become payable to the general contractor and in the order of receipt of such demands from subcontractors. All direct payments shall discharge the obligation of the awarding authority to the general contractor to the extent of such payment.

(h) The awarding authority shall deduct from payments to a general contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (f), are sufficient to satisfy all unpaid balances of demands for direct payment received from subcontractors. All such amounts shall be earmarked for such direct payments, and the subcontractors shall have a right in such deductions prior to any claims against such amounts by creditors of the general contractor.

(i) If the subcontractor does not receive payment as provided in subparagraph (a) or if the general contractor does not submit a periodic estimate for the value of the labor or materials performed or furnished by the subcontractor and the subcontractor does not receive payment for same when due less the deductions provided for in subparagraph (a), the subcontractor may demand direct payment by following the procedure in subparagraph (d) and the general contractor may file a sworn reply as provided in that same subparagraph. A demand made after the first day of the month following that for which the subcontractor performed or furnished the labor and materials for which the subcontractor seeks payment shall be valid even if delivered or mailed prior to the time payment was due on a periodic estimate from the general contractor. Thereafter the awarding authority shall proceed as provided in subparagraph (e), (f), (g) and (h).

(2) Any assignment by a subcontractor of the rights under this section to a surety company furnishing a bond under the provisions of section twenty-nine of chapter one hundred forty-nine shall be invalid. The assignment and subrogation rights of the surety to amounts included in a demand for direct payment which are in the possession of the awarding authority or which are on deposit pursuant to subparagraph (f) of paragraph (1) shall be subordinate to the rights of all subcontractors who are entitled to be paid under this section and who have not been paid in full.

(3) "Subcontractor" as used in this section (i) for contracts awarded as provided in sections forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall mean a person who files a sub-bid and receives a subcontract as a result of that filed sub- bid or who is approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, (ii) for contracts awarded as provided in paragraph (a) of section thirty-nine M of chapter thirty shall mean a person approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, and (iii) for contracts with the commonwealth not awarded as provided in forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall also mean a person contracting with the general contractor to supply materials used or employed in a public works project for a price in excess of five thousand dollars.

(4) A general contractor or a subcontractor shall enforce a claim to any portion of the amount of a demand for direct payment deposited as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the other and the bank shall not be a necessary party. A subcontractor shall enforce a claim for direct payment or a right to require a deposit as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the awarding authority and the general contractor shall not be a necessary party. Upon motion of any party the court shall advance for speedy trial any petition filed as provided in this paragraph. Sections fifty-nine and fifty- nine B of chapter two hundred thirty-one shall apply to such petitions. The court shall enter an interlocutory decree upon which execution shall issue for any part of a claim found due pursuant to sections fifty-nine and fifty-nine B and, upon motion of any party, shall advance for speedy trial the petition to collect the remainder of the claim. Any party aggrieved by such interlocutory decree shall have the right to appeal therefrom as from a final decree. The court shall not consolidate for trial the petition of any subcontractor with the petition of one or more subcontractors or the same general contract unless the court finds that a substantial portion of the evidence of the same events during the course of construction (other than the fact that the claims sought to be consolidated arise under the same general contract) is applicable to the petitions sought to be consolidated and that such consolidation will prevent unnecessary duplication of evidence. A decree in any such proceeding shall not include interest on the disputed amount deposited in excess of the interest earned for the period of any such deposit. No person except a subcontractor filing a demand for direct payment for which no funds due the general contractor are available for direct payment shall have a right to file a petition in court of equity against the awarding authority claiming a demand for direct payment is premature and such subcontractor must file the petition before the awarding authority has made a direct payment to the subcontractor and has made a deposit of the disputed portion as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1).

(5) In any petition to collect any claim for which a subcontractor has filed a demand for direct payment the court shall, upon motion of the general contractor, reduce by the amount of any deposit of a disputed amount by the awarding authority as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1) any amount held under a trustee writ or pursuant to a restraining order or injunction.

Chapter 30: Section 39K. Public building construction contracts; payments

Section 39K. Every contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building by the commonwealth, or by any county, city, town, district, board, commission or other public body, when the amount is more than five thousand dollars in the case of the commonwealth and more than two thousand dollars in the case of any county, city, town, district, board, commission or other public body, shall contain the following paragraph:— Within fifteen days (30 days in the case of the commonwealth, including local housing authorities) after receipt from the contractor, at the place designated by the awarding authority if such a place is so designated, of a periodic estimate requesting payment of the amount due for the preceding month, the awarding authority will make a periodic payment to the contractor for the workperformed during the preceding month and for the materials not incorporated in the work but delivered and suitably stored at the site (or at some location agreed upon in writing) to which the contractor has title or to which a subcontractor has title and has authorized the contractor to transfer title to the awarding authority, upon certification by the contractor that he is the lawful owner and that the materials are free from all encumbrances, but less (1) a retention based on its estimate of the fair value of its claims against the contractor and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section thirty-nine F, and less (3) a retention not exceeding five per cent of the approved amount of the periodic payment. After the receipt of a periodic estimate requesting final payment and within sixty-five days after (a) the contractor fully completes the work or substantially completes the work so that the value of the work remaining to be done is, in the estimate of the awarding authority, less than one per cent of the original contract price, or (b) the contractor substantially completes the work and the awarding authority takes possession

for occupancy, whichever occurs first, the awarding authority shall pay the contractor the entire balance due on the contract less (1) a retention based on its estimate of the fair value of its claims against the contractor and of the cost of completing the

incomplete and unsatisfactory items of work and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section thirty-nine F, or based on the record of payments by the contractor to the subcontractors under this contract if such record of payment indicates that the contractor has not paid subcontractors as provided in section thirty-nine F. If the awarding authority fails to make payment as herein provided, there shall be added to each such payment daily interest at the rate of three percentage points above the rediscount rate than charged by the Federal Reserve Bank of Boston commencing on the first day after said payment is due and continuing until the payment is delivered or mailed to the contractor; provided, that no interest shall be due, in any event, on the amount due on a periodic estimate for final payment until fifteen days (twenty-four days in the case of the commonwealth) after receipt of such a periodic estimate from the contractor, at the place designated by the awarding authority if such a place is so designated. The contractor agrees to pay to each subcontractor a portion of any such interest paid in accordance with the amount due each subcontractor.

The awarding authority may make changes in any periodic estimate submitted by the contractor and the payment due on said periodic estimate shall be computed in accordance with the changes so made, but such changes or any requirement for a corrected periodic estimate shall not affect the due date for the periodic payment or the date for the commencement of interest charges on the amount of the periodic payment computed in accordance with the changes made, as provided herein; provided, that the awarding authority may, within seven days after receipt, return to the contractor for correction, any periodic estimate which is not in the required form or which contains computations not arithmetically correct and, in that event, the date of receipt of such periodic estimate shall be the date of receipt of the corrected periodic estimate in proper form and with arithmetically correct computations. The date of receipt of a periodic estimate received on a Saturday shall be the first working day thereafter. The provisions of section thirty-nine G shall not apply to any contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building to which this section applies.

All periodic estimates shall be submitted to the awarding authority, or to its designee as set forth in writing to the contractor, and the date of receipt by the awarding authority or its designee shall be marked on the estimate. All periodic estimates shall contain a separate item for each filed subtrade and each sub-subtrade listed in sub-bid form as required by specifications and a column listing the amount paid to each subcontractor and sub-subcontractor as of the date the periodic estimate is filed. The person making payment for the awarding authority shall add the daily interest provided for herein to each payment for each day beyond the due date based on the date of receipt marked on the estimate.

A certificate of the architect to the effect that the contractor has fully or substantially completed the work shall, subject to the provisions of section thirty-nine J, be conclusive for the purposes of this section.

Notwithstanding the provisions of this section, at any time after the value of the work remaining to be done is, in the estimation of the awarding authority, less than 1 per cent of the adjusted contract price, or the awarding authority has determined that the contractor has substantially completed the work and the awarding authority has taken possession for occupancy, the awarding authority may send to the general contractor by certified mail, return receipt requested, a complete and final list of all incomplete and unsatisfactory work items, including, for each item on the list, a good faith estimate of the fair and reasonable cost of completing such item. The general contractor shall then complete all such work items within 30 days of receipt of such list or before the contract completion date, whichever is later. If the general contractor fails to complete all incomplete and unsatisfactory work items within 45 days after receipt of such items furnished by the awarding authority or before the contract completion date, whichever is later, subsequent to an additional 14 days' written notice to the general contractor by certified mail, return receipt requested, the awarding authority may terminate the contract and complete the incomplete and unsatisfactory work items and charge the cost of same to the general contractor and such termination shall be without prejudice to any other rights or remedies the awarding authority may have under the contract. The awarding authority shall note any such termination in the evaluation form to be filed by the awarding authority pursuant to the provisions of section 44D of chapter 149.

Chapter 30: Section 39N. Construction contracts; equitable adjustment in contract price for differing subsurface or latent physical conditions

Section 39N. Every contract subject to section forty-four A of chapter one hundred and forty-nine or subject to section thirty-nine M of chapter thirty shall contain the following paragraph in its entirety and an awarding authority may adopt reasonable rules or regulations in conformity with that paragraph concerning the filing, investigation and settlement of such claims:

If, during the progress of the work, the contractor or the awarding authority discovers that the actual subsurface or latent physical conditions encountered at the site differ substantially or materially from those shown on the plans or indicated in the contract documents either the contractor or the contracting authority may request an equitable adjustment in the contract price of the contract applying to work affected by the differing site conditions. A request for such an adjustment shall be in writing and shall be delivered by the party making such claim to the other party as soon as possible after such conditions are discovered. Upon receipt of such a claim from a contractor, or upon its own initiative, the contracting authority shall make an investigation of such physical conditions, and, if they differ substantially or materially from those shown on the plans or indicated in the contract documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the plans and contract documents and are of such a nature as to cause an increase or decrease in the cost of performance of the work or a change in the construction methods required for the performance of the work which results in an increase or decrease in the cost of the work, the contracting authority shall make an equitable adjustment in the contract price and the contract shall be modified in writing accordingly.

Chapter 30: Section 39O. Contracts for construction and materials; suspension, delay or interruption due to order of awarding authority; adjustment in contract price; written claim

Section 39O. Every contract subject to the provisions of section thirty-nine M of this chapter or subject to section forty-four A of chapter one hundred forty-nine shall contain the following provisions (a) and (b) in their entirety and, in the event a suspension, delay, interruption or failure to act of the awarding authority increases the cost of performance

to any subcontractor, that subcontractor shall have the same rights against the general contractor for payment for an increase in the cost of his performance as provisions (a) and (b) give the general contractor against the awarding authority, but nothing in provisions (a) and (b) shall in any way change, modify or alter any other rights which the general contractor or the subcontractor may have against each other.

(a) The awarding authority may order the general contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as it may determine to be appropriate for the convenience of the awarding authority; provided however, that if there is a suspension, delay or interruption for fifteen days or more or due to a failure of the awarding authority to act within the time specified in this contract, the awarding authority shall make an adjustment in the contract price for any increase in the cost of performance of this contract but shall not include any profit to the general contractor on such increase; and provided further, that the awarding authority shall not make any adjustment in the contract price under this provision for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this contract provides for an equitable adjustment of the contract price under any other contract provisions.

(b) The general contractor must submit the amount of a claim under provision (a) to the awarding authority in writing as soon as practicable after the end of the suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under this contract and, except for costs due to a suspension order, the awarding authority shall not approve any costs in the claim incurred more than twenty days before the general contractor notified the awarding authority in writing of the act or failure to act

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SECTION 00830

ATTACHMENT C

THE COMMONWEALTH OF MASSACHUSETTS SUPPLEMENTAL EQUAL EMPLOYMENT OPPORTUNITY ANTI-DISCRIMINATION AND AFFIRMATIVE ACTION PROGRAM

APPENDIX A1

Certification Statements wording required in the BID PROPOSAL of contracts bid under the provisions of c.30, s39M (Non-Building/Public Works Contract).

Pursuant to M.G.L. Ch. 62C, s49A, I certify under the penalties of perjury that I, to my best knowledge and belief, have filed all state tax returns and paid all State Taxes Required under law.

C.30 s39 (c) The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work.

The undersigned bidder hereby certifies he/she will comply with the specific affirmative action steps contained in the Equal Employment Opportunity/Affirmative Action (EEO/AA) provisions of this Contract, including compliance with the Disadvantaged Business Enterprise provisions as required under these contract provisions. The contractor receiving the award of the contract shall incorporate the EEO/AA provisions of this contract into all subcontracts and purchase orders so that such provisions will be binding upon each subcontractor or vendor.

C.30 s39 (a) The undersigned certifies under penalties of perjury that this bid is in all respects bonafide, fair and made without collusion or fraud with any other person. As use in this paragraph the "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

Certification undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of Section Twenty-Nine F of Chapter Twenty-Nine, or any other applicable debarment provisions of any other Chapter of the General Laws or any rule or regulations promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

(Date) (Name of General Bidder) (Federal Employer Identification No.)

By: _____
(Signature)

_____
(Title & Name of person signing bid)

_____
(Business Address)

_____
(City, State, Zip)

DEP-DMS-A1 Page 1 of 1

SECTION 00830

ATTACHMENT D

CHANGE ORDERS

Policy:

This section supplements Article 12, Change of Contract Price, in the General Conditions and Supplementary Conditions.

All executed change orders submitted to the Engineer for review and processing must be prepared in accordance with the attached change order format (Appendix A) with the appropriate number of copies, calculation sheet(s) (Appendix B) and all other supporting documentation necessary for evaluation. Failure to comply with these instructions will result in delays in processing the change order.

In order to avoid possible delays with approval of change orders, at the beginning of the project and as circumstances warrant, the Contractor shall submit a list of construction equipment, identifying major pieces of equipment to be utilized on the project. The list shall include the Contractor's designation, if any, the manufacturer, model, year of manufacture, serial number, size and horsepower of equipment. The Contractor shall also provide for approval a proposed bluebook equipment rental rate development that separately lists for each piece of equipment the monthly rental rate, area adjustment factor, depreciation factor, estimated operating cost per hour and total hourly rate. In the event the Contractor fails or is unable to provide appropriate rate information the Engineer may develop equipment rental rates for use on change orders.

Payment of Change Orders:

Payment of all change orders shall be in accordance with the relevant provisions of Massachusetts General Laws, Chapter 30, Section 39G for non-building construction and Section 39K for building construction as amended from time to time.

Payment of change orders shall be made in accordance with one of the following three methods:

A. Existing unit prices as set forth in the contract; or

B. Agreed upon lump sum or unit prices; or

C. Time and materials

A. Payment for work for which there is a unit price in the contract:

Where the contract contains a unit price for work and the Engineer orders a change for work of the same kind as other work contained in the contract and is performed under similar physical conditions, the Contractor shall accept full and final payment at the contract unit price(s) for the acceptable quantities. Under certain circumstances, the unit prices may be subject to revaluation and adjustment. See Article 11 in the Supplementary Conditions.

B. Payment for work or materials for which no price is contained in the contract:

If the Engineer directs, the Contractor shall submit promptly in writing to the Engineer an offer to do the required work on a lump sum or unit price basis, as specified by the Engineer. The stated price, either lump sum or unit price, shall be divided so as to show that it is the sum of:

1. The estimated cost of Labor, plus
2. Direct Labor Cost, plus
3. Material and Freight Costs, plus
4. Equipment Costs, plus
5. An amount not to exceed 20% of the sum of items 1 through 4 for overhead and profit, plus (if applicable),
6. In the case of work done by a subcontractor an amount not to exceed 7 ½%, for the general contractor of the sum of the cost (not including subcontractor's overhead and profit) of items 1 through 4 for his overhead and profit (less, if applicable),

7. Credits for work deleted from the contract, including actual costs of the deleted work plus the percentage of overhead, profit, bonds and insurance attributable to such credit amount.

C. Payment for work on a time and materials basis:

Unless an agreed lump sum and/or unit price is obtained as noted above and is so stated in the change price, the Contractor shall accept as full payment for which no agreement is contained in contract, an amount equal to:

1. The estimated cost of Labor, plus
2. The Direct Labor Costs, plus
3. Equipment Costs, plus
4. Material and Freight Costs, plus
5. An amount not to exceed 20% of the sum of items 1 through 4 for overhead and profit, plus, if applicable,
6. In the case of work done by a subcontractor an amount not to exceed 7 ½%, for the general contractor of the sum of the cost (not including subcontractor's overhead and profit) of items 1 through 4 for his overhead and profit (less, if applicable),
7. Credit for work deleted from the Contract, including actual costs of the deleted work plus the percentage of overhead, profit, bonds and insurance attributable to such credit amount.

Explanation of items 1 through 7 as outlined in "B" and "C" above:

1. Labor - Only those workers employed on the project who are doing the extra work, including the foreman in charge, are allowable. General foremen, superintendents, or other supervisory personnel are considered to be included in the overhead markup as provided in items 5 and/or 6. Hourly labor rates in excess of those as listed in the contract wage rates require documentation. As a minimum, an explanation and the appropriate copy of the certified payroll are required.
2. Direct Labor Costs - These costs are limited to those which are required in the contract document. Coverage in excess of the contract provisions, secured by the contractor/subcontractor(s) at his option, are ineligible. The following list of typical direct labor charges is provided for your assistance and is in no way intended to be complete or all encompassing:

   Workman's Compensation

   Federal/State: Social Security Tax and Unemployment Tax;

   Health, Welfare and Pension Benefits; (this cost is included in the wage rates appearing in the Attachment A Massachusetts Wage Rates.

Liability insurance:	Bodily injury; excess umbrella; property damage; public liability
Blasters insurance:	If applied to any required direct labor costs
Builders risk insurance:	If applied to any required direct labor costs
Experience modification insurance:	If applied to any required direct labor costs
Surcharges:	If applied to any required direct labor costs

   Following award and prior to execution of a construction contract, the Contractor and filed subbidders (where applicable) shall submit for review by the Owner, documentation to establish the markup percentage(s).

   The documented direct labor markup for this contract may be adjusted on an annual basis as measured from the date the contract is executed. The contract agreement will provide for the establishment of the Direct Labor Cost percentage.
3. Material and Freight - Only those materials required as a result of the change order and reasonable freight charges for delivery of same are allowable.
4. Equipment - Only the equipment required as a result of the change order is allowable.

Equipment rental rates shall be governed by the current Equipment Watch, division of Intertec Publishing [Formerly Nielson/Dataquest] Rental Rate Bluebook for Construction Equipment (the "Bluebook"). In determining the rental rate the following shall apply:

a. For equipment already on the project - the monthly prorated rental rate by the hourly use shall be applicable;

b. For equipment not on the project the daily rate, the weekly rate, or monthly rate will prevail, whichever will prove to be most cost effective. Small tools and manual equipment are examples of costs not allowable under this item. These costs are considered to be included in the overhead markup as provided in items 5 and/or 6.

(1 Month (Normal Use) = 176 hours)

5. Overhead and Profit - All other costs not previously mentioned are considered to be included in this item, be it for the general contractor or subcontractor(s).

6. Overhead and Profit - All other costs not previously mentioned are considered to be included in this item, be it for the general contractor or subcontractor(s).

7. Credits - Work deleted, material and equipment removed from the contract, stored and/or returned shall be credited to the cost of the change order, less documented costs.

This change order will be prepared in such manner as to clearly separate Eligible and Ineligible Costs (as applicable to state-funded projects).

The Contractor shall furnish itemized statements of the cost of the work ordered and shall give the Engineer access to all accounts, bills and vouchers relating thereto; and unless the Contractor shall furnish such itemized statements, and access to all accounts, bills and vouchers, he shall not be entitled to payment for any items of extra work for which such information is sought by the Engineer.

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APPENDIX A

CHANGE ORDER

Date	
Project Name	Meetinghouse Pond Area Collection System and Pumping Station Contract No. 2022-01 and SRF No. 7150
Change Order No.	
Owner's Name:	Town of Orleans, MA
Owner's Address:	19 School Road, Orleans, Massachusetts, 02653
Contractor's Name:	
Contractor's Address:	

Change Order Summary

Item Number	Description	Amount
1		
2		
	Total	

Item 1

Description of Change:

Reason for Change:

Backup Information:

Cost:

Item 2

Description of Change:

Reason for Change:

Backup Information:

Cost:

Contract Amount (As Bid)	
Amount of Previous Change Orders	
Net Change in Contract Price (this Change Order)	
Total Adjusted Contract Price (including this Change Order	
This Change Order extends the time to complete the work by	
The extended completion date for Phase I is	
The extended completion date for Phase II is	

This Change Order checked by:

AECOM Technical Services, Inc.		
Consultant Engineer	Martin (Reggie) Donoghue, P.E. Resident Representative	Date

This Change Order is requested by: Town of Orleans, MA

This Change Order is recommended by:

AECOM Technical Services, Inc.		
Consultant Engineer	Timothy Harrison, P.E. Project Manager	Date

The undersigned agree to the terms of the Change Order.

Contractor		Date
Town of Orleans, MA		
Owner	Orleans Town Administrator	Date

Certification of Appropriation under M.G.L. c.44, s.31C: Adequate funding in an amount sufficient to cover the total cost of this change order is available.

By: _____ _____
Cathy Doane, Orleans Finance Director — Date

Do not write below this space: this space reserved for STATE AGENCY APPROVAL

APPENDIX B

EXAMPLE CALCULATION SHEET

1.Labor

Foreman	10 hours @	$10.00/hour	$100.00
Engineer	10 hours @	$8.80/hour	$85.00
Operator	10 hours @	$9.50/hour	$95.00
Laborers	24 hours @	$7.00/hour	$168.00
			$448.00

2.Direct Labor Cost (use the agreed upon Direct Labor Cost)

*(30)% of $448.

*(used for example purposes only) $134.00

3.Materials & Freight

150 1.f. of 12" pipe @ $2.00/1.f.	$300.00
15 v.f. precast SMH	$1,700.00
Freight (slip 652-1 enclosed)	$25.00
	$2,025.00

EXAMPLE

4.Equipment

1 Backhoe - 10 hours @ $80.00/hour	$800.00
1 Truck-crane - 10 hours @ $100.00/hour	$1,000.00
	$1,800.00
TOTAL (items 1 through 4):	**$4,407.00**

5.(20%) markup for Overhead, Profit

(20%) of $4,407 $881.00

6.(7½ %) markup on subcontractor's cost for general contractor(if subcontractor is involved)

(7½ %) of $4,407 $331.00

7.Credits (deductibles)-$323.00

TOTAL COST: $5,296.00

Reminder: Provide support documentation as necessary i.e. vouchers, correspondence, calculation, photographs, reports**.**

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DOCUMENT 00852

SPECIAL CONDITIONS - GENERAL

1.01 STATUTORY REQUIREMENTS IN GENERAL

A. Keep fully informed of all existing and future state and federal laws and municipal ordinances and regulations in any manner affecting those engaged or employed in the Work, or the materials used or employed in the Work, or in any way affecting the conduct of the Work, and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over the same and of all provisions required by law to be made a part of this Contract, all of which provisions are hereby incorporated by reference and made a part thereof. If any discrepancy or inconsistency is discovered in the Contract Documents for this Work in relation to any such law, ordinance, regulation, order or decree, report the same to the Engineer in writing. At all times observe and comply with, and cause all agents and employees to observe and comply with all such existing and future laws, ordinances, regulations, orders and decrees; and protect and indemnify the Owner and Engineer and all of its and their officers, agents, and servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree, whether by itself or its employees or subcontractors.

B. All materials furnished and Work done are to comply with all state and federal laws and regulations.

1.02 POLICE OFFICERS

A. Any police officers, reserve, special or otherwise, employed by the Contractor, shall be paid the prevailing wage rates paid to regular police officers of the municipality in which the Work is to be performed.

1.03 RELATION OF SEWER MAINS TO WATER LINES

A. Horizontal Separation

1. Whenever possible, sewers should be laid at least 10 feet, horizontally, from any existing or proposed water mains.

2. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:

a. It is laid in a separate trench.

b. It is laid in the same trench with the water mains located at one side on a bench of undisturbed earth.

c. In either case the elevation of the crown of the sewer is at least 18 inches below the invert of the water main.

B. Vertical Separation

1. Whenever sewers must cross under water mains, the sewer shall be laid at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirement, the water main shall be relocated to provide this separation or reconstruction with slip-on or mechanical-joint cast-iron pipe, or prestressed concrete cylinder pipe for a distance of 10 feet on each side of the sewer. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.

2. When a sewer crosses above a water main, the following measures will be taken:

a. Both pipes will be encased in concrete for a distance of 10 feet on either side of the crossing, or

b. The sewer will be encased in concrete and the water main will be constructed of mechanical joint ductile iron pipe for a distance of 10 feet on either side of the crossing.

C. Special Conditions

1. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the water main shall be constructed of slip-on or mechanical-joint cast-iron pipe or prestressed concrete cylinder pipe and the sewer constructed of mechanical-joint cast-iron pipe and both services shall be pressure tested to assure water tightness.

1.04 RESOLUTION OF CONFLICT WITHIN CONTRACT DOCUMENTS

A. In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

1. Federal, State, and Local Law
2. Change Orders
3. The Agreement
4. Addenda, with those of later date having precedence over those of earlier date.
5. Special Conditions
6. Supplementary Conditions
7. General Conditions
8. Division 1 of the Specifications
9. Drawings
   9.1. Project-specific drawings
   9.2. Schedules
   9.3. General details and figures
10. Technical Specifications

END OF DOCUMENT

DOCUMENT 00855

SPECIAL CONDITIONS

COMMONWEALTH OF MASSACHUSETTS

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Article 1. Payment to Subcontractor (MGL Chapter 30, Section 39F)

Section 39F: Construction contracts; assignment and subrogation; subcontractor defined; enforcement of claim for direct payment; deposit, reduction of disputed amounts

(1) Every contract awarded pursuant to sections forty-four A to L, inclusive, of chapter one hundred and forty-nine shall contain the following subparagraphs (a) through (i) and every contract awarded pursuant to section thirty-nine M of chapter thirty shall contain the following subparagraphs (a) through (h) and in each case those subparagraphs shall be binding between the general contractor and each subcontractor.

(a) Forthwith after the general contractor receives payment on account of a periodic estimate, the general contractor shall pay to each subcontractor the amount paid for the labor performed and the materials furnished by that subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(b) Not later than the sixty-fifth day after each subcontractor substantially completes his work in accordance with the plans and specifications, the entire balance due under the subcontract less amounts retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, shall be due the subcontractor; and the awarding authority shall pay that amount to the general contractor. The general contractor shall forthwith pay to the subcontractor the full amount received from the awarding authority less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(c) Each payment made by the awarding authority to the general contractor pursuant to subparagraphs (a) and (b) of this paragraph for the labor performed and the materials furnished by a subcontractor shall be made to the general contractor for the account of that subcontractor; and the awarding authority shall take reasonable steps to compel the general contractor to make each such payment to each such subcontractor. If the awarding authority has received a demand for direct payment from a subcontractor for any amount which has already been included in a payment to the general contractor or which is to be included in a payment to the general contractor for payment to the subcontractor as provided in subparagraphs (a) and (b), the awarding authority shall act upon the demand as provided in this section.

(d) If, within seventy days after the subcontractor has substantially completed the subcontract work, the subcontractor has not received from the general contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, the subcontractor may demand direct payment of that balance from the awarding authority. The demand shall be by a sworn statement delivered to or sent by certified mail to the awarding authority, and a copy shall be delivered to or sent by certified mail to the general contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the seventieth day after the subcontractor has substantially completed the subcontract work. Within ten days after the subcontractor has delivered or so mailed the demand to the awarding authority and delivered or so mailed a copy to the general contractor, the general contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the awarding authority and a copy shall be delivered to or sent by certified mail to the subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor and of the amount due for each claim made by the general contractor against the subcontractor.

(e) Within fifteen days after receipt of the demand by the awarding authority, but in no event prior to the seventieth day after substantial completion of the subcontract work, the awarding authority shall make direct payment to the subcontractor of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount (i) retained by the awarding authority as the estimated cost of completing the incomplete or unsatisfactory items of work, (ii) specified in any court proceedings barring such payment, or (iii) disputed by the general contractor in the sworn reply; provided, that the awarding authority shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (d). The awarding authority shall make further direct payments to the subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

(f) The awarding authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (e) in an interest-bearing joint account in the names of the general contractor and the subcontractor in a bank in Massachusetts selected by the awarding authority or agreed upon by the general contractor and the subcontractor and shall notify the general contractor and the subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the general contractor and the subcontractor or as determined by decree of a court of competent jurisdiction.

(g) All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to subparagraph (f) shall be made out of amounts payable to the general contractor at the time of receipt of a demand for direct payment from a subcontractor and out of amounts which later become payable to the general contractor and in the order of receipt of such demands from subcontractors. All direct payments shall discharge the obligation of the awarding authority to the general contractor to the extent of such payment.

(h) The awarding authority shall deduct from payments to a general contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (f), are sufficient to satisfy all unpaid balances of demands for direct payment received from subcontractors. All such amounts shall be earmarked for such direct payments, and the subcontractors shall have a right in such deductions prior to any claims against such amounts by creditors of the general contractor.

(i) If the subcontractor does not receive payment as provided in subparagraph (a) or if the general contractor does not submit a periodic estimate for the value of the labor or materials performed or furnished by the subcontractor and the subcontractor does not receive payment for same when due less the deductions provided for in subparagraph (a), the subcontractor may demand direct payment by following the procedure in subparagraph (d) and the general contractor may file a sworn reply as provided in that same subparagraph. A demand made after the first day of the month following that for which the subcontractor performed or furnished the labor and materials for which the subcontractor seeks payment shall be valid even if delivered or mailed prior to the time payment was due on a periodic estimate from the general contractor. Thereafter the awarding authority shall proceed as provided in subparagraph (e), (f), (g) and (h).

(2) Any assignment by a subcontractor of the rights under this section to a surety company furnishing a bond under the provisions of section twenty-nine of chapter one hundred forty-nine shall be invalid. The assignment and subrogation rights of the surety to amounts included in a demand for direct payment which are in the possession of the awarding authority or which are on deposit pursuant to subparagraph (f) of paragraph (1) shall be subordinate to the rights of all subcontractors who are entitled to be paid under this section and who have not been paid in full.

(3) "Subcontractor" as used in this section (i) for contracts awarded as provided in sections forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall mean a person who files a sub-bid and receives a subcontract as a result of that filed sub-bid or who is approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, (ii) for contracts awarded as provided in paragraph (a) of section thirty-nine M of chapter thirty shall mean a person approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, and (iii) for contracts with the commonwealth not awarded as provided in forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall also mean a person contracting with the general contractor to supply materials used or employed in a public works project for a price in excess of five thousand dollars.

(4) A general contractor or a subcontractor shall enforce a claim to any portion of the amount of a demand for direct payment deposited as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the other and the bank shall not be a necessary party. A subcontractor shall enforce a claim for direct payment or a right to require a deposit as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the awarding authority and the general contractor shall not be a necessary party. Upon motion of any party the court shall advance for speedy trial any petition filed as provided in this paragraph. Sections fifty-nine and fifty-nine B of chapter two hundred thirty-one shall apply to such petitions. The court shall enter an interlocutory decree upon which execution shall issue for any part of a claim found due pursuant to sections fifty-nine and fifty-nine B and, upon motion of any party, shall advance for speedy trial the petition to collect the remainder of the claim. Any party aggrieved by such interlocutory decree shall have the right to appeal therefrom as from a final decree. The court shall not consolidate for trial the petition of any subcontractor with the petition of one or more subcontractors or the same general contract unless the court finds that a substantial portion of the evidence of the same events during the course of construction (other than the fact that the claims sought to be consolidated arise under the same general contract) is applicable to the petitions sought to be consolidated and that such consolidation will prevent unnecessary duplication of evidence. A decree in any such proceeding shall not include interest on the disputed amount deposited in excess of the interest earned for the period of any such deposit. No person except a subcontractor filing a demand for direct payment for which no funds due the general contractor are available for direct payment shall have a right to file a petition in court of equity against the awarding authority claiming a demand for direct payment is premature and such subcontractor must file the petition before the awarding authority has made a direct payment to the subcontractor and has made a deposit of the disputed portion as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1).

(5) In any petition to collect any claim for which a subcontractor has filed a demand for direct payment the court shall, upon motion of the general contractor, reduce by the amount of any deposit of a disputed amount by the awarding authority as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1) any amount held under a trustee writ or pursuant to a restraining order or injunction.

Article 2. Deviations from Plans and Specifications (MGL Chapter 30, Section 39I)

Section 39I: Deviations from plans and specifications

Every contractor having a contract for the construction, alteration, maintenance, repair or demolition of, or addition to, any public building or public works for the commonwealth, or of any political subdivision thereof, shall perform all the work required by such contract in conformity with the plans and specifications contained therein. No willful and substantial deviation from said plans and specifications shall be made unless authorized in writing by the awarding authority or by the engineer or architect in charge of the work who is duly authorized by the awarding authority to approve such deviations. In order to avoid delays in the prosecution of the work required by such contract such deviation from the plans or specifications may be authorized by a written order of the awarding authority or such engineer or architect so authorized to approve such deviation. Within thirty days thereafter, such written order shall be confirmed by a certificate of the awarding authority stating: (1) If such deviation involves any substitution or elimination of materials, fixtures or equipment, the reasons why such materials, fixtures or equipment were included in the first instance and the reasons for substitution or elimination, and, if the deviation is of any other nature, the reasons for such deviation, giving justification therefor; (2) that the specified deviation does not materially injure the project as a whole; (3) that either the work substituted for the work specified is of the same cost and quality, or that an equitable adjustment has been agreed upon between the contracting agency and the contractor and the amount in dollars of said adjustment; and (4) that the deviation is in the best interest of the contracting authority.

Such certificate shall be signed under the penalties of perjury and shall be a permanent part of the file record of the work contracted for.

Whoever violates any provision of this section willfully and with intent to defraud shall be punished by a fine of not more than five thousand dollars or by imprisonment for not more than six months, or both.

Article 3. No Arbitrary Decisions are Final (MGL Chapter 30, Section 39J)

Section 39J: Public construction contracts; effect of decisions of contracting body or administrative board

Notwithstanding any contrary provision of any contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or public works by the commonwealth, or by any county, city, town, district, board, commission or other public body, when the amount of the contract is more than five thousand dollars in the case of the commonwealth and more than two thousand dollars in the case of any county, city, town, district, board, commission or other public body, a decision, by the contracting body or by any administrative board, official or agency, or by any architect or engineer, on a dispute, whether of fact or of law, arising under said contract shall not be final or conclusive if such decision is made in bad faith, fraudulently, capriciously, or arbitrarily is unsupported by substantial evidence, or is based upon error of law.

Article 4. Construction Work by Foreign Corporations (MGL Chapter 30, Section 39L)

Section 39L: Public construction work by foreign corporations; restrictions and reports

Section 39L. The commonwealth and every county, city, town, district, board, commission or other public body which, as the awarding authority, requests proposals, bids or sub-bids for any work in the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or other public works (1) shall not enter into a contract for the work with, and shall not approve as a subcontractor furnishing labor and materials for a part of the work, a foreign corporation which has not filed with the awarding authority a certificate of the state secretary stating that the corporation has complied with requirements of section 15.03 of subdivision A of Part 15 of chapter 156D and the date of compliance, and further has filed all annual reports required by section 16.22 of subdivision B of Part 16 of said chapter 156D, and (2) shall report to the state secretary and to the department of corporations and taxation any foreign corporation performing work under such contract or subcontract, and any person, other than a corporation, performing work under such contract or subcontract, and residing or having a principal place of business outside the commonwealth.

Article 5. Substitution of Equal Products (MGL Chapter 30, Section 39M (b))

Section 39M: Contracts for construction and materials; manner of awarding

(a) Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is and estimated by the awarding authority to cost less than $10,000 dollars shall be obtained through the exercise of sound business practices as defined in section 2 of chapter 30B. The awarding authority shall make and keep a record of each procurement that, at a minimum, shall include the name and address of the person from whom the services were procured. An awarding authority that utilizes a vendor on a statewide contract procured through the operational services division, or a blanket contract procured by the awarding authority pursuant to this section, shall be deemed to have obtained the contract through sound business practices.

Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is estimated by the awarding authority to cost not less than $10,000 but not more than $50,000 shall be awarded to the responsible bidder offering to perform the contract at the lowest price. The awarding authority shall make public notification of the contract and shall seek written responses from no fewer than 3 persons who customarily perform such work. For purposes of this subsection, the term "public notification" shall include, but need not be limited to, posting, at least 2 weeks before the time specified in the notification for the receipt of responses, the contract and scope-of-work statement: (1) on the website of the awarding authority, (2) on the COMMBUYS system administered by the operational services division, (3) in the central register published pursuant to section 20A of chapter 9 and (4) in a conspicuous place in or near the primary office of the awarding authority; provided, however, that if the awarding authority obtains a minimum of 2 written responses from a vendor list established through a blanket contract or a statewide contract procured through the operational services division, and the lowest of those written responses is deemed acceptable to the awarding authority, public notification is not required. The solicitation shall include a scope-of-work statement that defines the work to be performed and provides potential responders with sufficient information regarding the objectives and requirements of the awarding authority and the time period within which the work shall be completed. The awarding authority shall record the names and addresses of all persons from whom written responses were sought, the names of the persons submitting written responses and the date and amount of each written response.

An awarding authority may utilize a vendor list established through a statewide contract procured through the operational services division to identify 1 or more of the persons from whom it will seek written responses for purposes of this subsection. An awarding authority may also procure a blanket contract to establish a listing of vendors in certain defined categories of work that are under contract to provide services for multiple individual tasks of not more than $50,000 each, and from whom written responses will be sought. Any such blanket contract procured by the awarding authority shall be procured pursuant to this section or sections 44A to 44J, inclusive, of chapter 149 which are applicable to projects over $50,000.

Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is estimated by the awarding authority to cost more than $50,000, and every contract for the construction, reconstruction, installation, demolition, maintenance or repair of any building by a public agency, as defined by subsection (1) of section 44A of chapter 149, estimated to cost more than $50,000 but not more than $150,000, shall be awarded to the lowest eligible responsible bidder on the basis of competitive bids publicly opened and read by the awarding authority forthwith upon expiration of the time for the filing thereof; provided, however, that such awarding authority may reject any and all bids, if it is in the public interest to do so. Every bid for such contract shall be accompanied by a bid deposit in the form of: (1) a bid bond, (2) cash, or (3) a certified check on, or a treasurer's or cashier's check issued by, a responsible bank or trust company, payable to the awarding authority. The amount of the bid deposit shall be 5 per cent of the value of the bid. Any person submitting a bid pursuant to this section shall, on such bid, certify as follows:

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

_____

(Name of person signing bid)

_____

(Company)

This subsection shall not apply to the award of any contract subject to the provisions of sections 44A to 44J, inclusive, of chapter 149 and every such contract shall continue to be awarded as provided therein. In cases of extreme emergency: (1) caused by enemy attack, sabotage or other such hostile actions or (2) resulting from an imminent security threat explosion, fire, flood, earthquake, hurricane, tornado or other such catastrophe, an awarding authority may, without competitive bids and notwithstanding any general or special law, award contracts otherwise subject to this subsection to perform work and to purchase or rent materials and equipment, all as may be necessary for temporary repair and restoration to service of any and all public work in order to preserve the health and safety of persons or property; provided, that this exception shall not apply to any permanent reconstruction, alteration, remodeling or repair of any public work.

(b) Specifications for such contracts, and specifications for contracts awarded pursuant to the provisions of said sections forty-four A to forty-four L of said chapter one hundred and forty-nine, shall be written to provide for full competition for each item of material to be furnished under the contract; except, however, that said specifications may be otherwise written for sound reasons in the public interest stated in writing in the public records of the awarding authority or promptly given in writing by the awarding authority to anyone making a written request therefor, in either instance such writing to be prepared after reasonable investigation. Every such contract shall provide that an item equal to that named or described in the said specifications may be furnished; and an item shall be considered equal to the item so named or described if, in the opinion of the awarding authority: (1) it is at least equal in quality, durability, appearance, strength and design, (2) it will perform at least equally the function imposed by the general design for the public work being contracted for or the material being purchased, and (3) it conforms substantially, even with deviations, to the detailed requirements for the item in the said specifications. For each item of material the specifications shall provide for either a minimum of three named brands of material or a description of material which can be met by a minimum of three manufacturers or producers, and for the equal of any one of said name or described materials.

(c) The term "lowest responsible and eligible bidder" shall mean the bidder: (1) whose bid is the lowest of those bidders possessing the skill, ability and integrity necessary for the faithful performance of the work; (2) who shall certify, that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (3) who shall certify that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; (4) who, where the provisions of section 8B of chapter 29 apply, shall have been determined to be qualified thereunder; and (5) who obtains within 10 days of the notification of contract award the security by bond required under section 29 of chapter 149; provided that for the purposes of this section the term "security by bond" shall mean the bond of a surety company qualified to do business under the laws of the commonwealth and satisfactory to the awarding authority; provided further, that if there is more than 1 surety company, the surety companies shall be jointly and severally liable.

(d) The provisions of this section shall not apply (1) to the extent that they prevent the approval of such specifications by any contributing federal agency, (2) to materials purchased under specifications of the state department of highways at prices established by the said department pursuant to advertisement and bidding in connection with work to be performed under the provisions of chapter eighty-one or chapter ninety, (3) to any transaction between the commonwealth and any of its political subdivisions or between the commonwealth and any public service corporation, and (4) to any contract of not more than $50,000 awarded by a governmental body, as defined by section two of chapter thirty B, in accordance with the provisions of section five of said chapter thirty B; and (5) to any contract solely for the purchase of material awarded by a governmental body, as defined by section 2 of chapter 30B, in accordance with section 5 of said chapter 30B, or procured through the operational services division pursuant to sections 22 and 52 of chapter 7.

(e) The word "material" as used in this section shall mean and include any article, assembly, system, or any component part thereof.

Article 6. Differing Site Conditions (MGL Chapter 30, Section 39N)

Section 39N: Construction contracts; equitable adjustment in contract price for differing subsurface or latent physical conditions

Section 39N. Every contract subject to section forty-four A of chapter one hundred and forty-nine or subject to section thirty-nine M of chapter thirty shall contain the following paragraph in its entirety and an awarding authority may adopt reasonable rules or regulations in conformity with that paragraph concerning the filing, investigation and settlement of such claims:

If, during the progress of the work, the contractor or the awarding authority discovers that the actual subsurface or latent physical conditions encountered at the site differ substantially or materially from those shown on the plans or indicated in the contract documents either the contractor or the contracting authority may request an equitable adjustment in the contract price of the contract applying to work affected by the differing site conditions. A request for such an adjustment shall be in writing and shall be delivered by the party making such claim to the other party as soon as possible after such conditions are discovered. Upon receipt of such a claim from a contractor, or upon its own initiative, the contracting authority shall make an investigation of such physical conditions, and, if they differ substantially or materially from those shown on the plans or indicated in the contract documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the plans and contract documents and are of such a nature as to cause an increase or decrease in the cost of performance of the work or a change in the construction methods required for the performance of the work which results in an increase or decrease in the cost of the work, the contracting authority shall make an equitable adjustment in the contract price and the contract shall be modified in writing accordingly.

Article 7. Equitable Adjustments for Delays (MGL Chapter 30, Section 39O)

Section 39O: Contracts for construction and materials; suspension, delay or interruption due to order of awarding authority; adjustment in contract price; written claim

Section 39O. Every contract subject to the provisions of section thirty-nine M of this chapter or subject to section forty-four A of chapter one hundred forty-nine shall contain the following provisions (a) and (b) in their entirety and, in the event a suspension, delay, interruption or failure to act of the awarding authority increases the cost of performance to any subcontractor, that subcontractor shall have the same rights against the general contractor for payment for an increase in the cost of his performance as provisions (a) and (b) give the general contractor against the awarding authority, but nothing in provisions (a) and (b) shall in any way change, modify or alter any other rights which the general contractor or the subcontractor may have against each other.

(a) The awarding authority may order the general contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as it may determine to be appropriate for the convenience of the awarding authority; provided however, that if there is a suspension, delay or interruption for fifteen days or more or due to a failure of the awarding authority to act within the time specified in this contract, the awarding authority shall make an adjustment in the contract price for any increase in the cost of performance of this contract but shall not include any profit to the general contractor on such increase; and provided further, that the awarding authority shall not make any adjustment in the contract price under this provision for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this contract provides for an equitable adjustment of the contract price under any other contract provisions.

(b) The general contractor must submit the amount of a claim under provision (a) to the awarding authority in writing as soon as practicable after the end of the suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under this contract and, except for costs due to a suspension order, the awarding authority shall not approve any costs in the claim incurred more than twenty days before the general contractor notified the awarding authority in writing of the act or failure to act involved in the claim.

Article 8. Decisions on Interpretation of Specifications (MGL Chapter 30, Section 39P)

Section 39P: Contracts for construction and materials; awarding authority's decisions on interpretation of specifications, etc.; time limit; notice

Section 39P. Every contract subject to section thirty-nine M of this chapter or section forty-four A of chapter one hundred forty-nine which requires the awarding authority, any official, its architect or engineer to make a decision on interpretation of the specifications, approval of equipment, material or any other approval, or progress of the work, shall require that the decision be made promptly and, in any event, no later than thirty days after the written submission for decision; but if such decision requires extended investigation and study, the awarding authority, the official, architect or engineer shall, within thirty days after the receipt of the submission, give the party making the submission written notice of the reasons why the decision cannot be made within the thirty day period and the date by which the decision will be made.

Article 9. Contractor's Records (MGL Chapter 30, Section 39R)

Section 39R: Keeping and maintaining of books, records and accounts; statement of management on internal accounting control; financial statements; enforcement

Section 39R. (a) The words defined herein shall have the meaning stated below whenever they appear in this section:

(1) "Contractor" means any person, corporation, partnership, joint venture, sole proprietorship, or other entity awarded a contract pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A to forty-four H, inclusive, of chapter one hundred and forty-nine, which is for an amount or estimated amount greater than one hundred thousand dollars.

(2) "Contract" means any contract awarded or executed pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A through forty-four H, inclusive, of chapter one hundred and forty-nine, which is for amount or estimated amount greater than one hundred thousand dollars.

(3) "Records" means books of original entry, accounts, checks, bank statements and all other banking documents, correspondence, memoranda, invoices, computer printouts, tapes, discs, papers and other documents or transcribed information of any type, whether expressed in ordinary or machine language.

(4) "Independent Certified Public Accountant" means a person duly registered in good standing and entitled to practice as a certified public accountant under the laws of the place of his residence or principal office and who is in fact independent. In determining whether an accountant is independent with respect to a particular person, appropriate consideration should be given to all relationships between the accountant and that person or any affiliate thereof. Determination of an accountant's independence shall not be confined to the relationships existing in connection with the filing of reports with the awarding authority.

(5) "Audit", when used in regard to financial statements, means an examination of records by an independent certified public accountant in accordance with generally accepted accounting principles and auditing standards for the purpose of expressing a certified opinion thereon, or, in the alternative, a qualified opinion or a declination to express an opinion for stated reasons.

(6) "Accountant's Report", when used in regard to financial statements, means a document in which an independent certified public accountant indicates the scope of the audit which he has made and sets forth his opinion regarding the financial statements taken as a whole with a listing of noted exceptions and qualifications, or an assertion to the effect that an overall opinion cannot be expressed. When an overall opinion cannot be expressed the reason therefor shall be stated. An accountant's report shall include as a part thereof a signed statement by the responsible corporate officer attesting that management has fully disclosed all material facts to the independent certified public accountant, and that the audited financial statement is a true and complete statement of the financial condition of the contractor.

(7) "Management", when used herein, means the chief executive officers, partners, principals or other person or persons primarily responsible for the financial and operational policies and practices of the contractor.

(8) Accounting terms, unless otherwise defined herein, shall have a meaning in accordance with generally accepted accounting principles and auditing standards.

(b) Subsection (a)(2) hereof notwithstanding, every agreement or contract awarded or executed pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven, or eleven C of chapter twenty-five A, and pursuant to section thirty-nine M of chapter thirty or to section forty-four A through H, inclusive, of chapter one hundred and forty-nine, shall provide that:

(1) The contractor shall make, and keep for at least six years after final payment, books, records, and accounts which in reasonable detail accurately and fairly reflect the transactions and dispositions of the contractor, and

(2) until the expiration of six years after final payment, the office of inspector general, and the commissioner of capital asset management and maintenance shall have the right to examine any books, documents, papers or records of the contractor or of his subcontractors that directly pertain to, and involve transactions relating to, the contractor or his subcontractors, and

(3) if the agreement is a contract as defined herein, the contractor shall describe any change in the method of maintaining records or recording transactions which materially affect any statements filed with the awarding authority, including in his description the date of the change and reasons therefor, and shall accompany said description with a letter from the contractor's independent certified public accountant approving or otherwise commenting on the changes, and

(4) if the agreement is a contract as defined herein, the contractor has filed a statement of management on internal accounting controls as set forth in paragraph (c) below prior to the execution of the contract, and

(5) if the agreement is a contract as defined herein, the contractor has filed prior to the execution of the contracts and will continue to file annually, an audited financial statement for the most recent completed fiscal year as set forth in paragraph (d) below.

(c) Every contractor awarded a contract shall file with the awarding authority a statement of management as to whether the system of internal accounting controls of the contractor and its subsidiaries reasonably assures that:

(1) transactions are executed in accordance with management's general and specific authorization;

(2) transactions are recorded as necessary

i. to permit preparation of financial statements in conformity with generally accepted accounting principles, and

ii. to maintain accountability for assets;

(3) access to assets is permitted only in accordance with management's general or specific authorization; and

(4) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference.

Every contractor awarded a contract shall also file with the awarding authority a statement prepared and signed by an independent certified public accountant, stating that he has examined the statement of management on internal accounting controls, and expressing an opinion as to

(1) whether the representations of management in response to this paragraph and paragraph (b) above are consistent with the result of management's evaluation of the system of internal accounting controls; and

(2) whether such representations of management are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to the applicant's financial statements.

(d) Every contractor awarded a contract by the commonwealth or by any political subdivision thereof shall annually file with the commissioner of capital asset management and maintenance during the term of the contract a financial statement prepared by an independent certified public accountant on the basis of an audit by such accountant. The final statement filed shall include the date of final payment. All statements shall be accompanied by an accountant's report. Such statements shall be made available to the awarding authority upon request.

(e) The office of inspector general, the commissioner of capital asset management and maintenance and any other awarding authority shall enforce the provisions of this section. The commissioner of capital asset management and maintenance may after providing an opportunity for the inspector general and other interested parties to comment, promulgate pursuant to the provisions of chapter thirty A such rules, regulations and guidelines as are necessary to effectuate the purposes of this section. Such rules, regulations and guidelines may be applicable to all awarding authorities. A contractor's failure to satisfy any of the requirements of this section may be grounds for debarment pursuant to section forty-four C of chapter one hundred and forty-nine.

(f) Records and statements required to be made, kept or filed under the provisions of this section shall not be public records as defined in section seven of chapter four and shall not be open to public inspection; provided, however, that such records and statements shall be made available pursuant to the provisions of clause (2) of paragraph (b).

Article 10. Limitations on Hours of Work (MGL Chapter 149, Section 34)

Section 34: Public contracts; stipulation as to hours and days of work; void contracts

Section 34. Every contract, except for the purchase of material or supplies, involving the employment of laborers, workmen, mechanics, foremen or inspectors, to which the commonwealth or any county or any town, subject to section thirty, is a party, shall contain a stipulation that no laborer, workman, mechanic, foreman or inspector working within the commonwealth, in the employ of the contractor, sub-contractor or other person doing or contracting to do the whole or a part of the work contemplated by the contract, shall be required or permitted to work more than eight hours in any one day or more than forty-eight hours in any one week, or more than six days in any one week, except in cases of emergency, or, in case any town subject to section thirty-one is a party to such a contract, more than eight hours in any one day, except as aforesaid; provided, that in contracts entered into by the department of highways for the construction or reconstruction of highways there may be inserted in said stipulation a provision that said department, or any contractor or sub-contractor for said department, may employ laborers, workmen, mechanics, foremen and inspectors for more than eight hours in any one day in such construction or reconstruction when, in the opinion of the commissioner, public necessity so requires. Every such contract not containing the aforesaid stipulation shall be null and void.

Article 11. Advertising Invitations to Bid (MGL Chapter 149, Section 44J)

Section 44J: Invitations to bid; notice; contents; violations; penalty

(1) No public agency or authority of the commonwealth or any political subdivision thereof shall award any contract for which competitive bids are required pursuant to section forty-four A of this chapter or section thirty-nine M of chapter thirty, or for which competitive proposals are required pursuant to subsection (4) of section forty-four E of this chapter or section eleven C of chapter twenty-five A, unless a notice inviting bids or proposals therefor shall have been posted no less than one week prior to the time specified in such notice for the receipt of said bids or proposals in a conspicuous place in or near the offices of the awarding authority, and shall have remained posted until the time so specified, and unless such notice shall also have been published at least once not less than two weeks prior to the time so specified in the central register published by the secretary of state pursuant to section twenty A of chapter nine and in a newspaper of general circulation in the locality of the proposed project, and on the COMMBUYS system administered by the operational services division. Said notice shall also be published at such other times and in such other newspapers or trade periodicals as the commissioner of capital asset management and maintenance may require, having regard to the locality of the work involved.

(2) Said notice shall specify the time and place where plans and specifications of the proposed work may be had; the time and place of submission of general bids; and the time and place for opening of the general bids. For contracts subject to the provisions of sections forty-four A to H, inclusive, of this chapter, said notice shall also specify the time and place for submission of filed sub-bids, where required pursuant to section forty-four F; and the time and place for opening of said filed sub-bids.

Said notice shall also provide sufficient facts concerning the nature and scope of such project, the type and elements of construction, and such other information as will assist applicants in deciding to bid on such contract.

(3) No contract or preliminary plans and specifications shall be split or divided for the purpose of evading the provisions of this section.

(4) General bids and filed sub-bids for any contract subject to this section shall be in writing and shall be opened in public at the time and place specified in the posted or published notice, and after being so opened shall be open to public inspection.

(5) The provisions of this section shall not apply to any transaction between the commonwealth and any public service corporation.

(6) The provisions of this section may be waived in cases of extreme emergency involving the health and safety of the people and their property, upon the written approval of said commissioner. The written approval shall contain a description of the circumstances and the reasons for the commissioner's determination.

(7) Whoever violates any provision of this section shall be punished by a fine of not more than ten thousand dollars or by imprisonment in the state prison for not more than three years or in a jail or house of correction for not more than two and one-half years, or by both said fine and imprisonment; and in the event of final conviction, said person shall be incapable of holding any office of honor, trust or profit under the commonwealth or under any county, district of municipal agency.

Each and every person who shall cause or conspire to cause any contract or preliminary plans and specifications to be split or divided for the purpose of evading the provisions of this section shall forfeit and pay to the commonwealth, a political subdivision thereof or other awarding authority subject to this section, the sum of not more than five thousand dollars and, in addition, such person or persons shall pay, apportioned among them, double the amount of damages which the commonwealth or political subdivision thereof or other awarding authority may have sustained by reason of the doing of such act, together with the costs of the action.

(8) If an awarding authority rejects all general bids or does not receive any general bids, and advertises for a second opening of general bids with the original filed sub-bids as set forth in subsection (1) of section forty-four E the notice for receipt of such general bids may be published in the central register and elsewhere as required not less than one week prior to the time specified for such second opening of general bids.

(9) No request for proposals or invitation for bids issued under sections 38A 1/2 to 38O, inclusive, of chapter 7, section 11C of chapter 25A, section 39M of chapter 30, this section and sections 44A to 44H, inclusive, shall be advertised if the awarding authority's cost estimate is greater than 1 year old.

Article 12. Excavations; Notice; Penalties (MGL Chapter 82, Section 40)

Section 40: Definitions

Section 40. The following words, as used in this section and sections 40A to 40E, inclusive, shall have the following meanings:

"Company", natural gas pipeline company, petroleum or petroleum products pipeline company, public utility company, cable television company, and municipal utility company or department that supply gas, electricity, telephone, communication or cable television services or private water companies within the city or town where such excavation is to be made.

"Description of excavation location", such description shall include the name of the city or town, street, way, or route number where appropriate, the name of the streets at the nearest intersection to the excavation, the number of the buildings closest to the excavation or any other description, including landmarks, utility pole numbers or other information which will accurately define the location of the excavation.

"Emergency", a condition in which the safety of the public is in imminent danger, such as a threat to life or health or where immediate correction is required to maintain or restore essential public utility service.

"Excavation", an operation for the purpose of movement or removal of earth, rock or the materials in the ground including, but not limited to, digging, blasting, augering, backfilling, test boring, drilling, pile driving, grading, plowing in, hammering, pulling in, jacking in, trenching, tunneling and demolition of structures, excluding excavation by tools manipulated only by human power for gardening purposes and use of blasting for quarrying purposes.

"Excavator", any entity including, but not limited to, a person, partnership, joint venture, trust, corporation, association, public utility, company or state or local government body which performs excavation operations.

"Premark", to delineate the general scope of the excavation or boring on the paved surface of the ground using white paint, or stakes or other suitable white markings on nonpaved surfaces. No premarking shall be acceptable if such marks can reasonably interfere with traffic or pedestrian control or are misleading to the general public. Premarking shall not be required of any continuous excavation that is over 500 feet in length.

"Safety zone", a zone designated on the surface by the use of standard color-coded markings which contains the width of the facilities plus not more than 18 inches on each side.

"Standard color-coded markings", red - electric power lines, cables, conduit or light cables; yellow - gas, oil, street petroleum, or other gaseous materials; orange - communications cables or conduit, alarm or signal lines; blue - water, irrigation and slurry lines; green - sewer and drain lines; white - premark of proposed excavation.

"System", the underground plant damage prevention system as defined in section 76D of chapter 164.

Section 40A: Excavations; notice

Section 40A. No excavator installing a new facility or an addition to an existing facility or the relay or repair of an existing facility shall, except in an emergency, make an excavation, in any public or private way, any company right-of-way or easement or any public or privately owned land or way, unless at least 72 hours, exclusive of Saturdays, Sundays and legal holidays but not more than 30 days before the proposed excavation is to be made, such excavator has premarked not more than 500 feet of the proposed excavation and given an initial notice to the system. Such initial notice shall set forth a description of the excavation location in the manner as herein defined. In addition, such initial notice shall indicate whether any such excavation will involve blasting and, if so, the date and the location at which such blasting is to occur.

The notice requirements shall be waived in an emergency as defined herein; provided, however, that before such excavation begins or during a life-threatening emergency, notification shall be given to the system and the initial point of boring or excavation shall be premarked. The excavator shall ensure that the underground facilities of the utilities in the area of such excavation shall not be damaged or jeopardized.

In no event shall any excavation by blasting take place unless notice thereof, either in the initial notice or a subsequent notice accurately specifying the date and location of such blasting shall have been given and received at least 72 hours in advance, except in the case of an unanticipated obstruction requiring blasting when such notice shall be not less than four hours prior to such blasting. If any such notice cannot be given as aforesaid because of an emergency requiring blasting, it shall be given as soon as may be practicable but before any explosives are discharged.

Section 40B: Designation of location of underground facilities

Section 40B. Within 72 hours, exclusive of Saturdays, Sundays and legal holidays, from the time the initial notice is received by the system or at such time as the company and the excavator agree, such company shall respond to the initial notice or subsequent notice by designating the location of the underground facilities within 15 feet in any direction of the premarking so that the existing facilities are to be found within a safety zone. Such safety zone shall be so designated by the use of standard color-coded markings. The providing of such designation by the company shall constitute prima facie evidence of an exercise of reasonable precaution by the company as required by this section; provided, however, that in the event that the excavator has given notice as aforesaid at a location at which because of the length of excavation the company cannot reasonably designate the entire location of its facilities within such 72 hour period, then such excavator shall identify for the company that portion of the excavation which is to be first made and the company shall designate the location of its facilities in such portion within 72 hours and shall designate the location of its facilities in the remaining portion of the location within a reasonable time thereafter. When an emergency notification has been given to the system, the company shall make every attempt to designate its facilities as promptly as possible.

Section 40C: Excavator's responsibility to maintain designation markings; damage caused by excavator

Section 40C. After a company has designated the location of its facilities at the location in accordance with section 40B, the excavator shall be responsible for maintaining the designation markings at such locations, unless such excavator requests remarking at the location due to the obliteration, destruction or other removal of such markings. The company shall then remark such location within 24 hours following receipt of such request.

When excavating in close proximity to the underground facilities of any company when such facilities are to be exposed, non-mechanical means shall be employed, as necessary, to avoid damage in locating such facility and any further excavation shall be performed employing reasonable precautions to avoid damage to any underground facilities including, but not limited to, any substantial weakening of structural or lateral support of such facilities, penetration or destruction of any pipe, main, wire or conduit or the protective coating thereof, or damage to any pipe, main, wire or conduit.

If any damage to such pipe, main, wire or conduit or its protective coating occurs, the company shall be notified immediately by the excavator responsible for causing such damage.

The making of an excavation without providing the notice required by section 40A with respect to any proposed excavation which results in any damage to a pipe, main, wire or conduit, or its protective coating, shall be prima facie evidence in any legal or administrative proceeding that such damage was caused by the negligence of such person.

Section 40D: Local laws requiring excavation permits; public ways

Section 40D. Nothing in this section shall affect or impair local ordinances or by-laws requiring a permit to be obtained before excavation in a public way or on private property; but notwithstanding any general or special law, ordinance or by-law to the contrary, to the extent that any permit issued under the provisions of the state building code or state fire code requires excavation by an excavator on a public way or on private property, the permit shall not be valid unless the excavator notifies the system as required pursuant to sections 40 and 40A, before the commencement of the excavation, and has complied with the permitting requirements of chapter 82A.

Section 40E: Violations of Secs. 40A to 40E; punishment

Section 40E. Any person or company found by the department of telecommunications and energy, after a hearing, to have violated any provision of sections 40A to 40E, inclusive, shall be fined $1,000 for the first offense and not less than $5,000 nor more than $10,000 for any subsequent offense within 12 consecutive months as set forth by the rules of said department; provided, however, that nothing herein shall be construed to require forfeiture of any penal sum by a state or local government body for violation of section 40A or 40C; and provided, further, that nothing herein shall be construed to require the forfeiture of any penal sum by a residential property owner for the failure to premark for an excavation on such person's residential property.

Article 13. Price Adjustments for Certain Materials in Construction Projects (MGL Chapter 30, Section 38A)

Section 38A: Price adjustment clause in contracts for road, bridge, water and sewer projects awarded under Sec. 39M

Section 38A. Contracts for road and bridge projects awarded as a result of a proposal or invitation for bids under section 39M shall include a price adjustment clause for each of the following materials: fuel, both diesel and gasoline; asphalt; concrete; and steel. Contracts for water and sewer projects awarded as a result of a proposal or invitation for bids under said section 39M shall include a price adjustment clause for fuel, both diesel and gasoline; liquid asphalt; and portland cement contained in cast-in-place concrete. A base price for each material shall be set by the awarding authority or agency and shall be included in the bid documents at the time the project is advertised. The awarding authority or agency shall also identify in the bid documents the price index to be used for each material. The price adjustment clause shall provide for a contract adjustment to be made on a monthly basis when the monthly cost change exceeds plus or minus 5 per cent.

END OF DOCUMENT

DOCUMENT 00858

SPECIAL CONDITIONS - PERMITS AND LICENSES

1.01 LIST OF PERMITS AND/OR LICENSES

A. The Town of Orleans has received the following Permits and Licenses:

1. Cape Cod Commission – Consistency Review
2. Massachusetts Department of Environmental Protection – CWMP Approval
3. Orleans, MA Conservation Commission - Order of Conditions
4. Massachusetts Department of Transportation - State-Highway Access Permit

The Applications and Permits and Licenses are included as an Attachment and are made part of the Contract Documents.

The Contractor is responsible for comping with the terms, conditions and any special conditions specified in the Permits and Licensees.

B. The Town of Orleans has applied for and anticipates obtaining the following Permits and Licenses prior to the bid date.

1. Not used

C. ATTACHMENTS

1. The Town of Orleans has obtained various easements for the Project. The Easements are included as an Attachment and are made part of the Contract Documents.
2. Archeological Report by Public Archeological Laboratory.

D. Town of Orleans, MA Trench Permit and Road Opening Permit (To be issued after the Contract is awarded).

E. Other Permits to be obtained by the Contractor as required by Federal, State and/or Local Regulatory Agencies.

END OF TEXT

See Attachments

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Cape Cod Commission – Consistency Review

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CAPE COD
COMMISSION

March 15, 2022

Maria E. Pinaud
Director, Municipal Services Division
Bureau of Water Resources
MassDEP, 5th Floor
One Winter Street
Boston, MA 02108

Ms. Pinaud,

This letter is regarding a consistency determination for those projects in the Town of Orleans included on the Draft Calendar Year 2022 Intended Use Plan (IUP) for the Clean Water State Revolving Fund (SRF). As you know, Cape Cod communities are subject to the Cape Cod Area Wide Water Quality Management Plan (208 Plan), which was certified and approved by the Massachusetts Department of Environmental Protection and the United States Environmental Protection Agency in 2015. Clean Water State Revolving Fund regulations (310 CMR 44.00) require projects be deemed consistent with the 208 Plan through written notice by the Regional Land Use Planning Agency for the region in which the municipal applicant is located.

The Town of Orleans proposes two separate projects, the first being an extension of the sewer collection system and construction of a new pump station. This project will replace 474 septic tanks using a combination of gravity and low-pressure sewers, with project costs totaling $32,906,000. This project, the Meetinghouse Pond Area Collection System and Pump Station, is a critical component of the Town's nitrogen removal commitments under the Pleasant Bay Watershed Permit, that will also provide water quality benefits to Town Cove and the town's drinking water supply points. The Town also proposes the installation of 18 permeable reactive barriers, totaling $63,320,000 in project costs, with $17,094,000 included on the 2022 IUP. The full scale PRB implementation plan is based on results from the Eldredge Park PRB demonstration project using the process outlined in draft amendments to the Orleans CWMP. Final locations and phasing for additional PRBs are anticipated in the Town's amended CWMP, which is expected by 2023 in alignment with the Pleasant Bay Watershed Permit. The overall project is anticipated to yield approximately 3,300 kg/year of nitrogen reduction from the Pleasant Bay, Rock Harbor, and Nauset Harbor watersheds.

The proposed work is included in the CWMP for the Town of Orleans, which was approved through Development of Regional Impact (DRI) review on October 13, 2011, and in subsequent Notices of

Project Change filed in 2018. The CWMP provides a strategy for wastewater management to achieve reductions of nitrogen loading to restore and protect Orlean's marine embayments. Additionally, these projects are acknowledged as components of the program for Orleans to meet its nitrogen removal commitments in Phases 2 and 3 of the Pleasant Bay Targeted Watershed Management Plan (TWMP) written in May 2018 and determined consistent with the 208 Plan on June 21, 2018, and consistent with the details of the Pleasant Bay Watershed Permit.

For the purposes of SRF financing, the Orleans projects included on the Draft 2022 IUP are consistent with the 208 Plan.

Please feel free to get in touch with me if you have any questions.

Sincerely,

Kristy Senatori
Executive Director

CC: Gary Moran, Deputy Commissioner, MassDEP
Millie Garcia-Serrano, Southeast Regional Director, MassDEP
Nate Keenan, Deputy Director, Massachusetts Clean Water Trust
John Kelly, Town Administrator, Town of Orleans
George Meservey, Town Planner, Town of Orleans
Kevin Galligan, Member, Orleans Selectboard; Orleans Representative, Cape Cod and Islands Water Protection Fund Management Board

Massachusetts Department of Environmental Protection – CWMP Approval

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The Commonwealth of Massachusetts

Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Deval L. Patrick
GOVERNOR

Timothy P. Murray
LIEUTENANT GOVERNOR

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January 28, 2011

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
SINGLE ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: Town of Orleans Comprehensive Wastewater Management Plan
PROJECT MUNICIPALITY	: Town of Orleans
PROJECT WATERSHED	: Cape and Islands
EOEA NUMBER	: 14414
PROJECT PROPONENT	: Town of Orleans
DATE NOTICED IN MONITOR	: December 22, 2010

As Secretary of Energy and Environmental Affairs, I hereby determine that the Single Environmental Impact Report (SEIR) submitted on this project **adequately and properly complies** with the Massachusetts Environmental Policy Act (M.G.L. c. 30, ss. 61-62I) and with its implementing regulations (301 CMR 11.00).

The comments I have received on the SEIR from MassDEP, the Cape Cod Commission (CCC) and others indicate that since the Secretary's issuance of the Certificate on the Expanded Environmental Notification Form (EENF), the Town of Orleans (the Town) has worked closely with MassDEP and CCC to provide additional information to address the comments raised on the EENF pertaining to water quality monitoring at the Orleans Wastewater Treatment Facility (Orleans WWTF) site, the Town's Adaptive Management Plan (AMP) and the project's potential impacts to coastal resource areas. I commend the Town on its continued coordination and outreach efforts in this regard. As a consequence of these efforts, MassDEP, CCC, the Pleasant Bay Resource Management Alliance and others have indicated their strong support for the Town's Comprehensive Wastewater Management Plan (CWMP).

I have received a number of comments on the SEIR that express continuing concerns regarding the Town's proposed centralized sewer system design, potential impacts to the

Namskaket Marsh embayment from the groundwater discharge at the Tri-Town site, and the Total Maximum Daily Loads (TMDLs) established for the coastal embayments surrounding the Town of Orleans.

I have fully considered all of the comments received on the EENF and the SEIR and, on balance, I am convinced that the Town has satisfactorily evaluated the project's potential environmental impacts and committed to an appropriate package of mitigation commitments. While I acknowledge the remaining concerns of a number of residents from the Town of Orleans and neighboring Cape Cod communities, I am confident that these concerns can be adequately addressed during the state and local permitting process and through the implementation of the Town's Adaptive Management Plan. Towards that end, I am directing the Town to continue the same high-level of coordination and cooperation with state, regional and local officials that it has shown throughout the MEPA review process for this project as the project proceeds to permitting.

Thus, after careful review of the SEIR and comment letters, and after consultation with MassDEP, the Cape Cod Commission and others, I believe that the SEIR has addressed the substantive issues outlined in the scope and has demonstrated to MEPA's and the permitting agencies' satisfaction that the Town of Orleans has avoided, minimized, and mitigated impacts to the maximum extent feasible. The project may proceed to state permitting where I expect that MassDEP will continue to scrutinize potential project impacts and require additional mitigation where appropriate.

Project Overview

The Orleans CWMP calls for the phased construction of a new centralized municipal sewer system and implementation of non-structural program elements to achieve significant reductions of nitrogen loading and meet TMDL limits for the coastal embayments surrounding the Town of Orleans over a 20-year phased project construction period.

The Town of Orleans' CWMP includes:

- Orleans WWTF

  Constructing a new centralized wastewater treatment and disposal facility to be located at the existing 26-acre Tri-Town Septage Treatment facility site in Orleans capable of achieving effluent concentration limits of 3-5 mg/L for total nitrogen (TN) with an initial designed capacity to treat and dispose up to 0.64 million gallons per day (MGD) of wastewater flows;

- Core Program Sewers

  Constructing approximately 74 miles of new municipal sewer pipe, and approximately 63 sewer pump stations in 6 construction phases to collect and convey approximately 0.64 MGD of wastewater flows from 2,800 individual properties located in the Pleasant Bay, Nauset and Rock Harbor watersheds for treatment and on-site disposal at the Orleans WWTF;

- Non Structural Program Elements

  Implementing non-structural program elements to provide additonal reductions in nutrient loading within the embayments surrounding Orleans including: fertilizer use controls, stormwater management controls, water conservation measures and enhancement of embayment flushing;

- Adaptive Management Plan

  Employing an Adaptive Management Plan that establishes a process for identifying measurable reductions in nitrogen loading; compliance with TMDLs for the coastal embayments surrounding Orleans; and the need for any adjustments or mid-course revisions to the Orleans CWMP prior to constructing the later Core Program phases; and,

- Regional Wastewater Management Opportunities

  The Town's Final CWMP has been designed to also accommodate potential additional future wastewater flows from the neighboring towns of Eastham and/or Brewster (Regional Program).

MEPA Review History

In May 2009, the Town of Orleans (the Town), in accordance with Section 11.05(7) of the MEPA regulations, submitted an EENF with a request that the Secretary allow the Proponent to fulfill its EIR obligations under MEPA with a Single EIR, rather than the usual process of a Draft and Final EIR. The EENF received an extended comment period pursuant to Section 11.06(8) of the MEPA regulations and the Town voluntarily extended the comment period an additional four weeks. The EENF included clear descriptions of the project, a description of the extensive planning and alternatives analysis conducted to date, identified potential environmental impacts associated with the project and provided initial commitments to mitigate impacts. Comments received from MassDEP, the Cape Cod Commission (CCC) and others indicated overwhelming support for the analysis and conclusions included in the EENF and its consistency with legal

requirements. In July 2009, the Secretary issued a Certificate on the EENF and based on a review of the EENF and after consultation with state agencies, determined that the EENF met the regulatory requirements and permitted the Proponent to file a SEIR in fulfillment of Section 11.03 of the MEPA regulations.

State Permits and Jurisdiction

The project is undergoing review pursuant to Sections 11.03(5)(a)(3) and (5)(b)(1) of the MEPA regulations, because the project will likely involve the construction of sewer mains ten or more miles in length and the development of a new wastewater treatment facility with a capacity of more than 1,000,000 gallons per day. The project will require a Groundwater Discharge Permit, a Chapter 91 License, and a 401 Water Quality Certificate from MassDEP. The project must be reviewed by the Natural Heritage Endangered Species Program (NHESP) and the Massachusetts Historical Commission (MHC) because portions of the project occur within Priority Habitat and within or adjacent to recorded archaeological sites and archaeologically sensitive areas, respectively. The project may require a Conservation and Management Permit from NHESP. It may require Federal Consistency Review with the Massachusetts Coastal Zone Management (MCZM) Office. It may also require a Construction Access Permit from the Massachusetts Highway Department. The project may need to obtain a Section 404 Permit from the U.S. Army Corps of Engineers. The project should comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for stormwater discharges from a construction site. It will also require an Order of Conditions from the Orleans Conservation Commission and on appeal only, a Superseding Order of Conditions from MassDEP.

The Town anticipates applying for State Revolving Fund (SRF) loans for subsequent planning and construction of proposed sewer project. Therefore, MEPA jurisdiction is broad and extends to all aspects of the project that may cause Damage to the Environment, as defined in the MEPA regulations.

REVIEW OF THE SINGLE ENVIRONMENTAL IMAPCT REPORT and FINAL CWMP

Project Description

The SEIR includes a detailed discussion of the findings of the Massachusetts Estuaries Project (MEP) Technical Reports and/or TMDLs established for Pleasant Bay, Rock Harbor, Namskaket and Little Namskaket embayments used by the Town in the design of the Orleans

CWMP. The SEIR provides additional information to satisfactorily demonstrate that the Tri-Town site is an acceptable effluent recharge site that could accommodate the treatment and on-site discharge of the Core Program's estimated wastewater flows. The SEIR provides a detailed description of the Town's proposed Adaptive Management Plan and its water quality monitoring program for the Tri-Town site and the coastal embayments surrounding the Town of Orleans. The SEIR identifies significant environmental benefits and impacts, and measures that will be taken to avoid, minimize and mitigate the Core Program sewer project's unavoidable impacts to environmental resource areas. The SEIR includes a proposed schedule for completing the final design and environmental permitting for the Orleans CWMP and each phase of its sewer construction program. The SEIR includes additional information and maps identifying the areas in Orleans where construction of new sewers or cluster systems are proposed and the locations where sewer lines, pumping stations, and other facilities will be located.

Structural Program Elements

Core Sewer Program

The Town's core sewer construction plan (Core Program) involves the phased construction of new sewers to eliminate septic systems in areas of Orleans having the greatest need for nitrogen control and located upgradient of nitrogen sensitive watersheds and major freshwater ponds. As described in the SEIR, the Core program's sewer service area was designed to provide for the collection of as much wastewater nitrogen as necessary using the least amount of wastewater collection and conveyance infrastructure.

The Core Program includes the construction of a new centralized wastewater treatment facility (Orleans WWTF) to be located at the existing 26-acre Tri-Town Septage Treatment facility located near the intersection of Route 6 and Route 6A at 29 Overland Way in Orleans. The new Orleans WWTF is designed with an initial capacity to treat and dispose up to 0.64 MGD and will employ a 4-stage Bardenpho nitrogen removal process that will provide treatment levels capable of achieving nitrogen effluent concentrations of 3-5 milligrams per liter (mg/l) of total effluent Nitrogen (Level 2 nitrogen limits) and the removal of numerous pathogenic organisms. Under the Core Program, a total of approximately 74 miles of new municipal sewer pipe, and approximately 63 sewer pump stations will be constructed in 6 construction phases to collect and convey 2030 design year wastewater flows (approximately 0.64 MGD) from 2,800 individual properties (approximately 53% percent of the Town) located in the Pleasant Bay, Nauset and Rock Harbor watersheds for treatment and on-site disposal at the Orleans WWTF site. Construction of Phase 1 of the Core Program is expected to be completed in 2017 and will include the construction of the new Orleans WWTF (to operate at 50% design capacity) and approximately 15 miles of new sewers and 7 pump stations located primarily throughout the downtown area of Orleans.

Phase II of the Core Program will include the construction of approximately 11 miles of sewers and 10 pump stations. Phase 2 will also involve the construction of five separate below-ground cluster wastewater treatment systems with approximately 11 miles of additional gravity sewers and new pump stations to serve neighborhoods located in the watersheds of four impacted coastal embayments and one freshwater pond including the headwaters of the Paw Wah Pond, Lonnies Pond, Arey's Pond, Mill Pond and Baker's Pond, respectively. As described in the SEIR, these cluster systems will provide interim nitrogen and phosphorous removal to these impacted surface water bodies in the early phases (Phases 1 and 2) of Core Program construction and many years in advance of the construction of the later phases of Core Program construction for these areas of Orleans. The Town proposes to eventually convert and incorporate these cluster wastewater treatment systems to serve as pump stations for the Core Program municipal sewer system. The Town anticipates that the Phase 2 sewer construction work will be completed in 2020. Construction of the remaining Core Program phases (Phases 3-6) is anticipated to be completed in 2032.

Septage Handling Facility

The Orleans WWTF will include facilities for a new septage receiving and handling station to replace the existing Tri-Town Septage Treatment Facility and will be designed to receive, treat and dispose of truck-transported septage from non-sewered areas in Orleans together with septage from the other Tri-Town District communities of Brewster and Eastham.

Sludge Handling Facility

The Orleans WWTF will also include new facilities for preparing remaining sludge materials resulting from the wastewater treatment and septage handling processes for off-site trucking for suitable reuse and disposal.

Non Structural Program Elements

The Orleans CWMP also calls for the implementation of a number of cost-effective non-structural elements designed to provide measurable reductions in nitrogen loading to the embayments surrounding Orleans such as fertilizer management, stormwater management, enhanced embayment flushing and land use controls.

According to the information provided in the SEIR, fertilizer use and stormwater runoff can contribute up to 7% and 8% of watershed nitrogen load to coastal embayments in Orleans, respectively. The Town has committed to implement fertilizer use controls to reduce the use of fertilizer products on lawns, gardens and agricultural areas in Orleans. The Town has also committed to adopting stormwater management regulations to reduce nutrient loading from surface runoff to embayments surrounding Orleans, and to pilot the potential use of enhanced

embayment flushing to increase the assimilative capacity of coastal embayments to reduce nitrogen loading by increasing their flushing rates. MassDEP has indicated that some of these non-structural program elements may hold promise for reducing nutrient loading to coastal embayments but will require an extensive evaluation by MassDEP to determine if an acceptable nitrogen reduction credit can be applied in the Orleans CWMP.

Water Quality and Wastewater Treatment

Marine Embayments

The SEIR includes a detailed discussion of the findings of the MEP Technical Reports and/or TMDLs established for Pleasant Bay, Rock Harbor, Namskaket and Little Namskaket embayments used by the Town in the design of the Final Orleans CWMP. The Town has continued to participate in MEP's efforts to conduct water quality sampling and identify nutrient loading problems for the Town's coastal embayments. The Technical Reports produced by the MEP are used by MassDEP and the US Environmental Protection Agency (EPA) to establish Total Maximum Daily Loads (TMDLs) for nitrogen loading to these coastal emabyments and their tributaries. The MEP has provided Technical Reports for Pleasant Bay and the Northside Cape Cod Bay embayments of Rock Harbor, Namskaket and Little Namskaket Creek. The final MEP Technical Report for Nauset Marsh has been delayed. MassDEP and EPA have established TMDLs for Pleasant Bay and its coastal tributaries.

The TMDLs for the Northside Cape Cod Bay embayments has not yet been released. As described in the SEIR and the comments received from CCC, the Town incorporated information from the draft MEP Technical Report findings for Nauset Marsh in the Town's final design of the Orleans CWMP. Specifically, the Orleans CWMP includes a conservative target percentage (55%) nitrogen removal for Nauset Marsh. CCC supports the Town's interim use of this nitrogen removal estimate for Nauset Marsh. According to the comments received from MassDEP and CCC, the estimated nitrogen loading reductions resulting from the Town's phased construction of the Core Program are consistent with published or expected TMDLs for the watersheds and embayments surrounding the Town of Orleans. As a condition of its approval of the Orleans CWMP project, CCC will require the Town to review the final MEP Report for Nauset Marsh when it becomes available to determine what if any revisions to the Orleans CWMP may be needed to address nutrient loading and water quality issues affecting the Nauset Marsh/Town Cove embayment.

MassDEP and CCC have requested that the Town provide confirmatory modeling results using the Linked Water Quality Model to identify estimated reductions in nitrogen loading and interim water quality improvements associated with each phase of the Town's Core Program sewer construction program. The Town will be required to complete the confirmatory modeling

for the Orleans CWMP as a condition of MassDEP's Groundwater Discharge Permit and CCC's Development of Regional Impact (DRI) approval process. MassDEP's comments on the SEIR identified the need for additional water quality modeling at the Little Naskaket Marsh and renewed monitoring and characterization of the Tri-Town plume. According to MassDEP comments, the wastewater plume from the Tri-Town site was last monitored in 2001 by the USGS and determined to be moving in a northwesterly direction. MassDEP has indicated that the Town will be required to fully characterize the plume's direction and extend of its leading edge as part of the Town's ongoing water quality monitoring program responsibilities. Studies of the Tri-Town wastewater plume and their findings will be made part of the Adaptive Management Plan and included in the Town's annual TMDL Compliance Report described below.

Freshwater Ponds

As described in the SEIR, Phase 2 work will include the construction of five separate below-ground cluster wastewater treatment systems with approximately 11 miles of additional gravity sewers and pump stations to serve neighborhoods located in the headwaters of the watersheds for four impacted coastal embayments and one freshwater pond including Paw Wah Pond, Lonnies Pond, Arey's Pond, Mill Pond and Baker's Pond, respectively. Each of the five cluster wastewater treatment systems will have a design capacity to accommodate approximately 10,000 – 20,000 gpd of wastewater flow (15 – 30 properties) to achieve an effluent nitrogen concentration of 5- 8 mg/L. These cluster systems will provide interim nitrogen and phosphorous removal to these impacted surface water bodies in the early phases (Phases 1 and 2) of Core Program construction and many years in advance of the construction of the later Core Program sewer phases in these areas of Orleans. The Town proposes to eventually convert and incorporate these cluster wastewater treatment systems to serve as pump stations for the Core Program municipal sewer system. The Phase 2 sewer construction work is expected to be completed in 2018. Construction of the remaining Core Program phases (Phases 3-6) is anticipated to be completed by 2030.

In comments previously submitted on the EENF, CCC recommended that the Town consider constructing an interim cluster wastewater collection and treatment system to serve the neighborhoods located in the headwaters of for Cedar Pond area as part of the Town's Phase 1 Core Program work. According to the information provided in the SEIR, factors contributing to the impairment of Cedar Pond have not yet been adequately identified. The Town has committed to review the forthcoming amended MEP Report for Rock Harbor when it becomes available to re-evaluate the need for constructing a cluster sewer system to serve the Cedar Pond neighborhoods.

Orleans Wastewater Treatment Facility

The proposed Orleans WWTF will have an initial design capacity of 0.64 MGD and will employ a 4-stage Bardenpho nitrogen removal process that will achieve nitrogen effluent concentrations of 3-5 milligrams per liter (mg/l) of total effluent Nitrogen. Treated wastewater effluent will be discharged to 10 rapid infiltration beds. The Town completed a review of existing hydrogeological studies, hydraulic load testing and other groundwater modeling analyses and determined that the Tri-Town site has an effluent disposal capacity (approximately 1.78 mgd) to accommodate the Core Program's wastewater flows. As discussed below, the Orleans WWTF is designed with reserve treatment capacity to accommodate the treatment of potential future additional wastewater flows anticipated from sewering the entire Town of Orleans under the Town's Expanded Program design. Acoording to the information provided in the SEIR, under the Extended Program, a total of 1.14 MGD of wastewater flow will be collected from 5,300 individual properties for treatment at the Orleans WWTF. According to the Town, construction of the Extended Program would require an additional 15-20 years from the completion of the Core Program sewer construction work.

The treatment and on-site disposal of the Core Program's wastewater flows will utilize approximately 60% of the infiltration system's capacity. The disposal of treated effluent under the Regional Program would utilize approximately 90% of the infiltration system's discharge capacity. The disposal of treated effluent under the Town's Extended Program would exceed the infiltration system's capacity and require one or more additional off-site groundwater disposal sites or water reuse options.

As described in the SEIR, approximately 67% of the treated wastewater effluent from the Tri-Town site will discharge to Namskaket Marsh, 9% will discharge to Little Namskaket Marsh and approximately 25% will discharge to Cape Cod Bay. The MEP Reports for the Namskaket and Little Namskaket Marsh systems indicate that these embayments have adequate assimilative capacity to prevent nitrogen overloading from the discharge of the Core Program's treated wastewater flows. The Town has concluded that the disposal of treated effluent from the Orleans WWTF will not impact local groundwater and surface water resources including existing water table mound heights and nutrient loading to both the Namskaket Marsh and Little Namskaket Marsh. The Town has committed to monitor groundwater resources around the periphery and down gradient of the Orleans WWTF site to identify any impacts on groundwater resources and coastal embayments surrounding the Town of Orleans. According to the comments received from MassDEP, this groundwater monitoring commitment will be incorporated into MassDEP's Groundwater Discharge Permit for the Orleans WWTF. CCC has indicated that the Town will be required to conduct groundwater monitoring of the Tri-Town site as part of the Town's Adaptive Management Plan as a condition of CCC's DRI approval process.

Adaptive Management Plan (AMP)

The Orleans CWMP contains an AMP that identifies a systematic process for determining the effectiveness of the early phases of Core Program construction and the need for any revisions to the Orleans CWMP before initiating later Core Program construction phases. The AMP includes a Groundwater and Surface Water Quality Monitoring Plan that identifies specific annual water quality monitoring activities to be completed by the Town for the Tri-Town Site area, sensitive coastal embayments and select freshwater ponds in Orleans. The AMP requires the Town to coordinate its ongoing water quality monitoring activities with MassDEP, CCC, and the ongoing water quality monitoring and modeling activities in Orleans being carried out by MEP, the United States Geological Survey (USGS), the Pleasant Bay Alliance, the Orleans Ponds Coalition and the Orleans Marine and Fresh Water Quality Task Force.

The AMP also requires the Town to prepare an annual TMDL Compliance Report to document the reductions in watershed nitrogen loads achieved from the Town's phased sewer construction program. MassDEP will review the TMDL Compliance Report to determine the Town's compliance with the established TDMLs included in the Orleans CWMP. The TMDL Compliance Report will also be used to identify the need to make any adjustments or mid-course corrections to the Orleans CWMP prior to initiating the next phase of project construction. The annual TMDL Compliance Report will be distributed to MassDEP, CCC, MEP, local area watershed associations and representatives from neighboring towns.

Comments received from the Sierra Club, Clean Water Action and others have requested that the Orleans CWMP incorporate a monitoring program to identify the presence of contaminants of emerging concern (CECs) in wastewater flows and effluent discharges at the Orleans WWTF. According to MassDEP, no regulations or policies are in place to govern the monitoring or treatment of CECs at WWTFs as this issue is currently being studied by MassDEP, the US Environmental Protection Agency (EPA) and others. MassDEP has indicated that when such CEC policies and regulations are established, they could be included in the Town's AMP for the Orleans CWMP. I ask that the Town work closely with MassDEP to ensure that the final design of the Orleans WWTF may be modified in the future to accommodate potential future opportunities for CEC monitoring and treatment.

Wetlands and Waterways

Most of Orleans' proposed Core Program sewer construction project is located within existing roadway right-of-ways. According to the information provided in the SEIR, the Town's sewer project will not directly impact BVW resources. The Town has indicated that the Core Program sewer line routes and/or pumping station locations may encroach in the 100-foot buffers

of regulated wetland resource areas and result in impacts to wetland buffer zone area. Prior to construction of projects within the resource area buffer zones, the Town will apply for wetlands related permits, in accordance with MassDEP and the Orleans Conservation Commission regulations. I anticipate that the Town will continue to examine alternatives that avoid impacts to wetland resource areas, their associated buffer zones, riverfront protection areas, and 100-year flood plain areas during permit review.

According to the SEIR, the Core program construction activities will not be located within tidelands and will not require a Chapter 91 License from MassDEP. The project may be revised as it advances to final design and permitting. In the event the project undergoes further revisions that result in the alterations to tidelands, the Town will need to contact the MEPA Office to determine if further MEPA review is required to address impacts to waterways and tidelands and if a Public Benefits Determination will be required.

Rare Species

As described in the SEIR, the Tri-Town Septage Treatment Facility site, is located within Priority Habitat for the Eastern Box Turtle (*Terrapene carolina*), the Diamond-backed Terrapin (*Malaclemys terrapin*), Salt Reedgrass (*Spartina cynosuroides*) and Mitchell's Sedge (*Carex mitchelliana*). According to NHESP's previous comments on the EENF, the construction of the Orleans WWTF will occur within mapped habitat for the Eastern Box Turtle (Terrapene carolina). The Town, in consultation with NHESP, completed an evaluation of alternative site layouts for the Orleans WWTF facility. The SEIR includes a detailed description of the Town's revised site layout for the Orleans WWTF that locates the facility's rapid infiltration beds to the northern most portion of the site and maximize the reuse of existing disturbed areas and septage facility infrastructure for wastewater treatment. According to the Town, the revised site layout will result in the permanent alteration of approximately 4.9 acres of on-site habitat and will avoid fragmentation of undisturbed habitat areas within the proposed Orleans WWTF site to avoid a 'take' of the Eastern Box Turtle. NHESP's comments on the SEIR indicate that the construction of the Orleans WWTF will create temporary disturbances from site grading and may result in more than 5 acres of impact to mapped habitat for the Eastern Box Turtle. NHESP anticipates that the Town may be able to further reduce the projects temporary impacts to habitat by revising the project's proposed site grading and re-vegetation plans.

I ask that the Town continue to work closely with NHESP and consult with the Orleans Conservation Commission during the final CWMP project design and for each phase of Core Program construction to identify necessary construction and post-construction conditions and commitments to avoid adverse impacts to resource area habitats for state-listed species that may be located within and adjacent to the Orleans WWTF site, the five local cluster system project sites and the Core program sewer collection area.

Historical/Archeological Resources

As described in the SEIR, portions of the Core Program's sewer construction work are located within the Old King's Highway Regional Historical District (OKHRHD). The Town has committed to design and construct above ground sewer pump stations located within the OKHRHD with appropriate architectural features consistent with OKHRHD standards. According to the Town, the proposed cluster wastewater treatment systems may also be located within or adjacent to areas where archaeological resources may be present. The Town has committed to complete a reconnaissance archeological survey for each of these cluster site locations. MHC recommends that the Town submit to MHC for review and comment detailed project plans for Core Program construction phase as they may become available. Detailed project plans for Core Program construction phase should also be submitted to the OKHRHD for review and comment I ask that the Town continue to work closely with MHC during final project design and prior to each successive sewer construction phase to identify opportunities to avoid, minimize and mitigate project construction impacts to historic and archeological resources in the project area.

Greenhouse Gas Emissions (GHG)

The project requires an EIR and therefore is subject to the requirements of the MEPA Greenhouse Gas Emissions Policy and Protocol ("the Policy"): http://www.mass.gov/envir/mepa/downloads/GHGPolicyRev1108.pdf . The policy requires project proponents to quantify the direct and indirect CO_2 emissions from the proposed project, including CO_2 emissions associated with the buildings & plant operations, and to compare those emissions to a project baseline, which includes no-build conditions as well as an assessment of the emissions associated with the current effective building code ("base case").

In this instance, the Town consulted with MassDEP, DOER and EPA and developed a "base case WWTF" using GHG emissions data obtained from EPA's Energy Star Portfolio Manager database for comparable WWTFs having similarly sized treatment capacities, wastewater nutrient loads and seasonal demand fluctuations. The Town's estimated GHG emissions for the Base Case WWTF is approximately 900 tons of carbon dioxide per year (CO_2/yr). The SEIR presented an evaluation of 20 GHG reduction mitigation measures associated with wastewater treatment processing, building systems and facility operation and management. The Town has committed to incorporate a number of GHG reduction measures related to Building and Process systems for the Orleans WWTF that will result in a reduction of approximately 64 tons CO_2/yr from the Base Case WWTF, a reduction of approximately 6 percent. Comments received from the Department of Energy Resources (DOER) indicate that even greater reductions may be achieved by through the use of alternative nitrogen demand technology. I encourage the Town to

consider DOER's comments. The Town also identified 11 additional GHG reduction measures including the use of on-site renewable energy (solar photovoltaic (PV), Wind Turbine) that the Town has committed to further explore during final design of the Orleans WWTF. As described in the SEIR, these 11 additional GHG reduction measures could result in a reduction of approximately 309 tons CO_2/yr (34.3%) from the Base Case WWTF. The Town should commit to continue to work closely with MassDEP and DOER during final WWTF design and permitting to identify and incorporate appropriate energy efficiency measures into the buildings, treatment processes and operations for the Orleans WWTF. MassDEP has indicated that it will work with the Town to incorporate these GHG reduction measures through its project financing and permitting authority. Upon completion of the construction of the Orleans WWTF, the Town should provide a certification to the MEPA Office signed by an appropriate professional (e.g., engineer, architect, general contractor) indicating that the all of the GHG mitigation measures committed to by the Town as described in the SEIR and this section of the Certificate that collectively will reduce Building and Process systems GHG Emissions for the proposed project by at least 6 percent have been incorporated into the Orleans WWTF project. This certification should be supported by as-built plans. For those measures that are operational in nature (i.e. TDM, recycling) the Town should provide an updated plan identifying the measures, the schedule for implementation and how progress towards achieving the measures will be obtained. MassDEP should incorporate this self-certification requirement into its Section 61 finding for this project.

Sewering and Growth Management

The SEIR includes a discussion of potential land use control mechanisms to limit unwanted secondary growth related to the construction of the Town's Core Program sewer project. The Orleans Board of Health adopted its Nutrient Management Regulation in 2008 restricting wastewater flow to 110 gpd per 10,000 sf of lot area for new development or expansion of existing development. The Town is proposing to implement a 'flow-neutral' Sewer Use Regulation to be administered through the Orleans Board of Health, which would limit the redevelopment of existing properties by restricting the amount of additional wastewater flow/nitrogen load from the redeveloped property to the amount of wastewater flow from the property to what is allowed under Title 5 and local zoning. The Town is also proposing to adopt Section 1A of the Chapter 83 of the Massachusetts General Laws to enable the Town to implement a "checkerboard" sewer connection bylaw that will allow the Town to select specific lots that will be connected to the municipal sewer system and lots that do not need sewering and therefore will not be allowed to connect to the new sewer system. Lastly, the Town is also considering implementing an accelerated program of open space acquisition in nitrogen-sensitive watersheds to avoid the potential nitrogen loads from the future development of these currently undeveloped properties. The Town should adopt and implement any proposed growth by-laws, regulations, and policies prior to the construction of any new sewers.

Costs to Homeowners

As described in the SEIR/Final CWMP, the Core Program will be constructed in six phases over 15-20 years and will have an estimated capitol cost of approximately $150,000,000. The estimated operation and maintenance (O&M) costs for the Core Program total approximately $1.4 million dollars. According to the Town, construction of the Expanded Program to extend the new centralized sewer system to the remaining properties located outside of the Core program area will cost an additional $96,000,000 in capital costs. The Town proposes to recover 80% of the project's municipal debt service through user and non-user property taxation and 20% through betterment assessments to be paid by users of the sewer system. The SEIR provides average cost estimates (capital and O&M) for households connected to the Core Program sewer system ($2,592.00) and those households not connected to the Core Program sewer system ($2,544.00). According to the information provided in the SEIR, the proposed Core Program of new sewer construction may qualify for available state and/or federal loan and grant assistance including the State Revolving Fund (SRF) and the US Department of Agriculture's Rural Development Grant program thereby reducing the average cost estimates (capital and O&M) for households connected to the Core Program sewer system from $2,592.00 to $1,692.00 and those households not connected to the Core Program sewer system from $2,544.00 to $1,965.00.

Future Sewer Expansion

The Town's Core Program sewer collection system has been designed to accommodate larger wastewater flows associated with the potential future expansion of new sewers to the entire Town of Orleans (Expanded Program) and/or additional wastewater flows from the neighboring towns of Eastham and Brewster (Regional Program).

Expanded Program

Under the Expanded Program, new sewers would be extended to all of the Town of Orleans and would result in the collection and conveyance of a total of 1.14 MGD of wastewater from 5,300 individual properties for treatment at the Orleans WWTF. As mentioned elsewhere in this Certificate, additional wastewater disposal sites and/or treated effluent reuse options may be required to accommodate the disposal of the Expanded Program wastewater flows.

Regional Program

The SEIR includes a detailed discussion of potential regional approaches to address the wastewater treatment and disposal needs for the Towns of Orleans, Eastham and Brewster, and the regional issues pertaining to nutrient loading, wastewater treatment and disposal affecting the Nauset Marsh/Town Cove and Pleasant Bay coastal embayments.

According to the comments received from the Town of Eastham, Eastham recently completed its wastewater planning study and identified as its preferred alternative a regional wastewater treatment option with the Town of Orleans involving the conveyance of a portion of Eastham's wastewater flows from the Nauset/Town Cove/Rock Harbor Watersheds to the Orleans WWTF for treatment and disposal. The Town of Eastham has expressed an interest in working with the Town of Orleans to identify opportunities for constructing its sewer connection to the Orleans WWTF in the early phases of Orleans' Core Program construction.

The SEIR indentifies a number of options for a regional wastewater treatment approach with the Town of Brewster including the conveyance of a portion of Brewster's wastewater flows from the Pleasant Bay Watershed to the Orleans WWTF for treatment and disposal and/or locating a new satellite WWTF in the Town of Brewster to treat a portion of Orleans' and Brewster' wastewater flows from the Pleasant Bay Watershed. As described in the comments received from the Town of Brewster on the SEIR, Brewster has recently initiated efforts to complete an Integrated Water Resources Management Plan. As part of its planning process, the Town of Brewster has expressed a desire to continue to work with the Town of Orleans, MassDEP and others to address regional water and wastewater management issues affecting their shared watersheds and coastal embayments.

I ask the Towns of Orleans, Eastham and Brewster work closely together with MassDEP and CCC and others including the Pleasant Bay Resource Management Alliance and the Cape Cod Water Protection Collaborative to continue the discussion of possible opportunities to integrate the Town of Orleans' wastewater treatment planning efforts with the water and wastewater management planning efforts being undertaken by the Towns of Eastham and Brewster.

Construction Impacts

The construction period will be the major source of impacts from the project, including impacts from earth moving, impacts to vegetation, potential impacts from erosion and sedimentation, traffic impacts on adjacent roadways, and impacts to adjacent land uses. Construction period impacts and mitigation measures have been described in the SEIR, including impacts from noise and dust, impacts on trees and other vegetation, and traffic impacts. This section of the SEIR includes a discussion of measures that will be taken by the Town to minimize and mitigate construction period impacts (in particular impacts on sensitive receptors or exceptional resources). Given the availability of Ultra Low Sulfur Diesel (ULSD) fuel and the requirements for off-road engines in 2010, the construction equipment for the project should operate on ULSD fuel to reduce emissions of fine particulate matter. The Town should consult with MassDEP to discuss additional construction period diesel mitigation measures. I strongly encourage the Town to commit to using lower emission equipment in addition to requiring its contractors to retrofit diesel-powered equipment with emissions controls, such as particulate filters or traps, and use low-sulfur diesel fuel. The Town should require its contractors to use

On-Road Low Sulfur Diesel (LSD) fuel in their off-road construction equipment which can increase the removal of particulate matter (PM) by approximately 25% beyond that which can be removed by retrofitting diesel-powered equipment. All construction-related refueling and equipment maintenance activities should be conducted under cover on impervious surface areas with containment, and outside of any wetlands resource areas, endangered species habitat areas, residential areas and wellhead protection areas.

The Town should develop and enforce a spills contingency plan to address potential releases of oil and/or hazardous materials from pre and post construction activities as recommended by MassDEP. To the extent feasible, existing access routes within the ROW will be used for construction access. In areas where access roads do not exist, the Proponent will construct temporary access roads along existing land contours to minimize grading requirements for construction vehicle access. Best Management Practices (BMPs) that will be implemented during construction include the use of swamp mats and erosion control barriers, and a Stormwater Pollution Prevention Plan.

Mitigation and Section 61 Findings

The SEIR includes a separate chapter on mitigation measures and proposed Section 61 Findings for all state permits and approvals required for the project. This section of the SEIR provides a description of the Town's proposed mitigation plan, and discusses the value of the proposed mitigation in terms of the resources it provides and the opportunities for open space protection, and active and/or passive recreation it affords. Final Section 61 Findings will be prepared by state agencies issuing permits for this project and will include conditions considered binding upon the Proponent as mitigation commitments. State agencies and the Town should forward final copies of Section 61 Findings to the MEPA Office for the project file and for notice in the Environmental Monitor. I ask the Town to continue to work closely with MassDEP, CCC and the Pleasant Bay Resource Management Alliance to design and implement a sustainable Comprehensive Wastewater Facilities Plan and mitigation plan for the Town of Orleans that will help to offset the proposed project's municipal sewering impacts.

Conclusion

After a thorough consideration of the comments received from MassDEP and others, I am satisfied that any outstanding design issues relating to sewer layout and construction phasing will be fully considered and addressed during state and local permitting. As noted elsewhere in this Certificate, the Town should continue to work closely with MassDEP, NHESP and MHC during final project design.

January 28, 2011
DATE

Richard K. Sullivan, Jr., Secretary

Comments received:

01/19/11 Division of Marine Resources (DMF)
01/19/11 Pleasant bay Resource Management Alliance
01/19/11 Town of Brewster
01/19/11 Mary Hartley
01/20/11 Cape Cod Commission (CCC)
01/20/11 David Farquhar
01/20/11 Department of Energy Resources (DOER)
01/20/11 Kevin H. Cassidy
01/20/11 Beverly M. Carney
01/21/11 MA Department of Environmental Protection (MassDEP) – SERO
01/21/11 Sierra Club, Cape Cod and the Islands
01/21/11 Alan McClennen, Jr. FAICP
01/21/11 Beverly M. Carney
01/21/11 Ben A. Buck
01/21/11 Clean Water Action
01/21/11 Brian and Judy Embleton
01/21/11 Victoria L. Reis
12/22/11 Massachusetts Historical Commission (MHC)
01/25/11 Town of Eastham
01/27/11 Natural Heritage & Endangered Species Program (NHESP)

SEIR #14414
RKS, Jr./NZ/nz

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Orleans, MA - Conservation Commission - Order of Conditions

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Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP: 054-2596
MassDEP File #

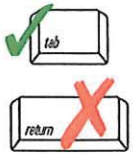
eDEP Transaction #

Orleans
City/Town

A. General Information

Please note: this form has been modified with added space to accommodate the Registry of Deeds Requirements

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



1. From: Orleans
   Conservation Commission

2. This issuance is for (check one): a. ☒ Order of Conditions b. ☐ Amended Order of Conditions

3. To: Applicant:

John	Kelly
a. First Name	b. Last Name

Town of Orleans
c. Organization

19 School Rd
d. Mailing Address

Orleans	MA	02653
e. City/Town	f. State	g. Zip Code

4. Property Owner (if different from applicant):

a. First Name	b. Last Name

Town of Orleans
c. Organization

19 School Rd
d. Mailing Address

Orleans	MA	02653
e. City/Town	f. State	g. Zip Code

5. Project Location:

Multiple streets & locations (see approved plans)	Orleans
a. Street Address	b. City/Town
c. Assessors Map/Plat Number	d. Parcel/Lot Number

Latitude and Longitude, if known:

1070739.707614	2746522.1256299
d. Latitude	e. Longitude

A. General Information (cont.)

6. Property recorded at the Registry of Deeds for (attach additional information if more than one parcel):

Barnstable
a. County

b. Certificate Number (if registered land)

c. Book

d. Page

7. Dates: Sep 30, 2022 (a. Date Notice of Intent Filed) | Oct 18, 2022 (b. Date Public Hearing Closed) | Oct 19, 2022 (c. Date of Issuance)

8. Final Approved Plans and Other Documents (attach additional plan or document references as needed):

Notice of Intent - Meetinghouse Pond Area Collection System and Pumping Station
a. Plan Title

AECOM
b. Prepared By

c. Signed and Stamped by

Sep 01, 2022
d. Final Revision Date

Variable, as noted
e. Scale

f. Additional Plan or Document Title

g. Date

B. Findings

1. Findings pursuant to the Massachusetts Wetlands Protection Act:

Following the review of the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Act (the Act). Check all that apply:

[X]	a. Public Water Supply	[ ]	b. Land Containing Shellfish	[X]	c. Prevention of Pollution
[X]	d. Private Water Supply	[ ]	e. Fisheries	[ ]	f. Protection of Wildlife Habitat
[X]	g. Groundwater Supply	[ ]	h. Storm Damage Prevention	[ ]	i. Flood Control

2. This Commission hereby finds the project, as proposed, is: (check one of the following boxes)

Approved subject to:

[X] a. the following conditions which are necessary in accordance with the performance standards set forth in the wetlands regulations. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

B. Findings (cont.)

Denied because:

☐ b. the proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect the interests of the Act, and a final Order of Conditions is issued. A description of the performance standards which the proposed work cannot meet is attached to this Order.

☐ c. the information submitted by the applicant is not sufficient to describe the site, the work, or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the Act's interests, and a final Order of Conditions is issued. A description of the specific information which is lacking and why it is necessary is attached to this Order as per 310 CMR 10.05(6)(c)

☒ 3. Buffer Zone Impacts: Shortest distance between limit of project disturbance and the wetland resource area specified in 310 CMR 10.02(1) — <1' a. linear feet

Inland Resource Area Impacts: Check all that apply below. (For Approvals Only)

Resource Area	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
☐ 4. Bank	a. linear feet	b. linear feet	c. linear feet	d. linear feet
☐ 5. Bordering Vegetated Wetland	a. square feet	b. square feet	c. square feet	d. square feet
☐ 6. Land Under Waterbodies and Waterways	a. square feet	b. square feet	c. square feet	d. square feet
	e. c/y dredged	f. c/y dredged		
☐ 7. Bordering Land Subject to Flooding	a. square feet	b. square feet	c. square feet	d. square feet
Cubic Feet Flood Storage	e. cubic feet	f. cubic feet	g. cubic feet	h. cubic feet
☐ 8. Isolated Land Subject to Flooding	a. square feet	b. square feet		
Cubic Feet Flood Storage	c. cubic feet	d. cubic feet	e. cubic feet	f. cubic feet
☐ 9. Riverfront Area	a. total sq. feet	b. total sq. feet		
Sq ft within 100 ft	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft	g. square feet	h. square feet	i. square feet	j. square feet

B. Findings (cont.)

Coastal Resource Area Impacts: Check all that apply below. (For Approvals Only)

		Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
☐	10. Designated Port Areas	Indicate size under Land Under the Ocean, below			
☐	11. Land Under the Ocean	a. square feet	b. square feet		
		c. c/y dredged	d. c/y dredged		
☐	12. Barrier Beaches	Indicate size under Coastal Beaches and/or Coastal Dunes below			
☐	13. Coastal Beaches	a. square feet	b. square feet	c. nourishment cu yd	d. nourishment cu yd
☐	14. Coastal Dunes	a. square feet	b. square feet	c. nourishment cu yd	d. nourishment cu yd
☒	15. Coastal Banks	1,580 a. linear feet	1,580 b. linear feet		
☐	16. Rocky Intertidal Shores	a. square feet	b. square feet		
☐	17. Salt Marshes	a. square feet	b. square feet	c. square feet	d. square feet
☐	18. Land Under Salt Ponds	a. square feet	b. square feet		
		c. c/y dredged	d. c/y dredged		
☐	19. Land Containing Shellfish	a. square feet	b. square feet	c. square feet	d. square feet
☐	20. Fish Runs	Indicate size under Coastal Banks, Inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above			
		a. c/y dredged	b. c/y dredged		
☒	21. Land Subject to Coastal Storm Flowage	23,000 a. square feet	23,000 b. square feet		
☐	22. Riverfront Area	a. total sq. feet	b. total sq. feet		
	Sq ft within 100ft	c. square feet	d. square feet	e. square feet	f. square feet
	Sq ft between 100-200 ft	g. square feet	h. square feet	i. square feet	j. square feet

B. Findings (cont.)

* **#23.** If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.5.c (BVW) or B.17.c (Salt Marsh) above, please enter the additional amount here.

☐ 23. Restoration/Enhancement *:

a. square feet of BVW

b. square feet of salt marsh

☐ 24. Stream Crossing(s):

a. number of new stream crossings

b. number of replacement stream crossings

C. General Conditions Under Massachusetts Wetlands Protection Act

The following conditions are only applicable to Approved projects.

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.
2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.
3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.
4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
   a. The work is a maintenance dredging project as provided for in the Act; or
   b. The time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.
   c. If the work is for a Test Project, this Order of Conditions shall be valid for no more than one year.
5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order. An Order of Conditions for a Test Project may be extended for one additional year only upon written application by the applicant, subject to the provisions of 310 CMR 10.05(11)(f).
6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not extend the issuance date of the original Final Order of Conditions and the **Order will expire on Oct 19, 2025** unless extended in writing by the Department.
7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.

C. General Conditions Under Massachusetts Wetlands Protection Act

8. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.

9. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to the Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work.

10. A sign shall be displayed at the site not less than two square feet or more than three square feet in size bearing the words,

"Massachusetts Department of Environmental Protection" [or, "MassDEP"]

"File Number 054-2596 "

11. Where the Department of Environmental Protection is requested to issue a Superseding Order, the Conservation Commission shall be a party to all agency proceedings and hearings before MassDEP.

12. Upon completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance (WPA Form 8A) to the Conservation Commission.

13. The work shall conform to the plans and special conditions referenced in this order.

14. Any change to the plans identified in Condition #13 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.

15. The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.

16. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.

C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

17. Prior to the start of work, and if the project involves work adjacent to a Bordering Vegetated Wetland, the boundary of the wetland in the vicinity of the proposed work area shall be marked by wooden stakes or flagging. Once in place, the wetland boundary markers shall be maintained until a Certificate of Compliance has been issued by the Conservation Commission.

18. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the applicant or his/her designee shall inspect the erosion controls on a daily basis and shall remove accumulated sediments as needed. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

19. The work associated with this Order (the "Project")

[X] (1) is subject to the Massachusetts Stormwater Standards

[ ] (2) is NOT subject to the Massachusetts Stormwater Standards

If the work is subject to the Stormwater Standards, then the project is subject to the following conditions:

a) All work, including site preparation, land disturbance, construction and redevelopment, shall be implemented in accordance with the construction period pollution prevention and erosion and sedimentation control plan and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollution Discharge Elimination System Construction General Permit as required by Stormwater Condition 8. Construction period erosion, sedimentation and pollution control measures and best management practices (BMPs) shall remain in place until the site is fully stabilized.

b) No stormwater runoff may be discharged to the post-construction stormwater BMPs unless and until a Registered Professional Engineer provides a Certification that:

i. all construction period BMPs have been removed or will be removed by a date certain specified in the Certification. For any construction period BMPs intended to be converted to post construction operation for stormwater attenuation, recharge, and/or treatment, the conversion is allowed by the MassDEP Stormwater Handbook BMP specifications and that the BMP has been properly cleaned or prepared for post construction operation, including removal of all construction period sediment trapped in inlet and outlet control structures;

ii. as-built final construction BMP plans are included, signed and stamped by a Registered Professional Engineer, certifying the site is fully stabilized;

iii. any illicit discharges to the stormwater management system have been removed, as per the requirements of Stormwater Standard 10;

C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

iv. all post-construction stormwater BMPs are installed in accordance with the plans (including all planting plans) approved by the issuing authority, and have been inspected to ensure that they are not damaged and that they are in proper working condition;

v. any vegetation associated with post-construction BMPs is suitably established to withstand erosion.

c) The landowner is responsible for BMP maintenance until the issuing authority is notified that another party has legally assumed responsibility for BMP maintenance. Prior to requesting a Certificate of Compliance, or Partial Certificate of Compliance, the responsible party (defined in General Condition 18(e)) shall execute and submit to the issuing authority an Operation and Maintenance Compliance Statement ("O&M Statement) for the Stormwater BMPs identifying the party responsible for implementing the stormwater BMP Operation and Maintenance Plan ("O&M Plan") and certifying the following:

i.) the O&M Plan is complete and will be implemented upon receipt of the Certificate of Compliance, and

ii.) the future responsible parties shall be notified in writing of their ongoing legal responsibility to operate and maintain the stormwater management BMPs and implement the Stormwater Pollution Prevention Plan.

d) Post-construction pollution prevention and source control shall be implemented in accordance with the long-term pollution prevention plan section of the approved Stormwater Report and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollution Discharge Elimination System Multi-Sector General Permit.

e) Unless and until another party accepts responsibility, the landowner, or owner of any drainage easement, assumes responsibility for maintaining each BMP. To overcome this presumption, the landowner of the property must submit to the issuing authority a legally binding agreement of record, acceptable to the issuing authority, evidencing that another entity has accepted responsibility for maintaining the BMP, and that the proposed responsible party shall be treated as a permittee for purposes of implementing the requirements of Conditions 18(f) through 18(k) with respect to that BMP. Any failure of the proposed responsible party to implement the requirements of Conditions 18(f) through 18(k) with respect to that BMP shall be a violation of the Order of Conditions or Certificate of Compliance. In the case of stormwater BMPs that are serving more than one lot, the legally binding agreement shall also identify the lots that will be serviced by the stormwater BMPs. A plan and easement deed that grants the responsible party access to perform the required operation and maintenance must be submitted along with the legally binding agreement.

f) The responsible party shall operate and maintain all stormwater BMPs in accordance with the design plans, the O&M Plan, and the requirements of the Massachusetts Stormwater Handbook.

C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

g) The responsible party shall:
1. Maintain an operation and maintenance log for the last three (3) consecutive calendar years of inspections, repairs, maintenance and/or replacement of the stormwater management system or any part thereof, and disposal (for disposal the log shall indicate the type of material and the disposal location);
2. Make the maintenance log available to MassDEP and the Conservation Commission ("Commission") upon request; and
3. Allow members and agents of the MassDEP and the Commission to enter and inspect the site to evaluate and ensure that the responsible party is in compliance with the requirements for each BMP established in the O&M Plan approved by the issuing authority.

h) All sediment or other contaminants removed from stormwater BMPs shall be disposed of in accordance with all applicable federal, state, and local laws and regulations.

i) Illicit discharges to the stormwater management system as defined in 310 CMR 10.04 are prohibited.

j) The stormwater management system approved in the Order of Conditions shall not be changed without the prior written approval of the issuing authority.

k) Areas designated as qualifying pervious areas for the purpose of the Low Impact Site Design Credit (as defined in the MassDEP Stormwater Handbook, Volume 3, Chapter 1, Low Impact Development Site Design Credits) shall not be altered without the prior written approval of the issuing authority.

l) Access for maintenance, repair, and/or replacement of BMPs shall not be withheld. Any fencing constructed around stormwater BMPs shall include access gates and shall be at least six inches above grade to allow for wildlife passage.

Special Conditions (if you need more space for additional conditions, please attach a text document):

This Order is subject to the Standard Conditions on all Orders dated 11/1/18 and the completion of the Acknowledgment of Contractor Form.

20. For Test Projects subject to 310 CMR 10.05(11), the applicant shall also implement the monitoring plan and the restoration plan submitted with the Notice of Intent. If the conservation commission or Department determines that the Test Project threatens the public health, safety or the environment, the applicant shall implement the removal plan submitted with the Notice of Intent or modify the project as directed by the conservation commission or the Department.

D. Findings Under Municipal Wetlands Bylaw or Ordinance

1. Is a municipal wetlands bylaw or ordinance applicable? ☒ Yes ☐ No

2. The Town of Orleans hereby finds (check one that applies):
   Conservation Commission

   ☐ a. that the proposed work cannot be conditioned to meet the standards set forth in a municipal ordinance or bylaw, specifically:

   _____ _____
   1. Municipal Ordinance or Bylaw 2. Citation

   Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides measures which are adequate to meet these standards, and a final Order of Conditions is issued.

   ☒ b. that the following additional conditions are necessary to comply with a municipal ordinance or bylaw:

   Orleans Wetlands Bylaw/Regulations Ch 160/196A
   1. Municipal Ordinance or Bylaw 2. Citation

3. The Commission orders that all work shall be performed in accordance with the following conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.

   The special conditions relating to municipal ordinance or bylaw are as follows (if you need more space for additional conditions, attach a text document):

   This Order is subject to the Standard Conditions on all Orders dated 11/1/18 and the completion of the Acknowledgment of Contractor Form:

E. Signatures

This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.

10/19/22
1. Date of Issuance

Please indicate the number of members who will sign this form.
This Order must be signed by a majority of the Conservation Commission.

6
2. Number of Signers

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate Department of Environmental Protection Regional Office, if not filing electronically, and the property owner, if different from applicant.

Signatures:

☒ by hand delivery on
10/19/22
Date

☐ by certified mail, return receipt requested, on
Date

F. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate MassDEP Regional Office to issue a Superseding Order of Conditions. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Any appellants seeking to appeal the Department's Superseding Order associated with this appeal will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order, or providing written information to the Department prior to issuance of a Superseding Order.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40), and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal ordinance or bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

G. Recording Information

Prior to commencement of work, this Order of Conditions must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Conditions. The recording information on this page shall be submitted to the Conservation Commission listed below.

Orleans
Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Orleans
Conservation Commission

Please be advised that the Order of Conditions for the Project at:

Project Location: _____ MassDEP File Number: 054-2596

Has been recorded at the Registry of Deeds of:

Barnstable (County) _____ (Book) _____ (Page)

for: Town of Orleans
Property Owner

and has been noted in the chain of title of the affected property in:

Book: _____ Page: _____

In accordance with the Order of Conditions issued on:

Date: _____

If recorded land, the instrument number identifying this transaction is:

Instrument Number: _____

If registered land, the document number identifying this transaction is:

Document Number: _____

Signature of Applicant: _____

FINDINGS AND STANDARD CONDITIONS ON ALL ORDERS, AS APPLICABLE
In accordance with M.G.L. Chapter 131, Section 40 and the Orleans Wetlands Protection Bylaw, Ch160

DEP #: 054-2596
Applicant: John Kelly

The Commission finds that, the Applicant, through the Public Hearing, has presented to the Commission clear and convincing evidence and was able to demonstrate that all State and Local Wetland Interests will be protected, the Commission hereby approves the project with the issuance of this Order and all of its protective Conditions.

---

1. Preface: Failure to comply with all conditions of this Order of Conditions may result in the following: Stop Work Order, Fines, or the inability to obtain a Certificate of Compliance.

2. Recording: No work shall be undertaken until the Order has been recorded in compliance with General Condition #9 (page 6) of this Order and proof of such recording has been submitted to this Commission.

3. Acknowledgement of Contractor: No work may proceed until the Commission is provided with an executed Acknowledgement of Contractor form proving that these Orders have been reviewed and received by such Contractor and that the Contractor understands the Order and all Conditions. The Contractor shall furnish any sub-contractor with a copy of this Order. The approved Contractor must monitor their work throughout the project to ensure its success and establishment. If he/she is unable to continue with the project, the new contractor must meet with the Conservation Commission or their Administrator for approval before commencing work under the Order.

4. Other Permits: No work may proceed until the Applicant has received all other permits required by law, (i.e. building permit, Board of Health, Planning Board, Board of Appeals, Army Corps of Engineers, etc.)

5. Appeals: No work shall be undertaken until all administrative appeal periods from this Order have elapsed or, if such an appeal has been filed, until all appeal proceedings have been completed.

6. Transfer of Ownership: If the Applicant transfers the interests authorized herein by conveyance of realty, the deed shall reference this Order and the terms and Conditions specified herein, and this Order shall be recorded along with the deed.

7. Term: ***This Order is valid for three (3) years.*** Application for an Extension must be submitted, ***in writing, thirty (30) days prior to the date of its expiration.***

8. Certificae of Compliance: ***Upon completion of the work permitted by this Order, or the expiration of this Order, a Certificate of Compliance shall be requested from the Commission in writing.*** Where a project has been completed in accordance with plans stamped by a professional engineer, architect, or other qualified professional, a written statement by such professional certifying compliance with the plans and Orders, shall accompany the request for the Certificate of Compliance. Please note the request should accompany the appropriate completed DEP form and Town of Orleans fee.

9. Approved Plans: ***A copy of this Order of Conditions and all approved plans shall be kept on site at all times during construction.*** All contractors and sub-contractors retained during construction must be provided with a copy of this Order and subsequent plans by the Applicant and should be prepared to produce the Order along with approved plans and supporting documents, upon request of the Conservation Commission. ***No deviations from the plans are allowed herein without prior Commission approval.*** All notes on the approved plans herein are adopted as additional conditions of this Order unless otherwise stated, except that where the Commission's Orders are more restrictive, they shall apply.

10. DEP Signage: A visible sign shall be displayed at the site, not less than two (2) square feet or more than three (3) square feet in size bearing the words "Massachusetts Department of Environmental Protection SE 54-" or "MA DEP SE 54-". Said sign is to remain in place until a Certificate of Compliance has been issued.

11. Silt Fence: If need is determined by the Commission, a continuous, securely staked fabric sedimentation barrier or other erosion control measures shall be installed along the Limit of Work and/or the access route as shown on the approved plan. ***Five (5) days prior to construction, notice shall be given to the Conservation office that all sedimentation controls or other markings required by these Orders are in place and ready for inspection by the Conservation Administrator.*** Properly installed sedimentation controls shall remain in place and be maintained throughout construction until the site is stabilized with vegetation and its removal has been permitted by the Commission or its Administrator.
Additional erosion control measures may be required during construction activity, if needed, at the Commission or its Administrator's discretion.

12. Limit of Work: The Limit of Work as shown on the plan shall be clearly marked by stakes or by installation of a sedimentation barrier/silt fence, and be inspected and approved by the Commission or its Administrator prior to commencement of construction, and shall remain in place and in good order until all disturbed areas have been revegetated. ***No work shall take place within the buffer zone or resource area outside the Limit of Work as marked on the plan without further approval by the Commission or its Administrator.***

13. Excavated Materials: All excess excavated materials shall be stockpiled per approved plan and as far from the resource area as possible. Excess materials shall be removed from the site upon completion of grading/construction. In no event shall excavated materials or additional materials brought on the site be stock piled less than 25' from the edge of a wetland or resource area unless approved by the Commission for special purposes.

14. Fertilizer Use: No fertilizer is permitted within 100' of a Resource Area per Town of Orleans General By-Law Chapter 103. If lawn and/or shrub fertilizers are used, in accordance with the exemptions allowed under Chapter 103, extreme care must be exercised to avoid contamination into the wetlands or groundwater.

15. Roof Runoff: Gutters and downspouts to drywells, or stone trenches at the roof drip line, are to be utilized to contain roof runoff. Drywell capacity should be able to accommodate a 2" rainfall in a 24-hour period. The size and location of the drywells shall be identified on the plan.

16. Vegetation Mitigation: All areas disturbed during construction are to be revegetated with suitable native plant materials according to the approved plans. Revegetation shall commence immediately upon completion of construction, unless otherwise addressed by an approved land management or landscape plan, and is to be completed by the beginning of the first growing season following completion of construction. Planting plans must be completed as part of this Order. Plants will be placed to ensure good coverage for the type and size of plant. More plants may be required than are shown on the planting plan and plants installed will be maintained and replaced until they have survived. Said vegetation and plants shall be successfully established, through multiple growing seasons, before a Certificate of Compliance can be granted.

17. Right of Entry: The Conservation Commission and/or its Administrator shall have the right of entry, during the period of the open Order, to inspect the property to determine and evaluate compliance with the provisions of this Order.

18. Violations: Failure to comply with any Conditions set forth herein shall be deemed a violation and good cause, after notice and an opportunity to be heard, to revoke or modify this Order, to impose fines of up to $300 per day per violation, to impose a stop work Order, or to require mitigation or such other measures as are legally justified. ***Owners, contractors, and sub-contractors will be liable for any violation of these Orders.***

In issuing these Orders, the Commission has relied on the information and data provided by the Applicant. If, subsequent to the issuance of this Order, such information and data prove to be false, incomplete, or inaccurate, this Order may be modified or revoked in whole or in part and the Commission may institute appropriate legal proceedings.

Town of Orleans
Conservation Commission

Town Hall
19 School Road
Orleans, Massachusetts 02653-3699
t: (508) 240-3700 ext 2425
f: (508) 240-3388

APPLICANT: John Kelly

DEP #: 054-2596

Attn:Homeowner and Engineer:

The Standard Conditions on all Orders issued by the Conservation Commission make it clear that no deviations from the approved Plan are to be permitted without prior Commission approval and that a silt fence on the limit of work must remain securely staked and in **good condition** throughout the project. Failure to comply with these conditions will subject the homeowner and contractors to fines of $300 per day.

The purpose of this notice is to make sure that you, any subsequent owners, all engineers and all contractors are made aware of these conditions. The property owner will bear the ultimate responsibility for compliance, so please be sure that any deviations from approved Plans are brought to the attention of the Conservation Commission before any work commences.

Accordingly, your contractor(s) should read the statement below and return a signed copy of this notice to the Orleans Conservation Commission at the address shown above before any work on this project is undertaken.

Acknowledgment of Contractor(s):

I have read the attached Order of Conditions and noted Standard Condition #6, "No deviations from the Plan approved herein or from these Orders are permitted without prior Commission approval" and #9, "A continuous securely staked fabric sedimentation barrier or other erosion control measures shall be installed along this work limit or the access route as shown on the Plan."

Signed: _____

Name: _____

Address: _____

Phone #: _____

Date: _____

Notice of Intent

Meetinghouse Pond Area Collection System and Pumping Station

Orleans, Massachusetts

Submitted To:

Orleans Conservation Commission

Massachusetts Department of Environmental Protection – Southeast Region

Prepared For:
Town of Orleans

PLANS APPROVED by ORLEANS CONSERVATION COMMISSION
FILE # 54-2596
BY JF DATE 10/18/22
ENGINEER Jeew 10/18/22

Prepared by:
AECOM

September 2022

AECOM
250 Apollo Dr
Chelmsford, MA 01824
www.aecom.com

(978) 905-2100 tel
(978) 905-2101 fax

September 29th, 2022

John Jannell, Conservation Administrator
Town of Orleans Conservation Commission
Orleans Town Hall
19 School Road
Orleans, MA 02653

SUBJECT: NOTICE OF INTENT
Meetinghouse Pond Area Collection System and Pumping Station
Orleans, Massachusetts

Dear Mr. Jannell:

On behalf of our client, the Town of Orleans, AECOM respectfully submits the enclosed Notice of Intent (NOI) for the Meetinghouse Pond Area Collection System and Pumping Station Project. Per your instructions, we are enclosing 14 copies of the NOI including narrative, associated figures, and plans. We have also provided a digital copy and are concurrently notifying abutters by certified mail, return receipt requested.

The enclosed NOI regards installation of Meetinghouse Pond Area proposed gravity sewers, low-pressure sewers, and force main. A portion of the proposed sewers and force main are located within Coastal Bank, Land Subject to Coastal Storm Flowage, or buffer zones. No permanent impacts are anticipated as all work is proposed within paved or gravel roads, which will be restored to existing conditions after pipeline installation. Temporary impacts are unavoidable due to the need to locate the sewers at the low topographic point in the service area in order to collect sewage flow by gravity, and then convey it to the WWTP via a force main connecting to the previously installed Phase I collection system.

We look forward to discussing the project with the Conservation Commission members at the hearing on October 18th. If there are any questions or additional information needs prior to the hearing and site visit, please feel free to contact me at (978) 905-2968 or Jennifer.Doyle-Breen@AECOM.com.

Sincerely,

Jennifer Doyle-Breen
Associate Vice President
T: (978) 905-2968
E: jennifer.doyle-breen@aecom.com

AECOM

Enclosure

cc: MA DEP – Southeast Region (1 Copy via eDEP)
John Kelly, Town of Orleans
Thomas Parece, AECOM
Reggie Donoghue, AECOM
File (1 Copy)

Contents

- **WPA Form 3 – Notice of Intent**
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List of Attachments

Attachment A Locus Map and Environmental Constraints Maps

Attachment B Project Plans

Plans included with the NOI are listed below. All Plans were prepared by AECOM and dated August 12, 2022

- Sheet 202, Plan and Profile Sewer, Uncle Vick's Way
- Sheet 203, Plan and Profile Sewer, Monument Road
- Sheet 206, Plan and Profile Sewer, Finlay Road
- Sheet 207, Plan and Profile Sewer, Finlay Road

- Sheet 210, Plan and Profile Sewer, Lake Farm Lane
- Sheet 214, Plan and Profile Sewer, Main Street
- Sheet 215, Plan and Profile Sewer, Barley Neck Road
- Sheet 216, Plan and Profile Sewer, Pochet Road
- Sheet 217, Plan and Profile Sewer, Pochet Road
- Sheet 218, Plan and Profile Sewer, Pochet Road
- Sheet 220, Plan and Profile Sewer, Great Oak Road
- Sheet 221, Plan and Profile Sewer, Great Oak Road
- Sheet 223, Plan and Profile Sewer, Pine Ridge Lane & Oak Lane
- Sheet 224, Plan and Profile Sewer, Beach Road
- Sheet 226, Plan and Profile Sewer, Cole Place
- Sheet 228, Plan and Profile Sewer, Barley Neck Road
- Sheet 229, Plan and Profile Sewer, Barley Neck Road
- Sheet 230, Plan and Profile Sewer, Harveys Lane
- Sheet 231, Plan and Profile Sewer, River Road
- Sheet 232, Plan and Profile Sewer, River Road
- Sheet 233, Plan and Profile Sewer, River Road
- Sheet 236, Plan and Profile Sewer, Karen Way
- Sheet 238, Plan and Profile Sewer, Deerwood Lane
- Sheet 239, Plan and Profile Sewer, Loomis Lane
- Sheet 240, Plan and Profile Sewer, Loomis Lane
- Sheet 241, Plan and Profile Sewer, Manito Road
- Sheet 242, Plan and Profile Sewer, Cheney Road
- Sheet 243, Plan and Profile Sewer, Lewis Road
- Sheet 244, Plan and Profile Sewer, Grist Road
- Sheet 245, Plan and Profile Sewer, Mill Lane
- Sheet 246, Plan and Profile Sewer, Natural Drive
- Sheet 247, Plan and Profile Sewer, Larboard Lane
- Sheet 248, Plan and Profile Sewer, Cedar Way
- Sheet 249, Plan and Profile Sewer, High Tide Lane
- Sheet 250, Plan and Profile Sewer, Pond View Road
- Sheet 251, Plan and Profile Sewer, Windy Hill Lane
- Sheet 252, Plan and Profile Sewer, Nauset Farms Way
- Sheet 255, Plan and Profile Sewer, Off Main Street (191 Main Street)

- Sheet 257, Plan and Profile Sewer, Baxter Lane, 1 of 2
- Sheet 258, Plan and Profile Sewer, Baxter Lane, 2 of 2
- Sheet 259, Plan and Profile Sewer, Reverend Treat Road & Bayberry Way
- Sheet 260, Plan and Profile Sewer, Packet Landing
- Sheet 501, Details I
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- Sheet 503 Details III
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- Sheet 505, Details V
- Sheet 506, Details VI
- Sheet 507, Details VII
- Sheet 508, Details VIII
- Sheet 509, Details IX

Attachment C Wetland Data Sheets

Attachment D Property Owner and Abutter Information

Attachment E Stormwater Checklist

WPA Form 3 – Notice of Intent

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 3 – Notice of Intent

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

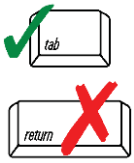
Provided by MassDEP:

MassDEP File Number

Document Transaction Number

City/Town

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



Note: Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

A. General Information

1. Project Location (**Note:** electronic filers will click on button to locate project site):

Multiple streets and locations — a. Street Address
Orleans — b. City/Town
02653 — c. Zip Code

Latitude and Longitude:
d. Latitude
e. Longitude

Please see Attachment D – property owner list — f. Assessors Map/Plat Number
multiple parcels — g. Parcel /Lot Number

2. Applicant:

John — a. First Name
Kelly — b. Last Name
Town of Orleans — c. Organization
19 School Road — d. Street Address
Orleans — e. City/Town
MA — f. State
02653 — g. Zip Code
(508) 240-3700 Ext. 415 — h. Phone Number
i. Fax Number
jkelly@town.orleans.ma.us — j. Email Address

3. Property owner (required if different from applicant): ☒ Check if more than one owner

a. First Name
b. Last Name
c. Organization
d. Street Address
e. City/Town
f. State
g. Zip Code
h. Phone Number
i. Fax Number
j. Email address

4. Representative (if any):

Jennifer — a. First Name
Doyle-Breen — b. Last Name
AECOM — c. Company
250 Apollo Drive — d. Street Address
Chelmsford — e. City/Town
MA — f. State
01824 — g. Zip Code
(978) 905-2968 — h. Phone Number
(978) 905-2102 — i. Fax Number
Jennifer.Doyle-Breen@aecom.com — j. Email address

5. Total WPA Fee Paid (from NOI Wetland Fee Transmittal Form):

Fee exempt - municipality — a. Total Fee Paid
b. State Fee Paid
c. City/Town Fee Paid

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 3 – Notice of Intent

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

City/Town

A. General Information (continued)

6. General Project Description:

The proposed project that includes the construction of service connections, a combination of gravity sewers and low-pressure sewers, a force main, and a sewage pumping station to service the Meetinghouse Pond area. Please see attached Project Narrative for further details.

7a. Project Type Checklist: (Limited Project Types see Section A. 7b.)

1. ☐ Single Family Home
2. ☐ Residential Subdivision
3. ☐ Commercial/Industrial
4. ☐ Dock/Pier
5. ☒ Utilities
6. ☐ Coastal engineering Structure
7. ☐ Agriculture (e.g., cranberries, forestry)
8. ☐ Transportation
9. ☐ Other

7b. Is any portion of the proposed activity eligible to be treated as a limited project (including Ecological Restoration Limited Project) subject to 310 CMR 10.24 (coastal) or 310 CMR 10.53 (inland)?

1. ☒ Yes ☐ No

If yes, describe which limited project applies to this project. (See 310 CMR 10.24 and 10.53 for a complete list and description of limited project types)

310 CMR 10.24(7)(b) and 10.53(3)(d): The construction, reconstruction, operation or maintenance of sewer lines.

If the proposed activity is eligible to be treated as an Ecological Restoration Limited Project (310 CMR10.24(8), 310 CMR 10.53(4)), complete and attach Appendix A: Ecological Restoration Limited Project Checklist and Signed Certification.

8. Property recorded at the Registry of Deeds for:

a. County	b. Certificate # (if registered land)
Barnstable	
c. Book	**d. Page Number**
Please see Attachment D	

B. Buffer Zone & Resource Area Impacts (temporary & permanent)

1. ☐ Buffer Zone Only – Check if the project is located only in the Buffer Zone of a Bordering Vegetated Wetland, Inland Bank, or Coastal Resource Area.
2. ☐ Inland Resource Areas (see 310 CMR 10.54-10.58; if not applicable, go to Section B.3, Coastal Resource Areas).

Check all that apply below. Attach narrative and any supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

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Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:

MassDEP File Number

Document Transaction Number

City/Town

B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

For all projects affecting other Resource Areas, please attach a narrative explaining how the resource area was delineated.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Bank	1. linear feet	2. linear feet
b. ☐ Bordering Vegetated Wetland	1. square feet	2. square feet
c. ☐ Land Under Waterbodies and Waterways	1. square feet 3. cubic yards dredged	2. square feet

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
d. ☐ Bordering Land Subject to Flooding	1. square feet	2. square feet
	3. cubic feet of flood storage lost	4. cubic feet replaced
e. ☐ Isolated Land Subject to Flooding	1. square feet	
	2. cubic feet of flood storage lost	3. cubic feet replaced
f. ☐ Riverfront Area	1. Name of Waterway (if available) - **specify coastal or inland**	

2. Width of Riverfront Area (check one):

   ☐ 25 ft. - Designated Densely Developed Areas only

   ☐ 100 ft. - New agricultural projects only

   ☐ 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project: _____ square feet

4. Proposed alteration of the Riverfront Area:

   a. total square feet _____ b. square feet within 100 ft. _____ c. square feet between 100 ft. and 200 ft. _____

5. Has an alternatives analysis been done and is it attached to this NOI? ☐ Yes ☐ No

6. Was the lot where the activity is proposed created prior to August 1, 1996? ☐ Yes ☐ No

3. ☒ Coastal Resource Areas: (See 310 CMR 10.25-10.35)

Note: for coastal riverfront areas, please complete **Section B.2.f**. above.

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B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

Check all that apply below. Attach narrative and supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below	
b. ☐ Land Under the Ocean	1. square feet 2. cubic yards dredged	
c. ☐ Barrier Beach	Indicate size under Coastal Beaches and/or Coastal Dunes below	
d. ☐ Coastal Beaches	1. square feet	2. cubic yards beach nourishment
e. ☐ Coastal Dunes	1. square feet	2. cubic yards dune nourishment

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
f. ☒ Coastal Banks	1580 1. linear feet	
g. ☐ Rocky Intertidal Shores	1. square feet	
h. ☐ Salt Marshes	1. square feet	2. sq ft restoration, rehab., creation
i. ☐ Land Under Salt Ponds	1. square feet 2. cubic yards dredged	
j. ☐ Land Containing Shellfish	1. square feet	
k. ☐ Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above 1. cubic yards dredged	
l. ☒ Land Subject to Coastal Storm Flowage	23,000 1. square feet	

4. ☐ Restoration/Enhancement
If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.2.b or B.3.h above, please enter the additional amount here.

a. square feet of BVW

b. square feet of Salt Marsh

5. ☐ Project Involves Stream Crossings

a. number of new stream crossings

b. number of replacement stream crossings

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C. Other Applicable Standards and Requirements

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section C and complete Appendix A: Ecological Restoration Limited Project Checklists – Required Actions (310 CMR 10.11).

Streamlined Massachusetts Endangered Species Act/Wetlands Protection Act Review

1. Is any portion of the proposed project located in **Estimated Habitat of Rare Wildlife** as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP)? To view habitat maps, see the *Massachusetts Natural Heritage Atlas* or go to http://maps.massgis.state.ma.us/PRI_EST_HAB/viewer.htm.

   a. ☐ Yes ☐ No

   If yes, include proof of mailing or hand delivery of NOI to:

   Natural Heritage and Endangered Species Program
   Division of Fisheries and Wildlife
   1 Rabbit Hill Road
   Westborough, MA 01581

   August 2021
   b. Date of map

   If *yes*, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18). To qualify for a streamlined, 30-day, MESA/Wetlands Protection Act review, please complete Section C.1.c, and include requested materials with this Notice of Intent (NOI); *OR* complete Section C.2.f, if applicable. *If MESA supplemental information is not included with the NOI, by completing Section 1 of this form, the NHESP will require a separate MESA filing which may take up to 90 days to review (unless noted exceptions in Section 2 apply, see below).*

   c. Submit Supplemental Information for Endangered Species Review*

      1. ☐ Percentage/acreage of property to be altered:

         (a) within wetland Resource Area _____ percentage/acreage

         (b) outside Resource Area _____ percentage/acreage

      2. ☐ Assessor's Map or right-of-way plan of site

2. ☐ Project plans for entire project site, including wetland resource areas and areas outside of wetlands jurisdiction, showing existing and proposed conditions, existing and proposed tree/vegetation clearing line, and clearly demarcated limits of work **

   (a) ☐ Project description (including description of impacts outside of wetland resource area & buffer zone)

   (b) ☐ Photographs representative of the site

* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review (see https://www.mass.gov/ma-endangered-species-act-mesa-regulatory-review).
Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.

** MESA projects may not be segmented (321 CMR 10.16). The applicant must disclose full development plans even if such plans are not required as part of the Notice of Intent process.

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C. Other Applicable Standards and Requirements (cont'd)

(c) ☐ MESA filing fee (fee information available at https://www.mass.gov/how-to/how-to-file-for-a-mesa-project-review).
Make check payable to "Commonwealth of Massachusetts - NHESP" and ***mail to NHESP*** at above address

*Projects altering **10 or more acres** of land, also submit:*

(d) ☐ Vegetation cover type map of site

(e) ☐ Project plans showing Priority & Estimated Habitat boundaries

(f) OR Check One of the Following

1. ☐ Project is exempt from MESA review.
Attach applicant letter indicating which MESA exemption applies. (See 321 CMR 10.14, https://www.mass.gov/service-details/exemptions-from-review-for-projectsactivities-in-priority-habitat; the NOI must still be sent to NHESP if the project is within estimated habitat pursuant to 310 CMR 10.37 and 10.59.)

2. ☐ Separate MESA review ongoing. a. NHESP Tracking # b. Date submitted to NHESP

3. ☐ Separate MESA review completed.
Include copy of NHESP "no Take" determination or valid Conservation & Management Permit with approved plan.

3. For coastal projects only, is any portion of the proposed project located below the mean high water line or in a fish run?

a. ☐ Not applicable – project is in inland resource area only b. ☐ Yes ☒ No

If yes, include proof of mailing, hand delivery, or electronic delivery of NOI to either:

South Shore - Cohasset to Rhode Island border, and the Cape & Islands:

Division of Marine Fisheries -
Southeast Marine Fisheries Station
Attn: Environmental Reviewer
836 South Rodney French Blvd.
New Bedford, MA 02744
Email: dmf.envreview-south@mass.gov

North Shore - Hull to New Hampshire border:

Division of Marine Fisheries -
North Shore Office
Attn: Environmental Reviewer
30 Emerson Avenue
Gloucester, MA 01930
Email: dmf.envreview-north@mass.gov

Also if yes, the project may require a Chapter 91 license. For coastal towns in the Northeast Region, please contact MassDEP's Boston Office. For coastal towns in the Southeast Region, please contact MassDEP's Southeast Regional Office.

c. ☐ Is this an aquaculture project? d. ☐ Yes ☐ No

If yes, include a copy of the Division of Marine Fisheries Certification Letter (M.G.L. c. 130, § 57).

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Provided by MassDEP:

MassDEP File Number

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City/Town

C. Other Applicable Standards and Requirements (cont'd)

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

4. Is any portion of the proposed project within an Area of Critical Environmental Concern (ACEC)?

   a. ☒ Yes ☐ No If yes, provide name of ACEC (see instructions to WPA Form 3 or MassDEP Website for ACEC locations). **Note:** electronic filers click on Website.

   Pleasant Bay

   b. ACEC

5. Is any portion of the proposed project within an area designated as an Outstanding Resource Water (ORW) as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00?

   a. ☐ Yes ☒ No

6. Is any portion of the site subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L. c. 131, § 40A) or the Coastal Wetlands Restriction Act (M.G.L. c. 130, § 105)?

   a. ☐ Yes ☒ No

7. Is this project subject to provisions of the MassDEP Stormwater Management Standards?

   a. ☒ Yes. Attach a copy of the Stormwater Report as required by the Stormwater Management Standards per 310 CMR 10.05(6)(k)-(q) and check if:

      1. ☐ Applying for Low Impact Development (LID) site design credits (as described in Stormwater Management Handbook Vol. 2, Chapter 3)

      2. ☒ A portion of the site constitutes redevelopment

      3. ☐ Proprietary BMPs are included in the Stormwater Management System.

   b. ☐ No. Check why the project is exempt:

      1. ☐ Single-family house

      2. ☐ Emergency road repair

      3. ☐ Small Residential Subdivision (less than or equal to 4 single-family houses or less than or equal to 4 units in multi-family housing project) with no discharge to Critical Areas.

D. Additional Information

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section D and complete Appendix A: Ecological Restoration Notice of Intent – Minimum Required Documents (310 CMR 10.12).

Applicants must include the following with this Notice of Intent (NOI). See instructions for details.

Online Users: Attach the document transaction number (provided on your receipt page) for any of the following information you submit to the Department.

1. ☐ USGS or other map of the area (along with a narrative description, if necessary) containing sufficient information for the Conservation Commission and the Department to locate the site. (Electronic filers may omit this item.)

2. ☐ Plans identifying the location of proposed activities (including activities proposed to serve as a Bordering Vegetated Wetland [BVW] replication area or other mitigating measure) relative to the boundaries of each affected resource area.

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D. Additional Information (cont'd)

3. ☒ Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s), Determination of Applicability, Order of Resource Area Delineation, etc.), and attach documentation of the methodology. **See Field Data Forms in Attachment**

4. ☒ List the titles and dates for all plans and other materials submitted with this NOI.

See Table of Contents
a. Plan Title

b. Prepared By

c. Signed and Stamped by

d. Final Revision Date

e. Scale

f. Additional Plan or Document Title

g. Date

5. ☐ If there is more than one property owner, please attach a list of these property owners not listed on this form.

6. ☐ Attach proof of mailing for Natural Heritage and Endangered Species Program, if needed.

7. ☐ Attach proof of mailing for Massachusetts Division of Marine Fisheries, if needed.

8. ☒ Attach NOI Wetland Fee Transmittal Form

9. ☐ Attach Stormwater Report, if needed. **N/A no new impervious surface**

E. Fees

1. ☒ Fee Exempt: No filing fee shall be assessed for projects of any city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority, municipal housing authority, or the Massachusetts Bay Transportation Authority.

Applicants must submit the following information (in addition to pages 1 and 2 of the NOI Wetland Fee Transmittal Form) to confirm fee payment:

2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payor name on check: First Name

7. Payor name on check: Last Name

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Provided by MassDEP:

MassDEP File Number

Document Transaction Number

City/Town

F. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

J L F Kelly
1. Signature of Applicant

9/27/22
2. Date

3. Signature of Property Owner (if different)

4. Date

5. Signature of Representative (if any)

9/27/22
6. Date

For Conservation Commission:
Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

For MassDEP:
One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a **copy** of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

Other:
If the applicant has checked the "yes" box in any part of Section C, Item 3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.

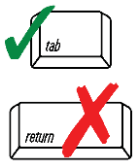
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

NOI Wetland Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

A. Applicant Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



1. Location of Project:

Multiple streets and locations	Orleans
a. Street Address	b. City/Town
c. Check number	d. Fee amount

2. Applicant Mailing Address:

John	Kelly	
a. First Name	b. Last Name	
Town of Orleans		
c. Organization		
19 School Road		
d. Mailing Address		
Orleans	MA	02653
e. City/Town	f. State	g. Zip Code
(508) 240-3700 Ext. 415		jkelly@town.orleans.ma.us
h. Phone Number	i. Fax Number	j. Email Address

3. Property Owner (if different):

a. First Name	b. Last Name	
c. Organization		
d. Mailing Address		
e. City/Town	f. State	g. Zip Code
h. Phone Number	i. Fax Number	j. Email Address

B. Fees

To calculate filing fees, refer to the category fee list and examples in the instructions for filling out WPA Form 3 (Notice of Intent).

Fee should be calculated using the following process & worksheet. ***Please see Instructions before filling out worksheet.***

Step 1/Type of Activity: Describe each type of activity that will occur in wetland resource area and buffer zone.

Step 2/Number of Activities: Identify the number of each type of activity.

Step 3/Individual Activity Fee: Identify each activity fee from the six project categories listed in the instructions.

Step 4/Subtotal Activity Fee: Multiply the number of activities (identified in Step 2) times the fee per category (identified in Step 3) to reach a subtotal fee amount. Note: If any of these activities are in a Riverfront Area in addition to another Resource Area or the Buffer Zone, the fee per activity should be multiplied by 1.5 and then added to the subtotal amount.

Step 5/Total Project Fee: Determine the total project fee by adding the subtotal amounts from Step 4.

Step 6/Fee Payments: To calculate the state share of the fee, divide the total fee in half and subtract $12.50. To calculate the city/town share of the fee, divide the total fee in half and add $12.50.

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NOI Wetland Fee Transmittal Form

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B. Fees (continued)

Step 1/Type of Activity	Step 2/Number of Activities	Step 3/Individual Activity Fee	Step 4/Subtotal Activity Fee

Step 5/Total Project Fee: _____

Step 6/Fee Payments:

Total Project Fee: _____ a. Total Fee from Step 5

State share of filing Fee: _____ b. 1/2 Total Fee **less $**12.50

City/Town share of filling Fee: _____ c. 1/2 Total Fee **plus** $12.50

C. Submittal Requirements

a.) Complete pages 1 and 2 and send with a check or money order for the state share of the fee, payable to the Commonwealth of Massachusetts.

Department of Environmental Protection
Box 4062
Boston, MA 02211

b.) **To the Conservation Commission:** Send the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and the city/town fee payment.

To MassDEP Regional Office (see Instructions): Send a copy of the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and a **copy** of the state fee payment. (E-filers of Notices of Intent may submit these electronically.)

Project Narrative

1.0 Introduction and Proposed Project Activities

1.1 Introduction

Excess nitrogen in the groundwater is impairing the water quality in coastal waters and estuaries in the Town of Orleans, Massachusetts. Because of this, in 2011, a comprehensive wastewater management plan (CWMP) that recommended sewer installation in approximately 60 percent of Orleans over 20 years was prepared and approved. The proposed new sewer system is being constructed in two phases that each covers a different area of Orleans: Phase 1 comprises the Downtown area and Phase 2 comprises the Meetinghouse Pond area (Attachment A, Figure 1). Phase 1 is substantially complete.

Phase 1 consisted of construction of a combination of gravity sewers and low-pressure sewers to service the Downtown area, construction of force mains, three sewage pumping stations, and a WWTF, and installation of the effluent disposal system. A Notice of Intent (NOI) application package was filed on August 28, 2019 for the Phase 1 portion of the project and the Conservation Commission issued an order of conditions on September 18, 2019.

This NOI application package is being submitted for the Phase 2 portion of the project that includes the construction of service connections, a combination of gravity sewers and low-pressure sewers, a force main, and a sewage pumping station to service the Meetinghouse Pond area, as shown in Attachments A and B. Additional details of the subject of this NOI are provided below.

1.2 Proposed Collection System

The proposed Meetinghouse Pond area collection system consists of approximately 15,750 linear feet of gravity sewers, 20,750 linear feet of low-pressure sewers, and 7,500 linear feet of force main. An estimated 486 users (properties/utility accounts) will be connected into the system with about 215 privately owned and maintained grinder pumps used to pump to the gravity system. The collection system for the Downtown area was designed to accept the future flows from the Meetinghouse Pond area, and the flow from proposed Meetinghouse Pond area pumping station—Pumping Station No. 4—will discharge to Tributary 1 of the Downtown area sewer project at the intersection of Lots Hollow Road and Finlay Road.

The wastewater collection system and associated force main will be installed by open trench cut and cover methods (within existing roadways). Polyvinyl chloride (PVC) pipe, couplings, and fittings will conform to ASTM D3034 for gravity sewers and ASTM D2241 for force mains. Joints for PVC pipe will be push-on joints using permanently bonded elastomeric ring joints. Each manhole-to-

manhole section of sewer pipeline will be leak tested using low-pressure air for gravity sewer lines and pressurized water for force mains. Manholes will be protected with external manhole encapsulation systems. Once installed, the system will create a barrier to water infiltration, effectively protect the manhole support structure and frame from ground moisture, and prevent corrosion and freeze-thaw damage. In addition, leakage tests will be performed for each sewer manhole.

1.3 Proposed Pumping Station

A sewage pumping station, Pumping Station No. 4, to be located immediately east of the Orleans Town Hall parking lot at 19 School Road, is included in the Meetinghouse Pond area collection system design and as part of this NOI. The pumping station site will be cleared and paved. The pumping station design includes the following:

- Wet well;
- Monitoring well;
- Valve vault;
- Transformer pad;
- Electrical pad;
- Four electrical pull boxes;
- Emergency generator on a generator enclosure pad;
- Catch basin;
- Leaching basin; and
- Three parking spaces.

The pumping station design includes a wet well, which is a concrete structure with a protective coating (entire interior of the structure) that will be set below grade with an equipment removal hatch flush with grade. The wet well will contain two submersible raw wastewater pumps and space to accommodate a third pump in the future. The proposed pump station and appurtenances are located outside of the wetland buffer zones.

2.0 Existing Conditions and Regulated Areas

The proposed Meetinghouse Pond project area consist mainly of previously developed areas within the Town of Orleans. Crystal Lake, Meetinghouse Pond, and Uncle Harvey's Pond border the project area to the south while the Orleans Cemetery borders the project area to the north (Attachment A). The vast majority of the project area is existing paved roadways and other

developed areas, such as existing lawn areas. A combination of businesses, residences, and naturally vegetated areas are located in the vicinity of the proposed project limits of work.

According to the Massachusetts Department of Conservation and Recreation's Areas of Critical Environmental Concern (ACEC) Program MassGIS layer (April 2009), portions of the project in the vicinity of Crystal Lake and Meetinghouse Pond are located in the Pleasant Bay ACEC, which was designated in 1987 (see Table 1). The installation of the sewers in the project boundaries and within the Pleasant Bay ACEC was previously approved by the Executive Office of Energy and Environmental Affairs (EEA) via review of an Environmental Notification Form and Single Environmental Impact Report, and a Massachusetts Environmental Policy Act Certificate was issued on January 28, 2011 (EEA Number 14414).

Table 1. Summary of Proposed Sewer Segments Within Pleasant Bay ACEC

Road	*Approximate Sewer Segment*		*Project Plan Sheet (Attachment B)*
	Beginning Station	*Ending Station*	
Cheney Road	9+00	10+25	04 C-142
Grist Road	4+50	5+00	04 C-144
High Tide Lane	5+00	8+25	04 C-144
	2+75	9+50	04 C-149
Lake Farm Lane	8+00	10+25	04 C-110
Lewis Road	5+25	6+25	04 C-143
Loomis Lane	3+00	9+50	04 C-139
	13+75	17+75	04 C-140
Pond View Road	5+00	5+50	04 C-150

Work will not occur within any areas mapped as Priority or Estimated Habitat or Certified Vernal Pools as identified by the Natural Heritage and Endangered Species Program datalayers (August 2017; accessed in OLIVER in August 2019). Portions of the limits of work are located within the FEMA 100-year floodplain (Land Subject to Coastal Storm Flowage (LSCSF)), Coastal Bank, and the 0-25 foot, 25-50 foot, and 50-100 foot Buffer Zones, as discussed in more detail below. The environmental constraints maps in Attachment A and the project plans in Attachment B illustrate environmental resources in the project area.

Site visits were conducted by BSC Group as part of this project. Numerous vegetated wetlands in the vicinity of the project were investigated and/or flagged as follows:

- **Location 1:** Behind 23 monument road;
- **Location 3:** South of Lake Farm Lane and North of Megs Lane, in between the two streets. Mixed Wooded Marsh and Marsh/Bog wetland types;
- **Location 4:** North of Uncle Vicks Way near the intersection where it meets Monument Road. Marsh/Bog wetland type;
- **Location 5:** West of Uncle Vicks Way. Wooded Marsh wetland type;
- **Location 6:** Behind 14 and 16 River Road;
- **Location 7:** West of the intersection of Ministers Prim Road and River Road. Wooded Marsh wetland type;
- **Location 8:** West of Karen Way and North of Main Street, near the intersection of Karen Way, Main Street and Deerwood Lane. Wooded Marsh wetland type;
- **Location 9:** Directly east of Loomis Lane, west of Manito road, in between the two. Wooded Marsh wetland type;

- **Location 10:** West of Pine Ridge Lane near the intersection where it meets Great Oak Road. Mixed Marsh/Bog and Cranberry Bog wetland type;
- **Location 11:** South of Great Oak Road near the intersection where it meets Pine Ridge Lane. Wooded Marsh wetland type;
- **Location 12:** South of Finlay Road near the intersection where it meets Kettle Pond Way. Wooded Marsh wetland type;
- **Location 13:** North of Finlay Road near the intersection where it meets Kettle Pond Way, south of Daleys Terrace. Cranberry Bog wetland type;
- **Location 14:** East of Grist Road near the intersection where it meets Barley Neck Road. Wooded Marsh wetland type;
- **Location 15:** North of Beach Road near the intersections where it meets Main Street. Wooded Marsh wetland type;
- **Location 16:** North of High Tide Lane near the intersection where it meets Cedar Way. Wooded Marsh wetland type;
- **Location 17:** West of Natural Drive and East of Mill Lane in between the intersections where they both meet Pochet Road. Wooded Marsh wetland type;
- **Location 18:** Located on Brick Hill Lane, north of Larboard Lane and south of Nuthatch Circle, in between the two. Wooded Marsh wetland type;
- **Location 20:** Between 3 Labrador Lane and 6 Brick Hill Road;
- **Location 22:** South of Windy Hill Lane, to the east of the intersection where Barley Neck Road meets Harveys Lane. Wooded Marsh wetland type;
- **Location 23:** Located East of the curve in Coles Place. Wooded Marsh wetland type;
- **Location 24:** Off Nauset Farms Way;
- **Location 25:** Northeast of Nauset Farms Private Way. Marsh/Bog wetland type;
- **Location 26:** Near the intersection of Brick Hill Road and Pochet Road, to the east of Larboard Lane. Open Water wetland type;
- **Location 27:** Northwest of the cul-de-sac on Lake Farm Lane. Certified Vernal Pool wetland type; and
- **Location 31:** South of Pond Road and West of Monument Road, near the intersection between the two. Wooded Marsh wetland type.

The locations of the vegetated wetlands in the vicinity of the project are shown on Environmental Constraints Map 2 in Attachment A. Additional details including vegetative community composition as observed by BSC Group can be found in the wetland data sheets for most of the delineated wetlands, provided in Attachment C.

3.0 Regulated Area Impacts

The installation of the Meetinghouse Pond area proposed gravity sewers, low-pressure sewers, service connections, and force main will result in impacts to jurisdictional areas protected under the Massachusetts Wetlands Protection Act and associated regulations and the Town of Orleans Wetlands Regulations (Chapter 196A) (see Table 2). These jurisdictional areas include: Coastal Bank, Land Subject to Coastal Storm Flowage (LSCSF), and the 0-50 foot, and 50-100 foot Buffer Zones (Attachment A, Figures 2 and 3 and Attachment B). No direct impacts to vegetated wetlands would occur.

Proposed Pumping Station No. 4 (located immediately east of the Orleans Town Hall parking lot) is not located within a jurisdictional area.

All impacts will be located within paved or gravel roadways and will be temporary in nature. Impacts were calculated with an approximate excavation trench width of 10 feet for all gravity sewers, force mains, and laterals. All disturbed areas will be restored to pre-existing conditions after construction is complete, and no elevation changes are proposed.

Table 2. Summary of Proposed Temporary and Permanent Jurisdictional Area Impacts Associated with the Meetinghouse Pond Area Collection System and Pumping Station Project Limits of Work

Jurisdictional Area	*Temporary Impacts*
Coastal Bank	1580 linear feet
Land Subject to Coastal Storm Flowage*	23,000 square feet
0-50 foot Buffer Zone*	36,000 square feet
50-100 foot Buffer Zone*	63,200 square feet

*Impacted areas of Land Subject to Coastal Storm Flowage and the various Buffer Zones often overlapped.
** Permanent impacts resulting from the construction of Pumping Station No. 3 (paved access driveway and/or pumping station components).
Please Note: All values are approximate.

4.0 Compliance with Performance Standards

Portions of this project qualify as a Limited Project under the MA Wetlands Protection Act Regulations at 310 CMR 10.24(7)(b) and 10.53(3)(d): The construction, reconstruction, operation or maintenance of sewer lines. Consequently, the Orleans Conservation Commission may elect to waive performance standards for resources areas in which impacts will occur. Nevertheless, the proposed work meets all performance standards as discussed below.

4.1 Coastal Bank

All impacts to Coastal Bank from sewer installation activities will be temporary in nature and pre-construction grades will be restored. The proposed work on Coastal Bank will not involve the construction of a new bulkhead, revetment, seawall, groin, or other coastal engineering structure. Work on Coastal Bank will not have an adverse effect due to wave action on the movement of sediment from the coastal bank to coastal beaches or land subject to tidal action. No buildings will be constructed on Coastal Bank, stability of the coastal bank will not be affected, and no work on Coastal Bank will be located within specified habitat sites of rare vertebrate or invertebrate species as part of this project. Therefore, the proposed work meets the performance standards for Coastal Bank at 310 CMR 10.30(3-8).

4.2 Land Subject to Coastal Storm Flowage

While no specific performance standards are provided for LSCSF in the Massachusetts Wetlands Protection Act Regulations, the Town of Orleans Wetlands Regulations (196A) provides the following:

> "A proposed project that may result in alteration of land subject to coastal storm flowage shall not cause or create the likelihood of the following:
> (1) Reduction in the ability of the land to absorb and contain waters.
> (2) Reduction in the ability of the land to buffer more inland areas from flooding and wave damage.
> (3) Displacement or diversion of flood waters to other areas.
> (4) Damage to other structures or property.
> (5) Pollution of groundwater, surface water, or salt water.
> (6) Reduction of an area's capacity to provide for wildlife.
> (7) An increase in the elevation or velocity of flood waters.
> (8) Prevention of the migration of resource areas such as salt marshes due to sea level rise."

Due to the temporary and at-grade/subsurface nature of the proposed work in LSCSF (most of which is currently developed), activities within LSCSF would comply with the performance standards above.

4.3 Buffer Zones

Work for the project will occur within the 0-25 foot, 25-50 foot, and 50-100 foot Buffer Zones. All temporary impacts within the buffer zones will be restored to approximate pre-existing conditions following proposed project activities. The plans provided in Attachment B illustrate the 0-50 foot and 50-100 foot buffer boundaries; for clarity due to the amount of detail already shown in the plans, the 0-25 foot boundary is not depicted.

According to the Town of Orleans Wetlands Regulations, "installation of underground utilities (gas mains, water mains, power lines, etc.) within the buffer zone are to be considered as new construction and must be conditioned as such. Any installation within the 50 foot buffer strip of a resource area will require a variance from the regulations." The proposed work within the 0-25 foot and 25-50 foot buffer zones will occur within existing paved or gravel road surfaces. However, an Alternatives Analysis and request for a variance is discussed below.

4.4 Alternatives Analysis

As described in Section 11 of the 2010 Comprehensive Wastewater Management Plan/Supplemental Environmental Impact Report (CWMP/SEIR), three plans were considered for meeting Orleans' wastewater management needs, including:

- Plan 1: Decentralized wastewater treatment at four sites and effluent disposal at 11 sites;
- Plan 2: Centralized treatment and disposal at the site of the existing Tri-Town Septage Treatment Facility; and
- Plan 3: Centralized treatment and disposal at sites in South Orleans and/or Brewster with summer spray irrigation of Brewster golf courses.

As detailed in the 2010 CWMP/SEIR, each plan was analyzed with respect to cost, environmental and technical factors and subject to a significant public review. As a result of this process, a decision was made to proceed with a program centered on Plan 2, and this approach was approved through the Massachusetts Environmental Policy Act, Cape Cod Commission, and Town Meeting review processes. The approach includes phased sewering in the Town as well as construction of a new WWTF. As described in Section 1.0 , Phase 2 of the program is to construct service connections, a combination of gravity sewers and low-pressure sewers, a force main, and a sewage pumping station to service the Meetinghouse Pond area. The total length of sewers will be approximately 6.9 miles. In addition to the new sewers, approximately 1.42 miles of new effluent force main are proposed between Pump Station No. 4 and the discharge location at sewer manhole 100 in Finlay Road by the intersection of Lots Hollow Road.

4.5 Compliance with Massachusetts Stormwater Policy

According to MassDEP's *Checklist for Redevelopment Projects*, a redevelopment is defined to include the following:

- "Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving;
- Development rehabilitation, expansion and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area; and
- Remedial projects specifically designed to provide improved stormwater management, such as projects to separate storm drains and sanitary sewers, and stormwater retrofit projects."

The proposed project will not result in a net increase in impervious area at the project site with the exception of the proposed pumping station, which is outside of jurisdictional areas regulated under the Massachusetts Wetlands Protection Act and the Town of Orleans Wetland Regulations . The Stormwater Checklist provided in Attachment E describes how the proposed stormwater management design addresses each of the applicable standards.

5.0 Mitigation

5.1 General Construction

An erosion and sedimentation control program, consisting of compost silt socks and silt fences, catch basin, silt sack sediment traps, sedimentation filter bags, and temporary stockpile area staked straw bales, will be implemented to minimize impacts to the adjacent resource areas during the construction phase of the project. Proper implementation of the erosion and sedimentation control program would:

- Minimize exposed soil areas through sequencing and temporary stabilization; and
- Place structures to manage stormwater runoff and erosion.

Prior to any ground disturbance, erosion control barriers consisting of compost silt socks and silt fence would be installed along the limits of work in the areas shown in Attachment B. The erosion control areas depicted represent the minimum amount of erosion control to be used at the site, and the contractor will be required to install additional erosion control as necessary to prevent erosion or sedimentation of jurisdictional resource areas. If sediment has accumulated to a depth which impairs proper functioning of the barrier, it would be removed by hand. This material would be either

reused at the site or disposed of at a suitable offsite location. Any damaged sections of erosion control would be repaired or replaced immediately upon discovery.

Dewatering (where necessary) will be conducted in compliance with the USEPA/MassDEP Construction General Permit requirements, thereby minimizing potential impacts to adjacent resources. Any catch basins, drain, or outfalls to be used in dewatering operations will be receive water treated by filters, onsite settling basins, settling tank trucks, or other devices so that no observable sediments or pollutants are carried into any resource area, street drain, or adjacent property. Measures will be taken so that no erosion or scouring shall occur on public or private property, or on the banks or bottoms of waterbodies, as a result of dewatering operations.

Waste material, debris, and trash will be cleaned from the work site at the end of each day and placed in trash barrels and/or dumpsters for disposal off site. Dumping of spoils material, waste, or other debris into wetland resource areas and/or buffer zones will not be allowed.

5.2 Temporary Impacts

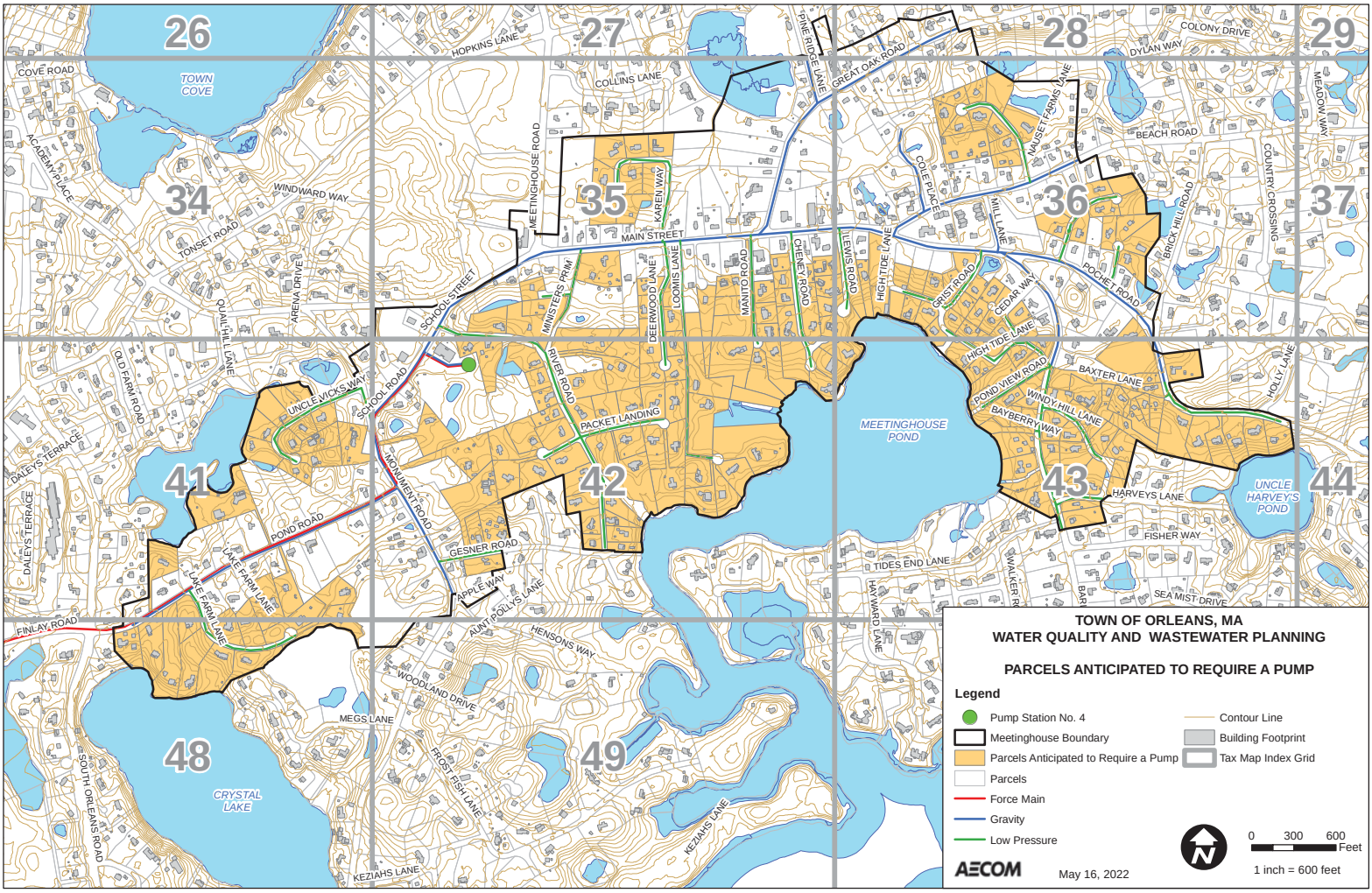
Temporary impacts as a result of the project will be mitigated in place. Paved and gravel roadways will be repaved following construction activities and all temporarily disturbed surfaces will be restored to pre-existing grades.

Attachment A

Meetinghouse Pond Area

and

Environmental Constraints Maps



TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

PARCELS ANTICIPATED TO REQUIRE A PUMP

Legend

- Pump Station No. 4
- Meetinghouse Boundary
- Parcels Anticipated to Require a Pump
- Parcels
- Force Main
- Gravity
- Low Pressure
- Contour Line
- Building Footprint
- Tax Map Index Grid

AECOM

May 16, 2022

0 300 600 Feet

1 inch = 600 feet

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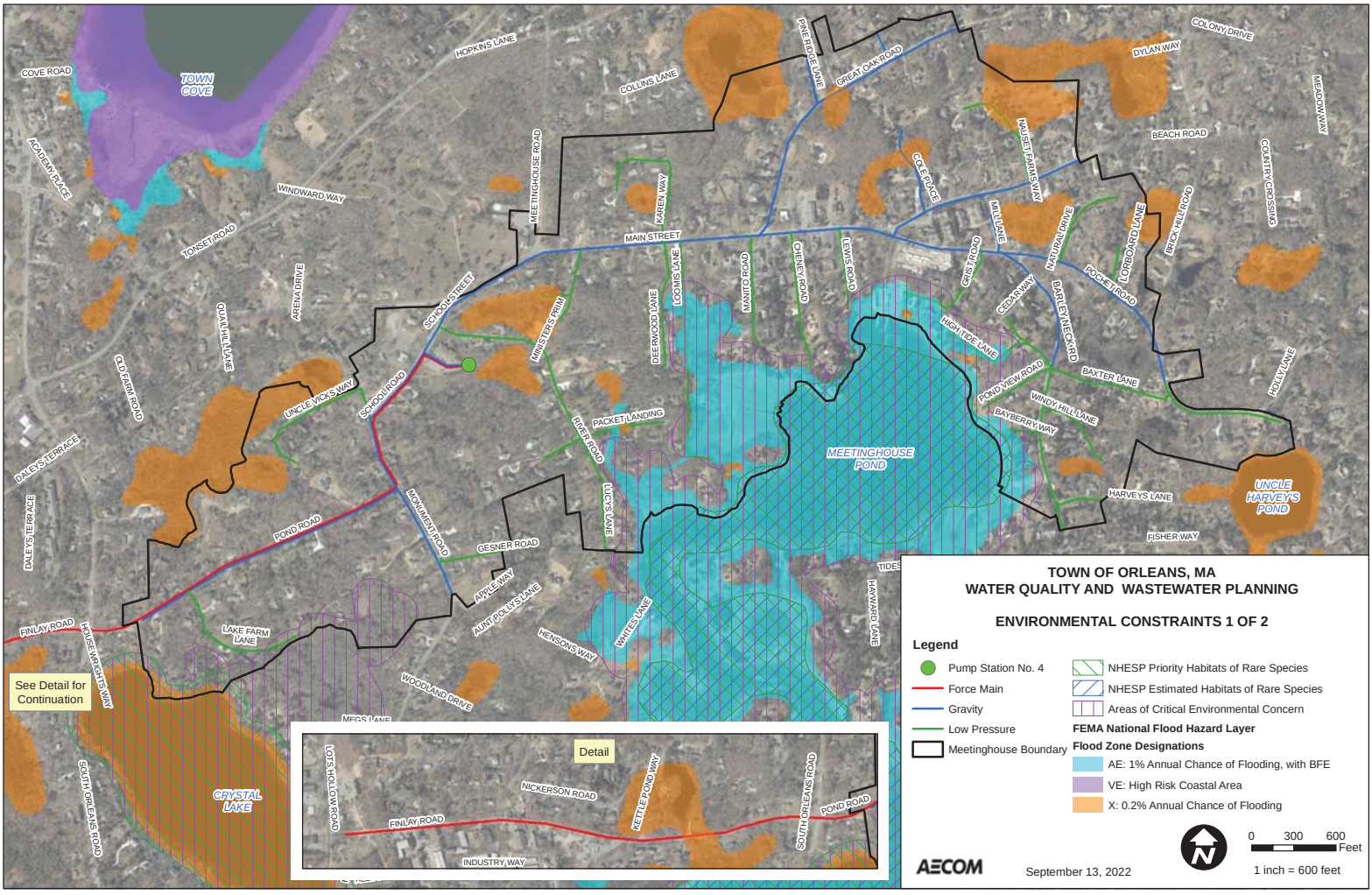

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

ENVIRONMENTAL CONSTRAINTS 1 OF 2

Legend

- Pump Station No. 4
- Force Main
- Gravity
- Low Pressure
- Meetinghouse Boundary
- NHESP Priority Habitats of Rare Species
- NHESP Estimated Habitats of Rare Species
- Areas of Critical Environmental Concern
- **FEMA National Flood Hazard Layer**
- **Flood Zone Designations**
- AE: 1% Annual Chance of Flooding, with BFE
- VE: High Risk Coastal Area
- X: 0.2% Annual Chance of Flooding

AECOM

September 13, 2022

0 300 600 Feet

1 inch = 600 feet

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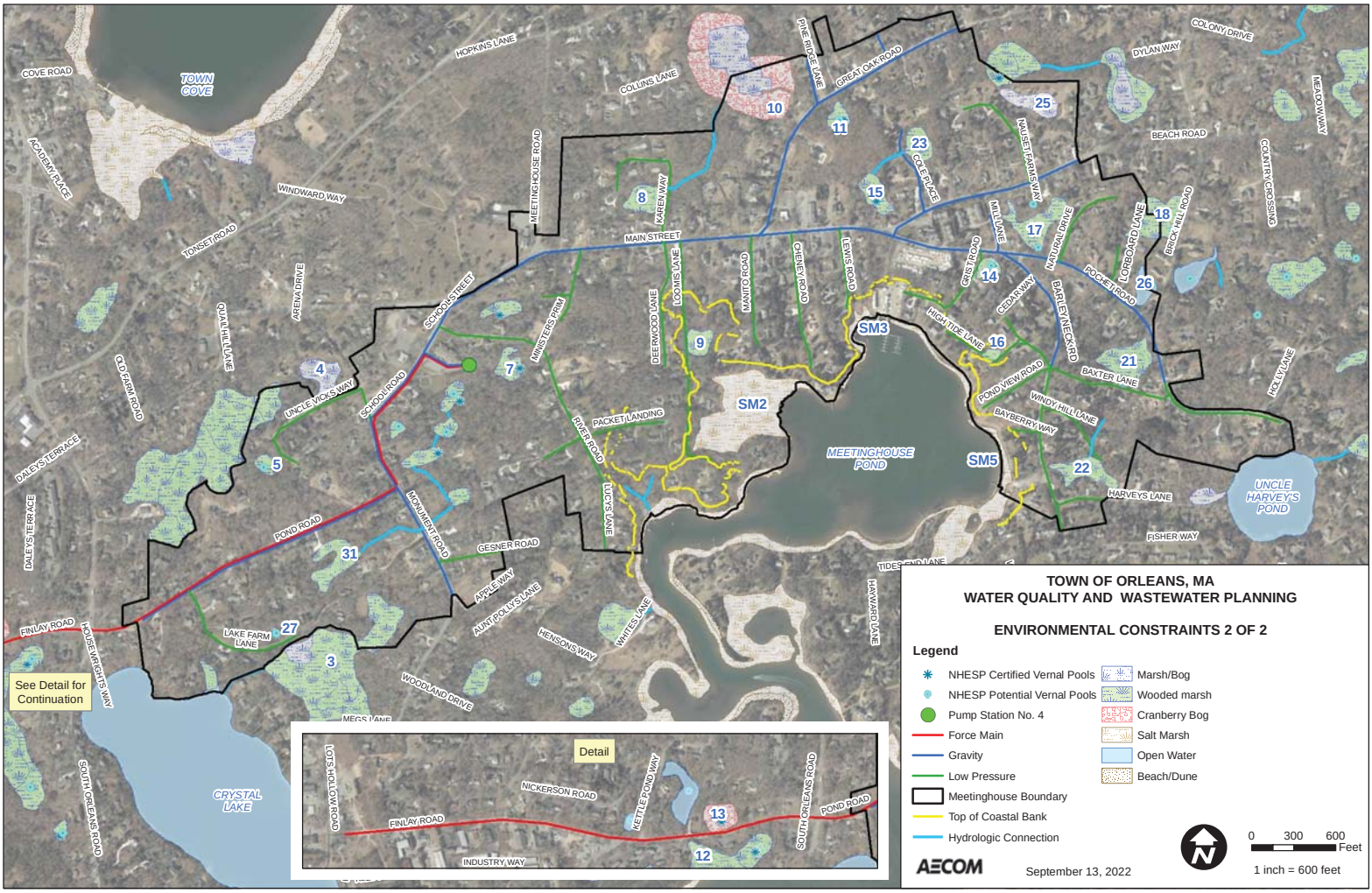

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

ENVIRONMENTAL CONSTRAINTS 2 OF 2

Legend

- NHESP Certified Vernal Pools
- NHESP Potential Vernal Pools
- Pump Station No. 4
- Force Main
- Gravity
- Low Pressure
- Meetinghouse Boundary
- Top of Coastal Bank
- Hydrologic Connection
- Marsh/Bog
- Wooded marsh
- Cranberry Bog
- Salt Marsh
- Open Water
- Beach/Dune

AECOM

September 13, 2022

0 300 600 Feet

1 inch = 600 feet

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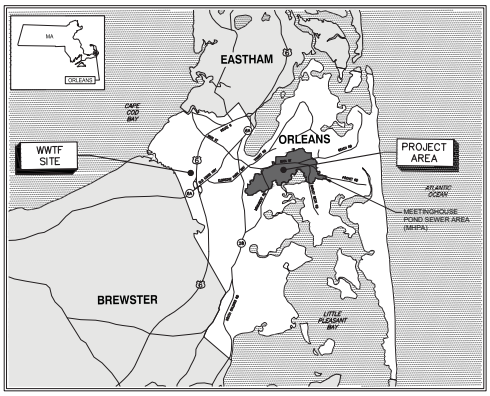
Attachment B

Project Plans

TOWN OF ORLEANS, MA

MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION

CONTRACT NO. 2022-01
SRF NO. 7150
OCTOBER 2022



LOCATION PLAN
APPROXIMATE SCALE: 1" = 5000'

0 5000 10,000 20,000
SCALE: 1"=5000'

PERMIT PLANS
AUGUST 12, 2022
NOT FOR CONSTRUCTION

AECOM

PROJECT
MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION
CONTRACT No. 2022-01
SRF No. 7150

OWNER
TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER
AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (978) 905-2100
www.aecom.com

DRAFT

8-12-2022
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NOTE: This document is preliminary only and is not intended for any purpose except review and comment by the owner and its agents.

REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER
60652634

Designed By:	M. DONOGHUE
Drawn By:	S. NAPOLITANO
Dept Check:	C. BENZIGER
Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE
GENERAL

SHEET TITLE
COVER SHEET AND LOCATION PLAN

SHEET NUMBER
00 G-001

PATH/FILENAME: L:\DOT\PROJECT MANTER\SERVICE_CAPE_WORK\MEETINGHOUSE\SPEWS_CAD_\SERVICE_CAD\00-MEETING\00-001-PERMIT.DWG
LAST SAVED: Thursday, August 25, 2022 11:24:03 AM
PLOT DATE: Thursday, September 29, 2022 11:24:25 AM

GENERAL NOTES

1. HORIZONTAL DATUM IN U.S. SURVEY FEET IS REFERENCED TO THE MASSACHUSETTS STATE PLANE, MAINLAND COORDINATE SYSTEM (NAD83).
2. VERTICAL DATUM IN U.S. SURVEY FEET IS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
3. THE INFORMATION SHOWN HEREON IS BASED ON THE REFERENCED DATA ACCUMULATION PLANS. THESE PLANS DO NOT REPRESENT A PROPERTY OR BOUNDARY SURVEY, AND THE PROPERTY LINES SHOWN DO NOT REPRESENT A LAND SURVEYOR'S PROPERTY BOUNDARY OPINION. THE BOUNDARY INFORMATION SHOWN ON THESE PLANS WAS COMPILED FROM OTHER MAPS, RECORD RESEARCH, AND OTHER SOURCES OF INFORMATION. THE BOUNDARIES SHOWN HEREON SHALL NOT BE CONSTRUED AS HAVING BEEN OBTAINED AS THE RESULT OF AN ACCURATE ON THE GROUND SURVEY, AND ARE SUBJECT TO CHANGE AS AN ACCURATE FIELD SURVEY MAY DISCLOSE.
4. SIDELINES OF RIGHTS OF WAY AND PROPERTY LINES ARE AS SHOWN ON PLANS PREPARED BY BSC GROUP, ENTITLED: "MEETINGHOUSE POND AREA SANITARY SEWER PROJECT": OCTOBER 8, 2021 AND SUBSEQUENT DATES. WHERE SUPPLEMENTAL RIGHT OF WAY AND PROPERTY LINE INFORMATION WAS REQUIRED, TOWN OF ORLEANS AND/OR MASS GIS DATA WAS USED. UPDATED AND SUPPLEMENTAL BUILDING LOCATIONS ARE BASED ON PLANIMETRICS FROM BLUE SKY AERIAL SURVEY OF SPRING 2021.
5. LOCATION OF WATER, SEWER, TELEPHONE, ELECTRIC, AND GAS LINES ARE APPROXIMATE, BASED UPON RECORD LOCATION INFORMATION PROVIDED TO BSC GROUP, INC. AND FOR REFERENCE ONLY.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AT NO ADDITIONAL COST TO THE OWNER.
7. ALL CONSTRUCTION OPERATIONS SHALL BE ACCOMPLISHED IN ACCORDANCE WITH APPLICABLE STATE STATUES AND U.S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS (O.S.H.A). COPIES OF O.S.H.A.'S STANDARDS MAY BE PURCHASED FROM THE U.S GOVERNMENT PRINTING OFFICE. THE CONTRACTOR ALONE WILL BE RESPONSIBLE FOR THE EXECUTION OF THE WORK IN ACCORDANCE WITH ALL APPLICABLE HEALTH AND SAFETY REQUIREMENTS.
8. THE CONTRACTOR SHALL HAVE A HEALTH AND SAFETY PLAN AND SHALL PROVIDE COPIES OF SAME TO THE ENGINEER.
9. THE CONTRACTOR SHALL TAKE ALL NECESSARY MEASURES AND SHALL PROVIDE ALL NECESSARY CONTINUOUS BARRIERS OF SUFFICIENT TYPE, SIZE AND STRENGTH TO PREVENT ACCESS TO ALL OPEN EXCAVATIONS AT THE COMPLETION OF EACH DAY'S WORK.
10. CONTRACTOR SHALL FOLLOW ALL REQUIREMENTS OF THE LOCAL MUNICIPALITY AND THE STATE WHEN WORKING IN THEIR RIGHTS OF WAY.
11. NO WORK, STORAGE, OR TRESPASS SHALL BE PERMITTED BEYOND THE BOUNDARIES OF ANY EASEMENTS OR PUBLIC RIGHTS OF WAY WITHOUT WRITTEN PERMISSION OF THE PROPERTY OWNER.
12. ALL CONSTRUCTION ACTIVITY SHALL BE CONFINED TO THE AREA WITHIN THE LIMIT OF WORK AS SHOWN ON THE PLANS. LIMIT OF WORK SHALL BE DEFINED AS THE SERVICE RECIPIENTS PROPERTY LINE AND THE ADJACENT RIGHT-OF-WAY. RIGHTS OF ENTRY AND/OR EASEMENTS HAVE BEEN OBTAINED FOR ALL PROPERTIES INCLUDED IN THIS PROJECT.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SECURING A SITE FOR DISPOSAL OF ALL EXCAVATED UNACCEPTABLE MATERIAL THAT IS UNSUITABLE FOR USE AS BACKFILL AND ALL OTHER EXCESS EXCAVATED MATERIALS. THE CONTRACTOR SHALL PROVIDE THE ENGINEER WITH THE LOCATION OF THE DISPOSAL SITE AND WRITTEN PERMISSION FOR USE OF THE SITE FROM THE PROPERTY OWNER. THE COST FOR SECURING AND MAINTAINING THE DISPOSAL SITE SHALL BE THE CONTRACTOR'S RESPONSIBILITY.
14. IF AT ANY TIME THE CONSTRUCTION EXCAVATION REVEALS ANY ARTICLE OF HISTORIC OR ARCHEOLOGICAL SIGNIFICANCE, WORK AT THE LOCATION WILL CEASE AND THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER.
15. THE CONTRACTOR SHALL COORDINATE ALL WORK AS NECESSARY WITH MASSDOT AND THE TOWN OF ORLEANS AND/OR ITS REPRESENTATIVES.
16. WORKING HOURS WITHIN THE TOWN ARE 7:00 A.M. TO 5:00 P.M., MONDAY THROUGH FRIDAY OR AS SPECIFIED IN THE MASSDOT PERMIT AND SPECIFICATIONS. PERMISSION IS REQUIRED FROM THE TOWN VIA THE ENGINEER TO WORK ON SUNDAY, LEGAL HOLIDAYS, OR ANY WEEKDAY NIGHT PAST THE HOURS SPECIFIED. THIS PERMISSION MUST BE REQUESTED 72 HOURS IN ADVANCE. SUNDAY WORK WILL ONLY BE ALLOWED IN CASE OF EMERGENCY.
17. EXISTING VALVES OR HYDRANTS SHALL BE OPERATED BY THE MUNICIPAL OWNER. THE CONTRACTOR SHALL COORDINATE WITH THE MUNICIPAL OWNER OF THE WATER SYSTEM.
18. THE CONTRACTOR IS RESPONSIBLE FOR PERFORMING ALL WORK AS INDICATED ON THE DRAWINGS, IN THE SPECIFICATIONS AND AS DIRECTED BY THE ENGINEER IN CONFORMANCE WITH ALL APPLICABLE CODES AND IN A PROPER AND WORKMANLIKE MANNER.
19. CONTRACTOR TO SUBMIT WORK SCHEDULE INCLUDING NECESSARY UTILITY RELOCATIONS BASED ON RESULTS OF TEST PITS. NO PIPE INSTALLATION SHALL OCCUR PRIOR TO APPROVAL OF THE SCHEDULE AND COMPLETION OF TEST PITS.
20. THE CONTRACTOR IS RESPONSIBLE FOR SEQUENCING OF ALL WORK TO AVOID CONFLICTS BETWEEN ALL NEW WORK.
21. THE CONTRACTOR SHALL PREPARE AND SUBMIT A TRAFFIC MANAGEMENT PLAN FOR ALL WORK PRIOR TO THE START OF CONSTRUCTION TO SHOW HOW TRAFFIC FLOW WILL BE MAINTAINED DURING CONSTRUCTION. THE CONTRACTOR SHALL FURNISH ALL PROTECTIVE AND/OR WARNING DEVICES AS REQUIRED TO CONTROL TRAFFIC AND PROTECT THE PUBLIC IN ALL WORK AREAS.
22. ALL SIGNAGE AND PAVEMENT MARKINGS SHALL BE IN ACCORDANCE WITH LOCAL AND STATE GUIDELINES.
23. THE CONTRACTOR SHALL MAINTAIN EMERGENCY ACCESS TO ALL AREAS AFFECTED BY THE WORK AT ALL TIMES. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING AN EMERGENCY RESPONSE PLAN. THIS PLAN SHALL BE COORDINATED WITH THE ENGINEER, THE TOWN AND ALL EMERGENCY DEPARTMENTS.
24. PRIOR TO CLOSING ANY ROADWAY (PARTIALLY OR COMPLETELY), MUNICIPAL POLICE, THE TOWN AND LOCAL FIRE OFFICIALS SHALL BE NOTIFIED. THE CONTRACTOR SHALL COMPLY WITH ANY CONDITIONS SET BY THE PUBLIC SAFETY OFFICIALS, IN CONJUNCTION WITH THE OWNER AND ENGINEER.
25. CONTRACTOR TO PROVIDE AND MAINTAIN SEDIMENTATION AND EROSION CONTROL MEASURES TO PROTECT ALL CATCH BASINS, DRAINAGE INLETS AND SWALES IN THE CONSTRUCTION ZONE.
26. ALL EROSION CONTROL MEASURES FOR THE WORK ZONE SHALL BE IN PLACE PRIOR TO THE START OF CONSTRUCTION.
27. THE CONTRACTOR IS RESPONSIBLE FOR THE PROTECTION OF THE EXISTING FEATURES AND STRUCTURES WITHIN AND ADJACENT TO THE WORK. CONTRACTOR SHALL BOX ALL TREES, SHRUBS, FLOWER BOXES, AND HEDGES BEFORE PLACING EARTH AGAINST OR NEAR THEM. IN THE EVENT OF DAMAGE, REPAIRS OR REPLACEMENT SHALL BE COMPLETED AT THE CONTRACTOR'S EXPENSE AS APPROVED BY THE ENGINEER.
28. EXCAVATION OF ANY TYPE SHALL BE ACCOMPLISHED IN SUCH A MANNER THAT UNDERGROUND UTILITIES OR STRUCTURES ARE NOT DAMAGED. ALL ROADWAYS, PARKING AREAS, SIDEWALKS AND OTHER STRUCTURES DISTURBED BY CONSTRUCTION IN OR OUTSIDE THE PROJECT AREA SHALL BE RETURNED TO THEIR ORIGINAL CONDITION OR BETTER. ALL COSTS RELATED TO THE REPAIR OF DAMAGED UTILITIES OR STRUCTURES SHALL BE BORNE BY THE CONTRACTOR.
29. CONTRACTOR SHALL SAW-CUT ALL PAVEMENT, ROADS, AND DRIVEWAYS TO BE DISTURBED DURING CONSTRUCTION.
30. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING PROPER AND ADEQUATE TRENCH SHORING AND BRACING AT ALL TIMES IN ACCORDANCE WITH REQUIRED SAFETY STANDARDS.
31. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL EXISTING CONDITIONS AT EACH SITE RECEIVING SEWER SERVICE, INCLUDING BUT NOT LIMITED TO, INVERT ELEVATIONS AT EACH MANHOLE, DEPTH AND LOCATION OF EXISTING PIPING TO ON-SITE WASTE DISPOSAL SYSTEMS (OWDS) AND THE LOCATION OF EXISTING OWDS.
32. ALL NEW GRAVITY SEWER SERVICES SHALL BE 6" DIAMETER PVC UNLESS OTHERWISE NOTED. ALL NEW LOW PRESSURE SEWER SERVICES SHALL BE 1-1/4" DIAMETER UNLESS OTHERWISE NOTED
33. ALL NEW PRECAST SEWER MANHOLE INVERTS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH DETAILS.

GENERAL NOTES - (CONT.)

35. ALL UNEXCAVATED ROCK WITHIN 3'-0" HORIZONTALLY OF THE ENDS OF BUILDING CONNECTIONS, BRANCHES AND STUBS, AND DOWN TO A HORIZONTAL PLANE 6-INCHES BELOW THE BOTTOMS OF SUCH CONNECTIONS, BRANCHES AND STUBS, SHALL BE REMOVED.
36. ROCK REMOVAL BY THE MECHANICAL METHOD SHALL CONSIST OF CUTTING AWAY ROCK AT TRENCH BOTTOM TO FORM A LEVEL BEARING SURFACE 6" BELOW INVERT ELEVATION OF PIPE.
37. NO TREES OR TREE LIMBS ALONG THE ENTIRE ROUTE OF CONSTRUCTION ON PUBLIC WAYS SHALL BE CUT UNLESS OTHERWISE DIRECTED BY THE ENGINEER AND APPROVED BY THE TOWN.
38. THE CONTRACTOR SHALL EXERCISE CARE TO PREVENT DAMAGE TO ROOT SYSTEMS OF EXISTING TREES OR SHRUBS IN LOCATIONS OF NEW SEWER LINES.
39. THE LOCATIONS OF UTILITIES SHOWN ON THESE PLANS ARE APPROXIMATE. THE CONTRACTOR SHALL COORDINATE WITH THE TOWN AND UTILITY COMPANIES INVOLVED TO VERIFY IN THE FIELD THE EXACT LOCATION, SIZE, AND MATERIAL OF CONSTRUCTION OF MAINS AND SERVICES TO PREVENT DAMAGE. LOSS OF SERVICE DURING CONSTRUCTION AND FOR REPLACEMENT OF SERVICES. THE CONTRACTOR SHALL NOTIFY "DIG SAFE" 72-HOURS PRIOR TO ANY EXCAVATION.
40. THE CONTRACTOR IS RESPONSIBLE TO VERIFY THE DEPTH OF EXISTING UTILITY CROSSINGS EITHER BELOW OR ABOVE THE NEW PIPING. METHODS FOR DETERMINING DEPTHS TO UTILITIES WILL BE BY TEST PITS OR BY VACUUM EXCAVATION, WHICHEVER IS DEEMED ACCEPTABLE AT THE SPECIFIC LOCATION.
41. EXISTING UTILITIES TO REMAIN IN SERVICE DURING CONSTRUCTION. ANY INTERRUPTION OF SERVICE SHALL BE COORDINATED WITH THE ENGINEER AND APPROVED BY THE TOWN.
42. EXISTING UTILITIES INTERFERING WITH THE WORK SHALL BE RELOCATED AS DIRECTED BY THE ENGINEER.
43. THE CONTRACTOR IS RESPONSIBLE FOR MAKING ALL ARRANGEMENTS FOR ANCHORING, SUPPORTING AND/OR RELOCATING AND PROTECTING ALL UTILITIES DURING CONSTRUCTION. ALL COSTS SHALL BE INCLUDED IN THE UNIT PRICES BID. IN THE EVENT OF DAMAGE, THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF ALL REPAIRS.
44. THE CONTRACTOR SHALL MAINTAIN ACCESS TO ALL EXISTING FIRE HYDRANTS AT ALL TIMES. SHOULD AN EXISTING HYDRANT NEED TO BE TAKEN OUT OF SERVICE, THE CONTRACTOR SHALL NOTIFY THE LOCAL FIRE DEPARTMENT 24 HOURS PRIOR TO TAKING IT OUT OF SERVICE.
45. IF WATER MAINS NEED TO BE RE-LAYED AS A RESULT OF NEW PIPELINE CONSTRUCTION, THE WATER MAINS SHALL BE LAID A MINIMUM OF 10-FEET HORIZONTALLY FROM AN EXISTING SEWER OR STORM SEWER, UNLESS OTHERWISE DIRECTED BY THE ENGINEER. WHEN WATER MAINS MUST CROSS ABOVE A SEWER, THE WATER MAIN SHALL BE LAID AT SUCH AN ELEVATION THAT THE TOP OF THE SEWER IS AT LEAST 18-INCHES BELOW THE BOTTOM OF THE WATER MAIN. WHERE RE-LAYED WATER MAINS ARE SHOWN TO CROSS SEWERS, THE RE-LAYED WATER MAIN SHALL BE INSTALLED SO THAT A FULL LENGTH OF WATER MAIN CROSSES THE SEWER MIDWAY BETWEEN THE JOINTS OF THE WATER MAIN.
46. CONTRACTOR SHALL MAKE HIS OWN ARRANGEMENTS TO OBTAIN WATER FOR FLUSHING, CHLORINATION, AND TESTING. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING, FURNISHING, INSTALLING, AND REMOVING ALL NECESSARY MATERIAL (TAPS, CORPORATIONS, AND SERVICE PIPE) REQUIRED FOR PROPER TESTING AND CHLORINATION OF WATER MAINS.
47. AFTER TESTING, ALL CORPORATIONS INSTALLED FOR TESTING AND CHLORINATION SHALL BE REMOVED AND REPLACED WITH BRASS PLUGS. WATER TIGHTNESS OF BRASS PLUGS SHALL BE OBSERVED VISUALLY UNDER PRESSURE.
48. ALL ROAD CUTS SHALL BE RESTORED WITH SUB-BASE MATERIAL AT THE END OF EACH WORK DAY. CONTRACTOR SHALL MAINTAIN ROAD CUTS UNTIL THE TEMPORARY/PERMANENT PAVEMENT IS INSTALLED.
49. TEMPORARY TRENCH PAVEMENT SHALL BE INSTALLED AT THE END OF EACH WEEK AND DAILY FOR STATE ROADS UNLESS OTHERWISE DIRECTED BY THE OWNER. PERMANENT TRENCH PAVEMENT SHALL BE INSTALLED 90 TO 180 DAYS AFTER PIPELINE INSTALLATION UNLESS OTHERWISE DIRECTED BY THE OWNER.
50. THE CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO PRE-CONSTRUCTION GRADES UPON COMPLETION OF SEWER CONSTRUCTION, EXCEPT WHERE PERMANENT GRADE CHANGES ARE SPECIFICALLY NOTED OR ORDERED.
51. ALL ROADS AND DRIVEWAYS SHALL BE REPLACED TO COMPLY WITH MASSDOT REQUIREMENTS AND TOWN OF ORLEANS SPECIFICATIONS AS APPLICABLE.
52. ALL PAVED GUTTERS (ASPHALT WING), ALL STONE CURBS, AND ALL CONCRETE CURB ALONG ROADWAYS DISTURBED BY CONSTRUCTION SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO THE OWNER.
53. ALL EXISTING FRAMES, COVERS, BOXES, ETC. SHALL BE RAISED TO FINISH GRADES PRIOR TO PLACEMENT OF PAVEMENT WEARING COURSE.
54. THE CONTRACTOR SHALL REMOVE AND DISPOSE OF ALL WASTE BUILDING MATERIAL, CONCRETE, MASONRY, TREES, SHRUBS, DEBRIS AND OTHER MATERIALS NECESSARY FOR THE SATISFACTORY COMPLETION OF THE WORK AND AS REQUIRED BY THE OWNER. CONSTRUCTION DEBRIS SHALL BE DISPOSED OF IN STRICT ACCORDANCE WITH ALL APPLICABLE LOCAL, STATE AND FEDERAL LAWS.
55. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTINUOUS CLEANING OF MUD, DIRT AND DEBRIS OFF STREETS, WHEN SUCH MUD, DIRT OR DEBRIS IS DEPOSITED THERE AS A RESULT OF HIS CONSTRUCTION ACTIVITY. ANY DEBRIS, MUD, OR DELETERIOUS MATERIAL FROM THE PROJECT WILL BE REMOVED FROM THE STREET AND SURROUNDING STREETS BY CONTRACTOR AT THE END OF EACH WORKING DAY, OR BEFORE, IF DIRECTED BY THE OWNER OR ENGINEER.
56. USE WATER SPRINKLING, TEMPORARY ENCLOSURES AND OTHER SUITABLE METHODS TO LIMIT DUST AND DIRT RISING AND SCATTERING IN THE AIR.
57. CONTRACTOR IS RESPONSIBLE FOR REPLACING ALL EXISTING PAVEMENT MARKINGS INCLUDING CENTER LINES, EDGE LINES, STOP LINES, CROSSWALKS AND LETTERING FOLLOWING PLACEMENT OF TEMPORARY PAVEMENT AND FOLLOWING PERMANENT PAVEMENT OR AS DIRECTED BY THE ENGINEER. THERMOPLASTIC PLASTIC ROAD PAINT SHALL BE UTILIZED FOR ALL PAVEMENT MARKING IN STATE ROADWAYS. ACETONE ROAD PAINT SHALL BE UTILIZED FOR ALL ROADWAY MARKING IN TOWN ROADWAYS. REFER TO SECTION 02503, PAVING, CURBING, SIDEWALKS AND ROADWAYS.

ABBREVIATIONS

B.B.	BITUMINOUS BERM	INV	INVERT
BIT. CURB	BITUMINOUS CURB	LP	LOW PRESSURE
BIT. CONC.	BITUMINOUS CONCRETE	LSA	LANDSCAPED AREA
B.O.E.	BOTTOM OF EXPLORATION	MB	MAIL BOX
BM	BENCH MARK	MIN	MINIMUM
CB	CATCH BASIN	NTS	NOT TO SCALE
CI	CAST IRON	PL	PLASTIC
CICL	CEMENT LINED CAST IRON	PVC	POLYVINYL CHLORIDE
CMP	CORRUGATED METAL PIPE	PVMT	PAVEMENT
CONC.	CONCRETE	PWW	PAVED WATERWAY
CONN.	CONNECT	R	RIM
CS	CARBON STEEL	RCP	REINFORCED CONCRETE PIPE
DI	DUCTILE IRON	S	SLOPE
DICL	DUCTILE IRON CEMENT LINED	SMH	SEWER MANHOLE
DMH	DRAINAGE MANHOLE	SWL	SINGLE WHITE LINE
DOE	DEPTH OF EXPLORATION	SYL	SINGLE YELLOW LINE
DYL	DOUBLE YELLOW LINE	STA	STATION
ELEC	ELECTRICAL	TBM	TEMPORARY BENCHMARK
EL	ELEVATION	TMH	TELEPHONE MANHOLE
EOP	EDGE OF PAVEMENT	T.O.P.	TOP OF PIPE
EP	EXISTING PAVEMENT	TRANS	TRANSFORMER
EXIST.	EXISTING	TYP	TYPICAL
FT	FEET	UE	UNDERGROUND ELECTRIC
FM	FORCE MAIN	UP	UTILITY POLE
G	GAS	VCP	VITRIFIED CLAY PIPE
GAR	GARAGE	WTFC	WATERTIGHT FRAME AND COVER
GC	GRANITE CURB	W	WITH
HDPE	HIGH DENSITY POLYETHYLENE	WF	WETLAND FLAG

LEGEND

EXISTING	NEW
CONCRETE BOUND WITH DRILL HOLE	LIMIT OF WORK
CONCRETE BOUND	EROSION PROTECTION
MASS HIGHWAY BOUND	SEDIMENTATION CONTROL AT CATCH BASIN
IRON ROD FOUND	TEST PIT
ROUND CATCH BASIN	DEMOLITION - (REMOVE AND LEGALLY DISPOSE OF)
CATCH BASIN	
DOUBLE CATCH BASIN	STRUCTURE
CULVERT	
DRAIN MANHOLE	ACCESS HATCH
DRAINAGE HEADWALL	VENT
SEWER MANHOLE	SEWER MANHOLE
DISPOSAL SYSTEM COVER	CENTERLINE
CESSPOOL	GRAVITY SEWER AND FLOW DIR.
ELECTRIC BOX	SEWER SERVICE LINE
ELECTRIC MANHOLE	SEWER FORCEMAIN
GAS VALVE	PIPING LESS THAN 12" DIAM.
TELEPHONE BOX	PLUG VALVE
TELEPHONE MANHOLE	REDUCER
WATER GATE	STATIONING
IRRIGATION CONTROL VALVE	STORM DRAIN AND FLOW DIR.
FIRE HYDRANT	CATCH BASIN
UTILITY POLE WITH RISER	LEACHING BASIN AND EXTENT OF GRAVEL
UTILITY POLE	ELECTRICAL DUCT
UTILITY POLE WITH LIGHT	PROJECT PAVEMENT RESTORATION LIMITS
UTILITY POLE WITH LIGHT AND RISER	EDGE OF PAVEMENT AND CAPE COD BERM
UTILITY POLE WITH TRANSFORMER	CONTOUR AND ELEVATION
GUY	SPOT ELEVATION
DECIDUOUS TREE	GUARD POST
CONIFER TREE	PARKING SPACES
SHRUB	PAINTED AREA - NO PARKING
SIGN (SINGLE POSTED)	
SIGN (DOUBLE POSTED)	PROPOSED TREE LINE
TRAFFIC SIGNAL	BORING LOCATION AND NUMBER
POST	MONITORING WELL AND NUMBER
MONITORING WELL	
BORING LOCATION AND ID	
LIGHT POLE	
FLAG POLE	
FIRE DEPARTMENT CONNECTION	
VENT	
SPOT ELEVATION	
WETLAND FLAG	
WETLAND 100' BUFFER	
PROPERTY LINE	
FENCE	
SEWER LINE	
SEWER FORCEMAIN	
DRAIN LINE	
WATER LINE	
GAS LINE	
UNDERGROUND ELECTRIC	
UNDERGROUND CABLE	
TELEPHONE LINE	
OVERHEAD WIRES	
INTERMEDIATE CONTOURS	
INDEX CONTOURS	
EXISTING TREELINE	
100 YR FLOOD EXTENT	
WETLAND	
WETLAND AND COASTAL BANK BUFFERS	
BUILDING	

AECOM

PROJECT

MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION
CONTRACT No. 2022-01
SRF No. 7150

OWNER

TOWN OF ORLEANS, MA
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Dept Check:	C. BENZIGER
Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

LEGEND, ABBREVIATIONS AND GENERAL NOTES

SHEET NUMBER

00 C-001

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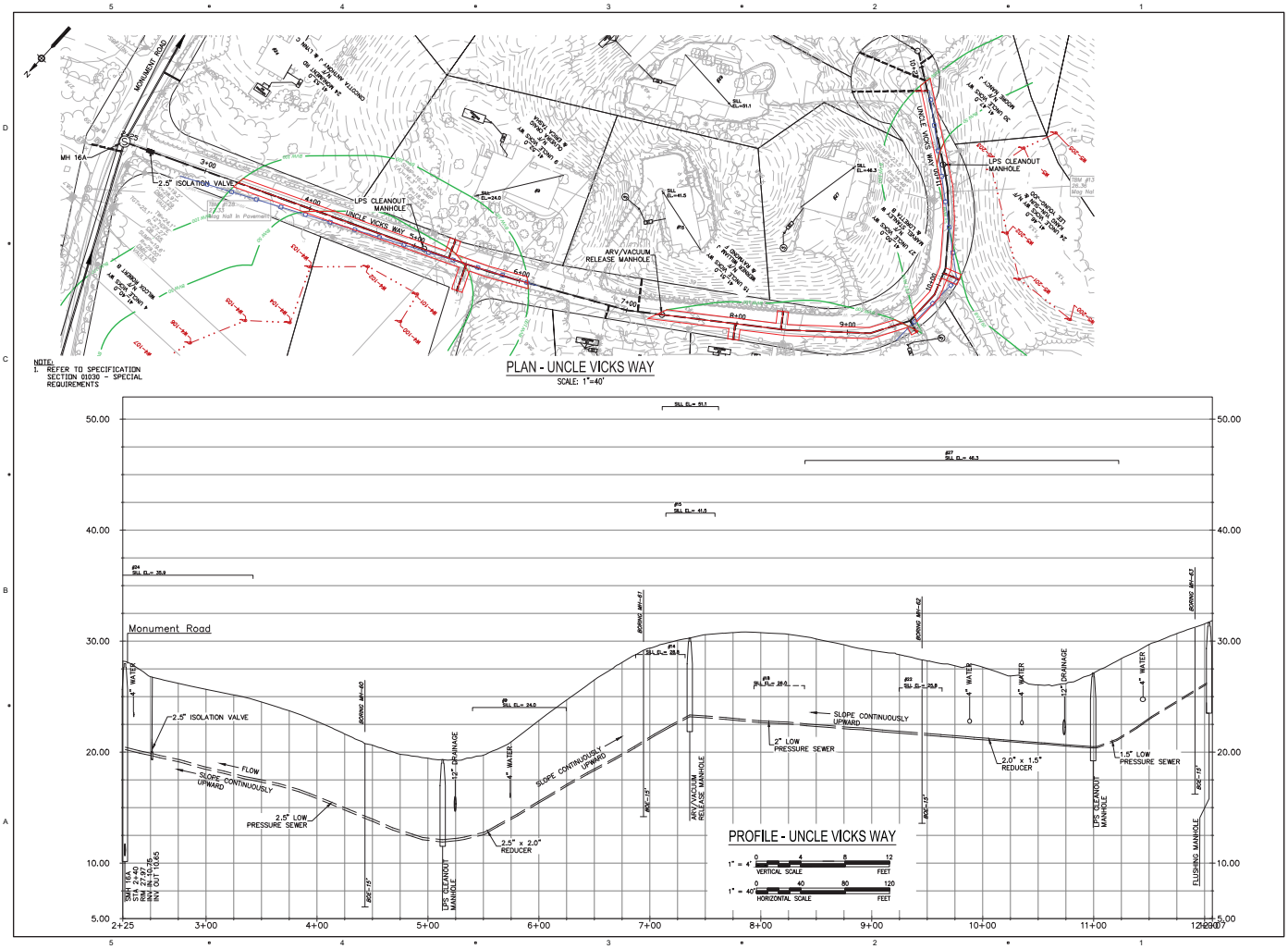

PLAN - UNCLE VICKS WAY
SCALE: 1"=40'

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PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

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Drawn By:	S. GREBENNIKOV
Dept Check:	T. PARECE
Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER UNCLE VICKS WAY

SHEET NUMBER

04 C-202

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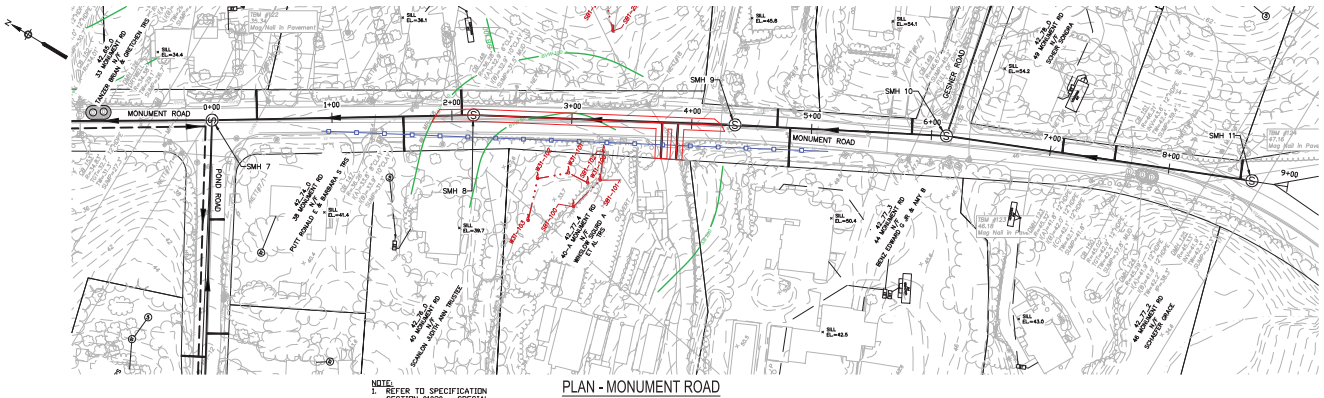
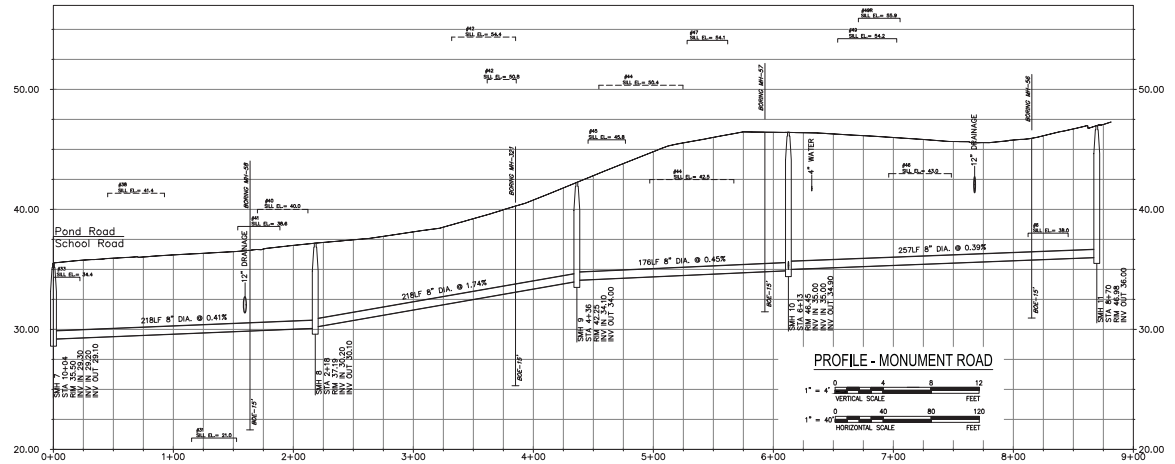


NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - MONUMENT ROAD
SCALE: 1"=40'



PROFILE - MONUMENT ROAD
1" = 4' VERTICAL SCALE
1" = 40' HORIZONTAL SCALE

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Proj Check:	T. HARRISON
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Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
PLAN AND PROFILE SEWER MONUMENT ROAD

SHEET NUMBER
04 C-203

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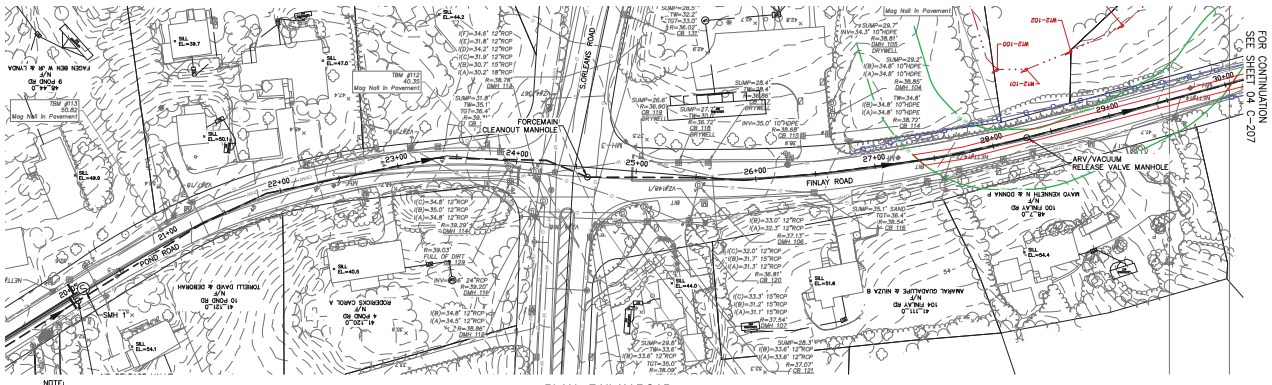
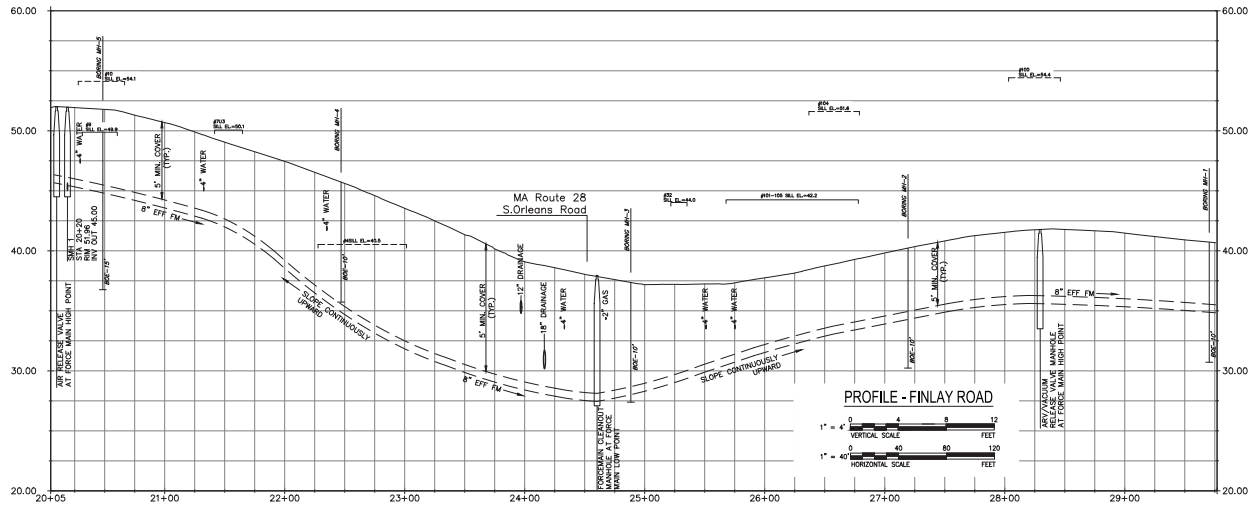


PLAN - FINLAY ROAD
SCALE: 1"=40'



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SHEET TITLE

PLAN AND PROFILE SEWER FINLAY ROAD

SHEET NUMBER

04 C-206

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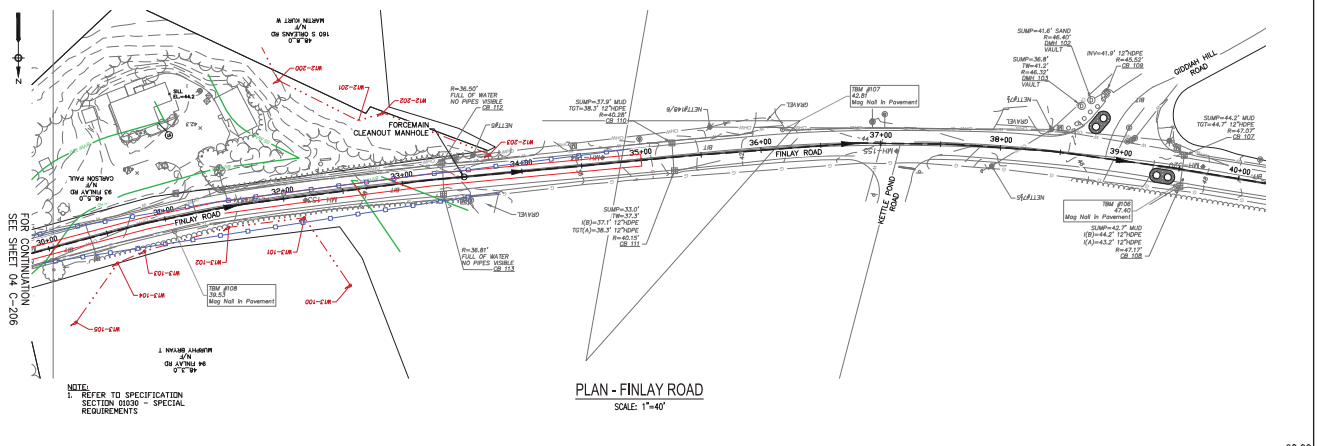

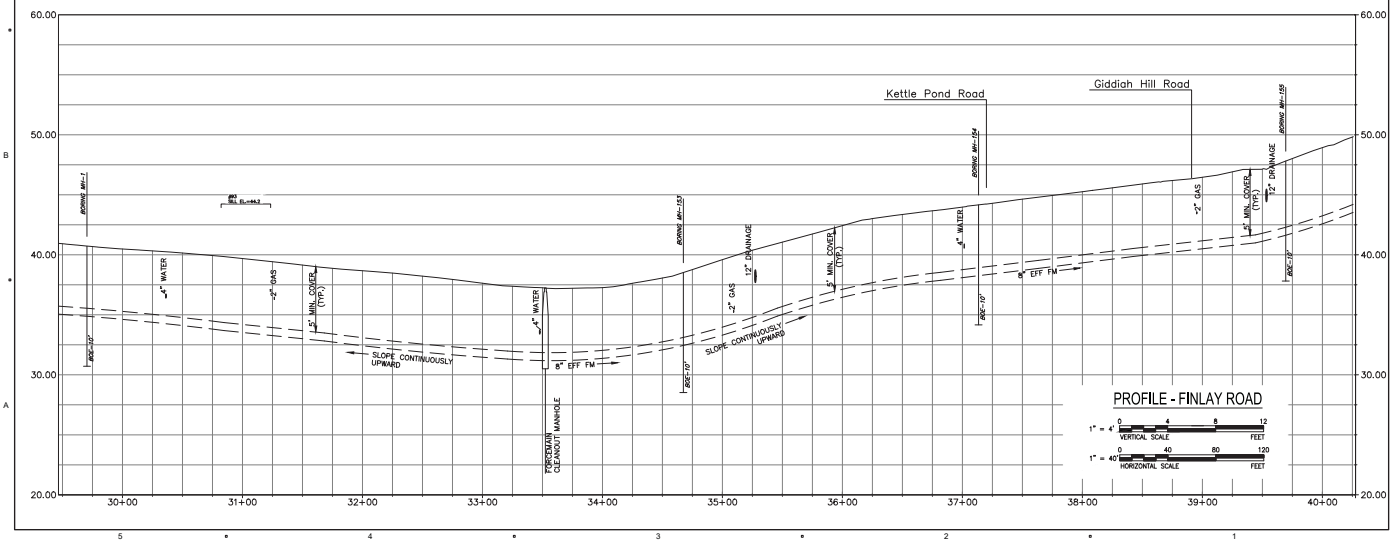

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SHEET TITLE

PLAN AND PROFILE SEWER FINLAY ROAD

SHEET NUMBER

04 C-207

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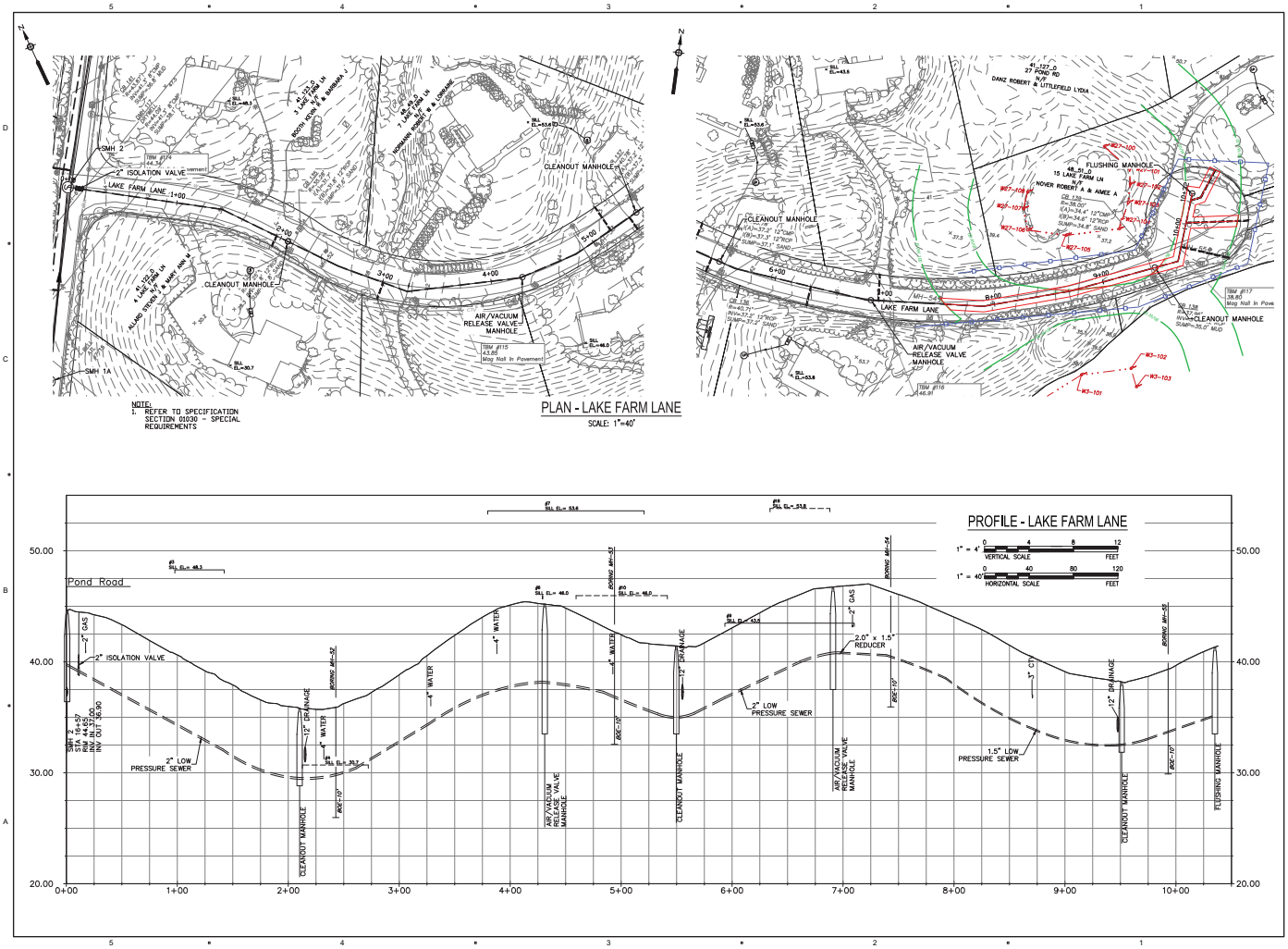

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - LAKE FARM LANE
SCALE: 1"=40'

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MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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SHEET TITLE

PLAN AND PROFILE SEWER LAKE FARM LANE

SHEET NUMBER

04 C-210

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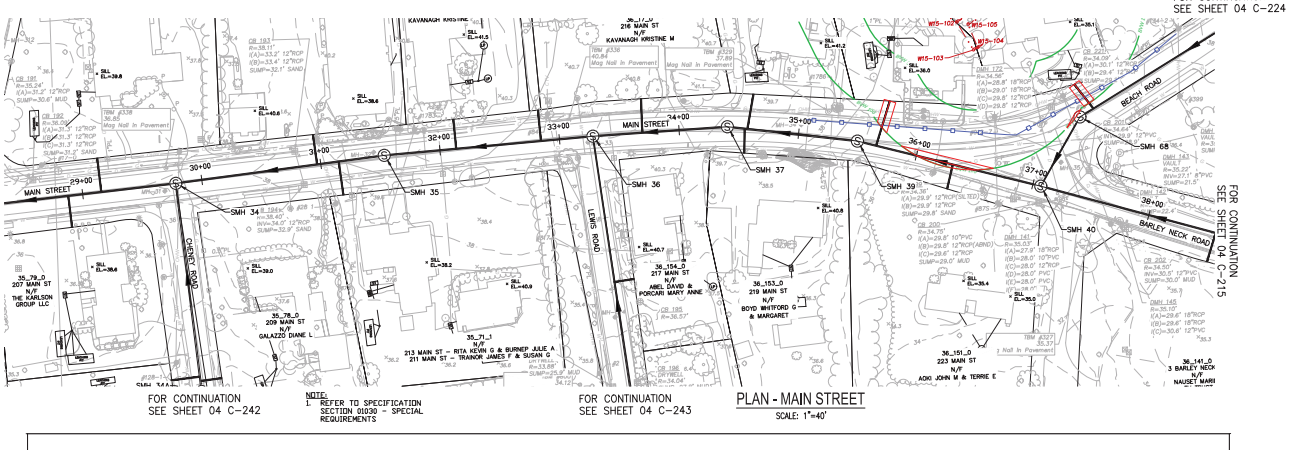
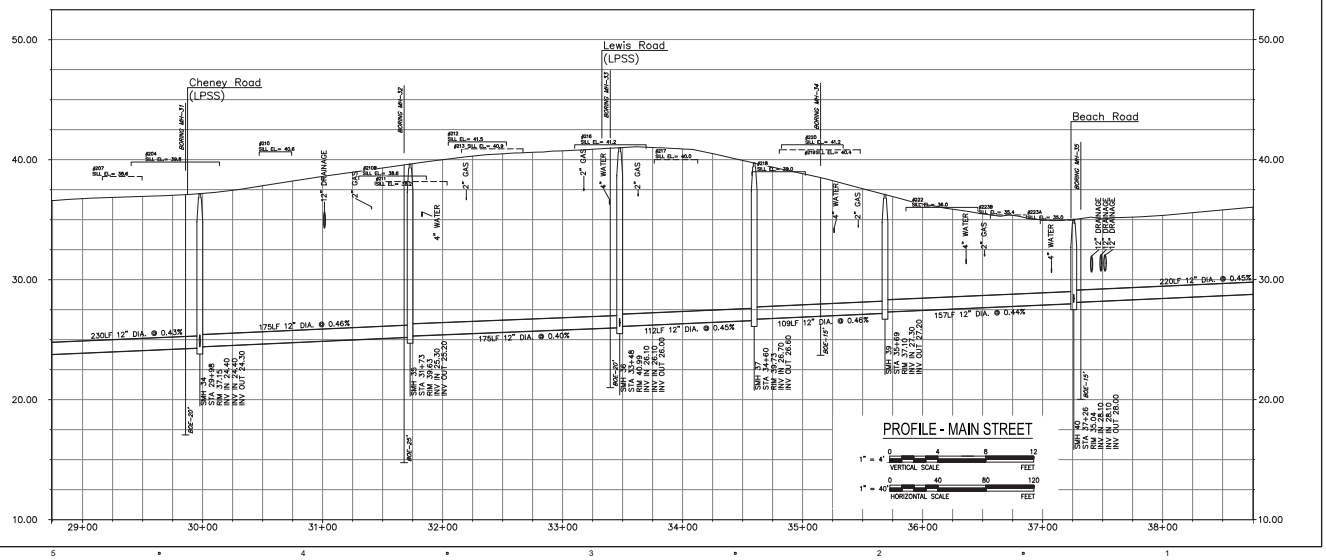


NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - MAIN STREET
SCALE: 1"=40'



PROFILE - MAIN STREET

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
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DISCIPLINE

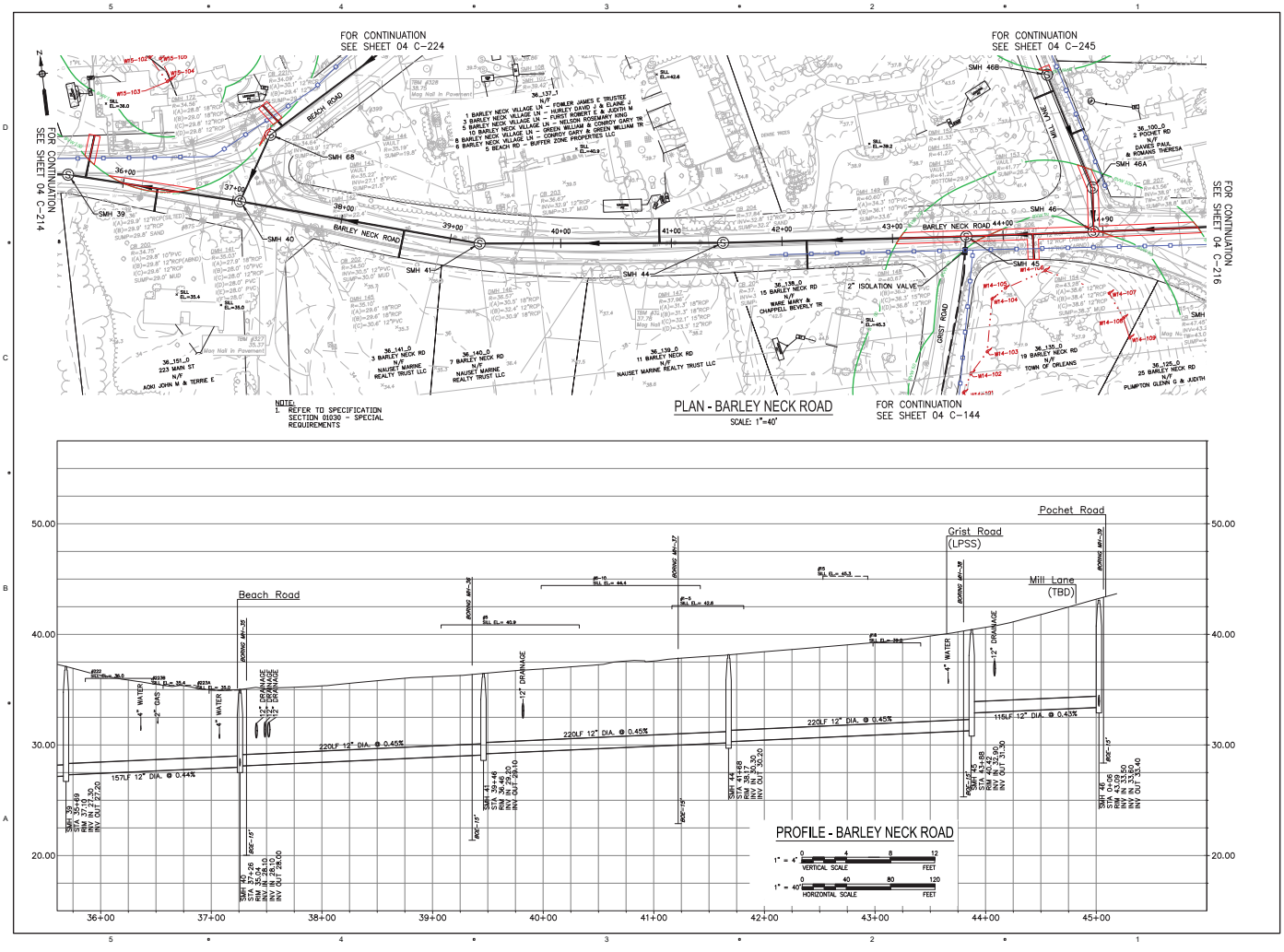
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER MAIN STREET

SHEET NUMBER

04 C-214



PLAN - BARLEY NECK ROAD

SCALE: 1"=40'

PROFILE - BARLEY NECK ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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Proj Check:	T. HARRISON
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Scale:	AS NOTED

DISCIPLINE

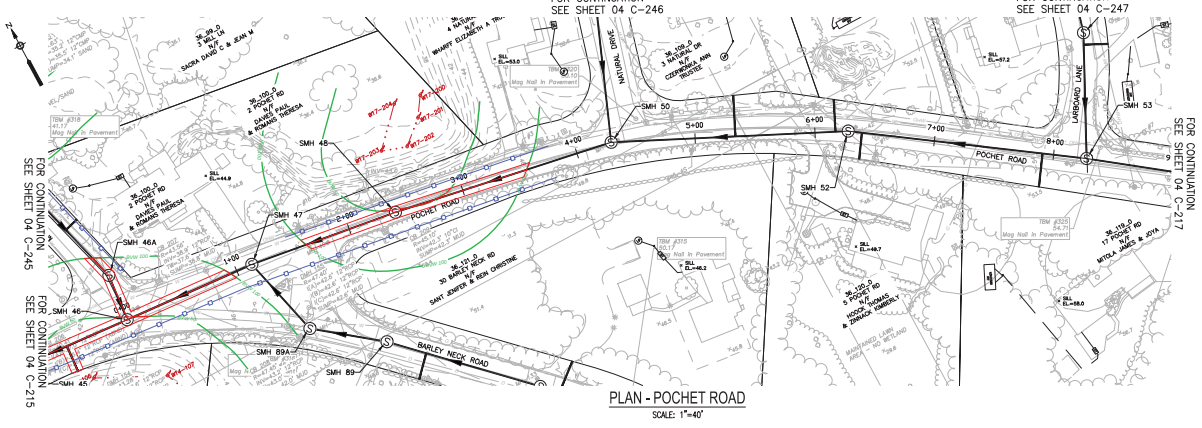
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER BARLEY NECK ROAD

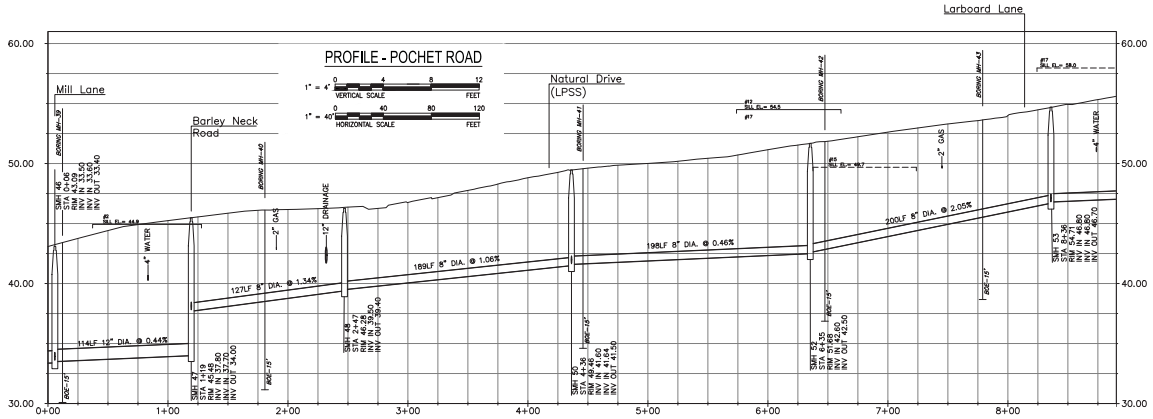
SHEET NUMBER

04 C-215



PLAN - POCHET ROAD
SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



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Proj Check:	T. HARRISON
Date:	JUNE 2022
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SHEET TITLE

PLAN AND PROFILE SEWER POCHET ROAD

SHEET NUMBER

04 C-216

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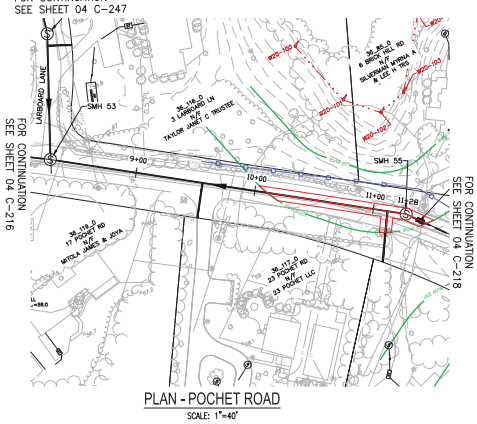
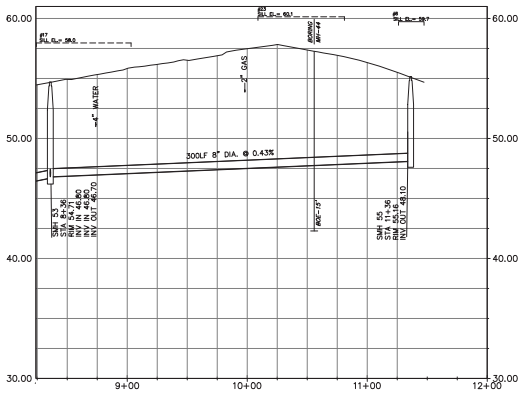


PLAN - POCHET ROAD

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - POCHET ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

AECOM

PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

OWNER

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (978) 905-2100
www.aecom.com

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60652634

Designed By:	M. DONOGHUE
Drawn By:	S. GREBENNIKOV
Dept Check:	T. PARECE
Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER POCHET ROAD

SHEET NUMBER

04 C-217

Last saved by: GREBENNIKOV (2022-05-23) Last Plotted: 2022-05-23
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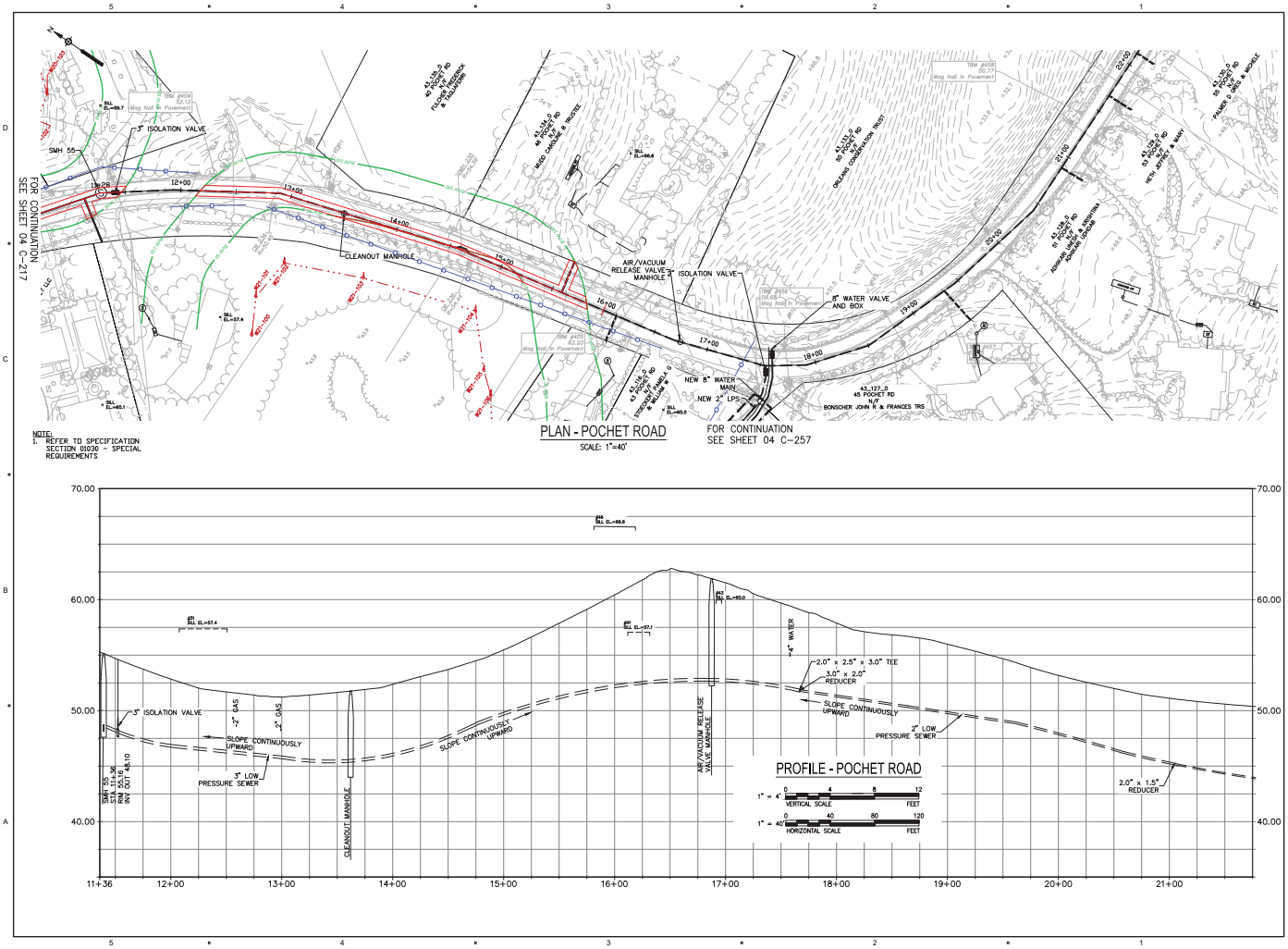

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - POCHET ROAD
SCALE: 1"=40'

PROFILE - POCHET ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

AECOM

PROJECT
MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

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Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
PLAN AND PROFILE SEWER POCHET ROAD

SHEET NUMBER
04 C-218

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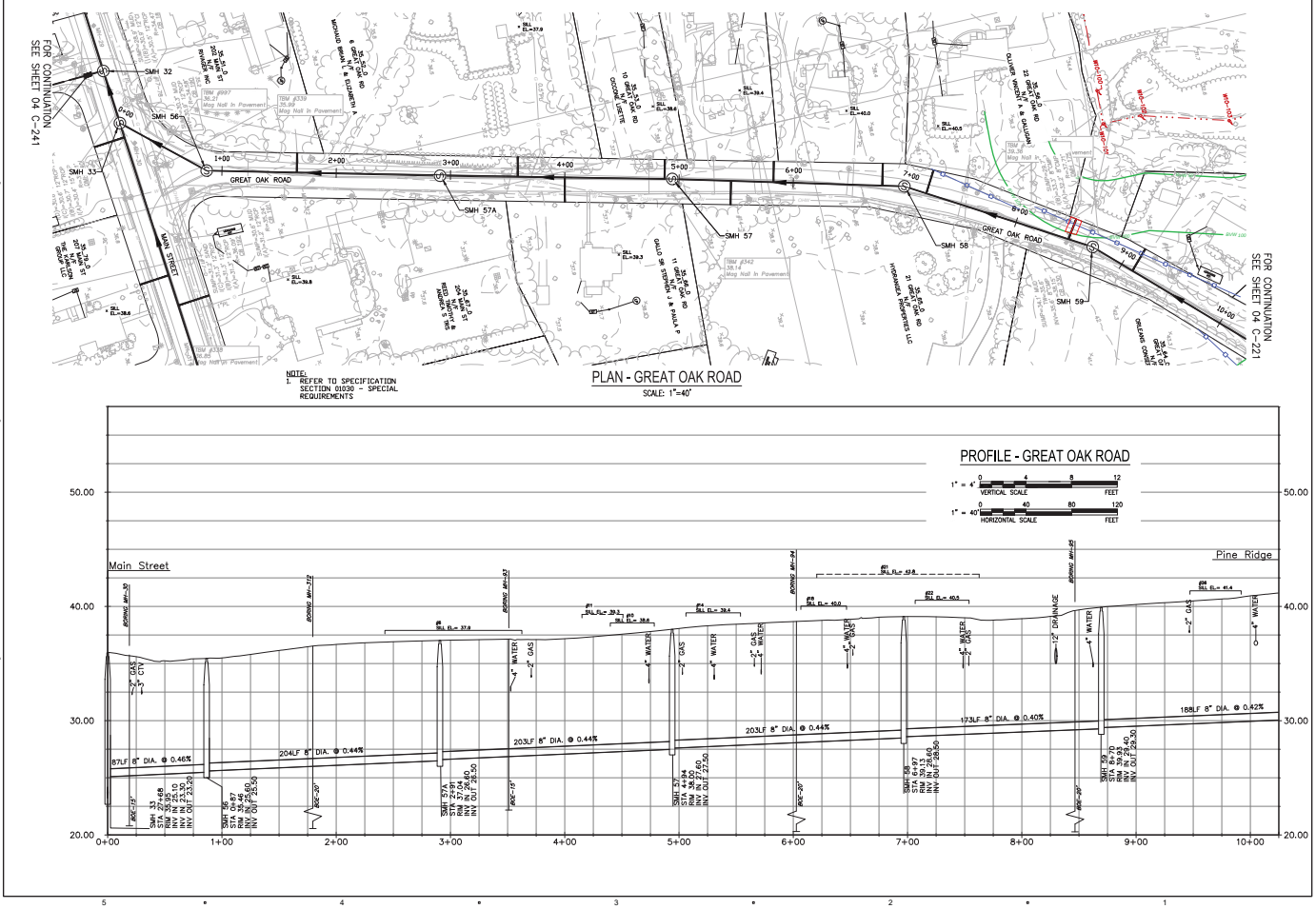

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PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

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DISCIPLINE

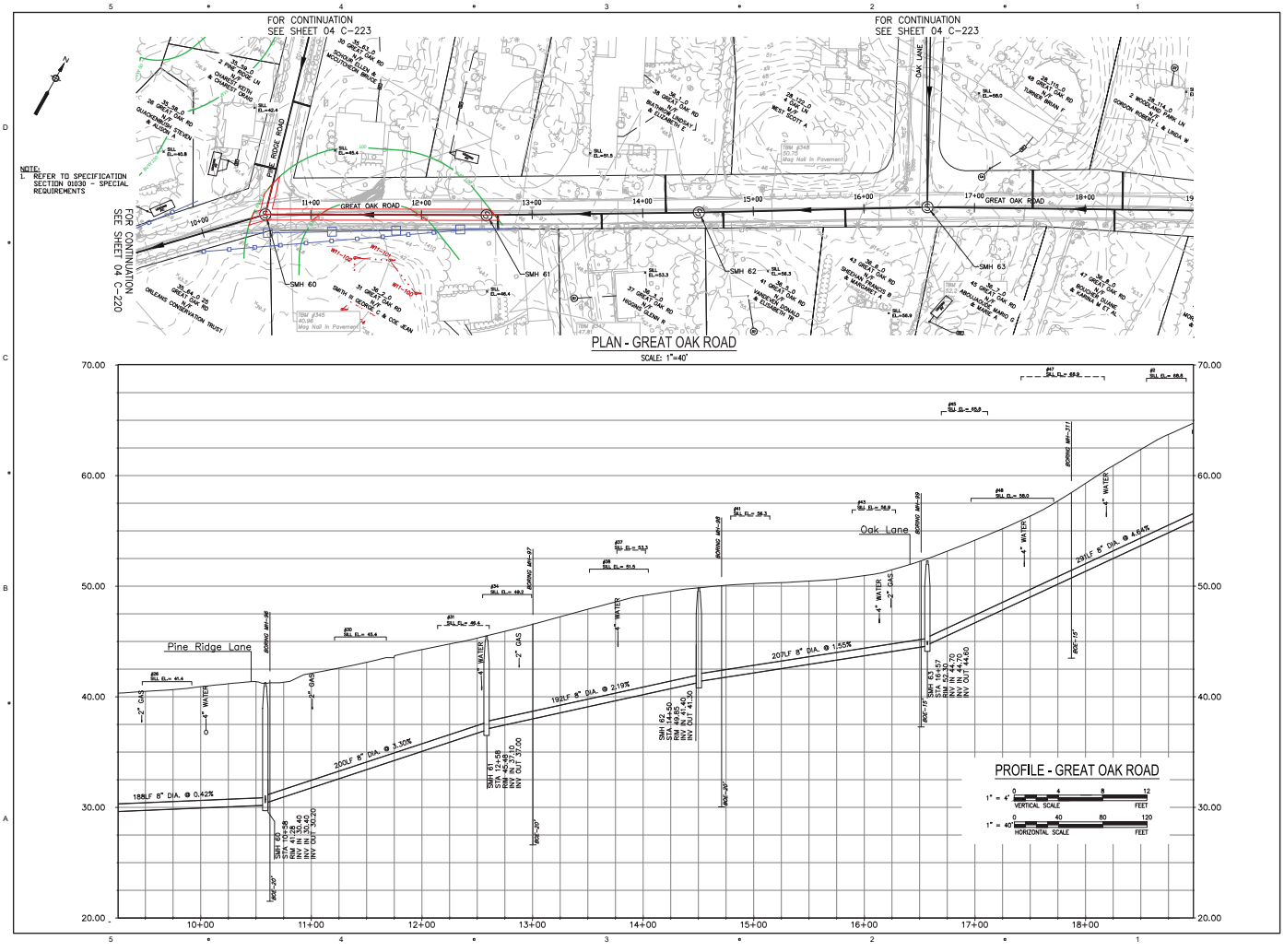
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER GREAT OAK ROAD

SHEET NUMBER

04 C-220



PLAN - GREAT OAK ROAD

SCALE: 1"=40'

PROFILE - GREAT OAK ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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Proj Check:	T. HARRISON
Date:	JUNE 2022
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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER GREAT OAK ROAD

SHEET NUMBER

04 C-221

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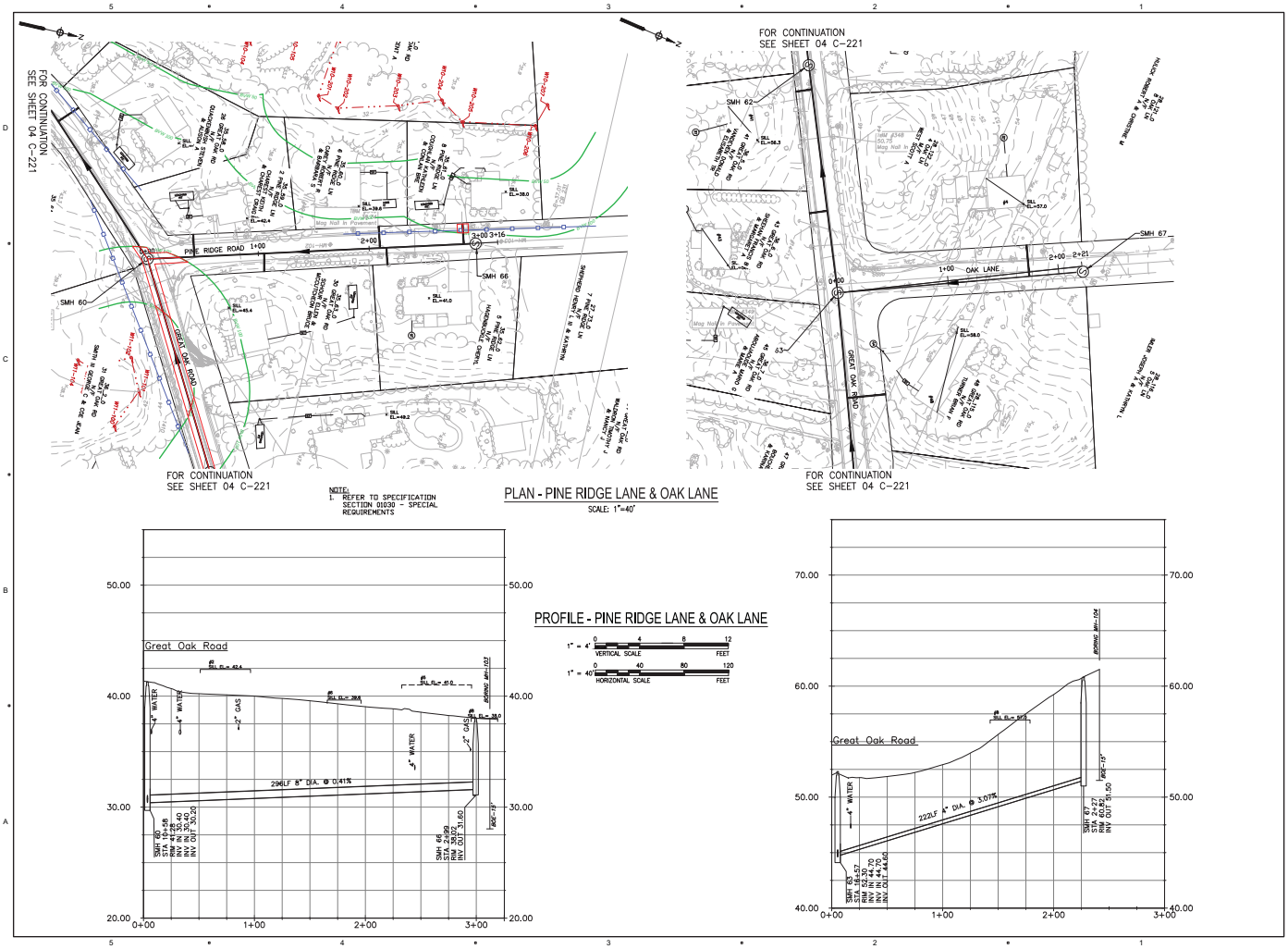

PLAN - PINE RIDGE LANE & OAK LANE

SCALE: 1"=40'

PROFILE - PINE RIDGE LANE & OAK LANE

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
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Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER PINE RIDGE LANE & OAK LANE

SHEET NUMBER

04 C-223

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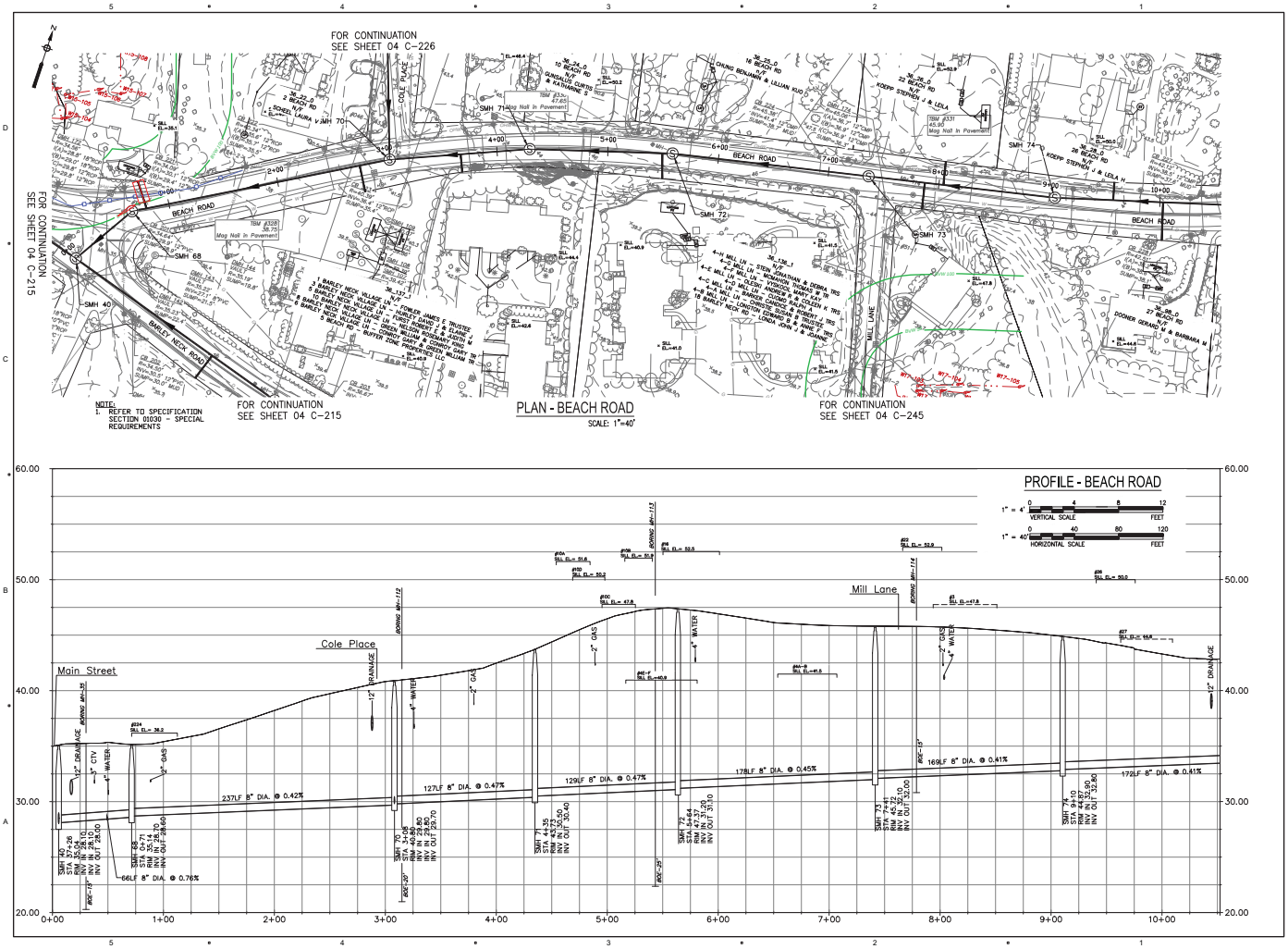

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MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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A	01-28-2022	ADDENDUM NO. 1

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Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE

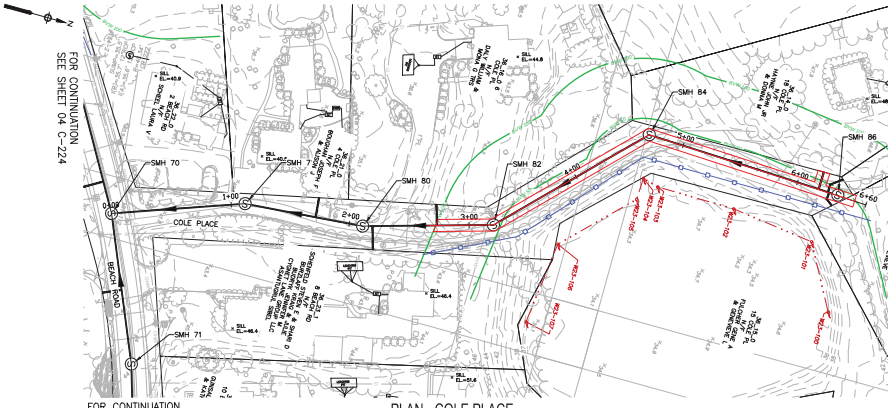
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER BEACH ROAD

SHEET NUMBER

04 C-224



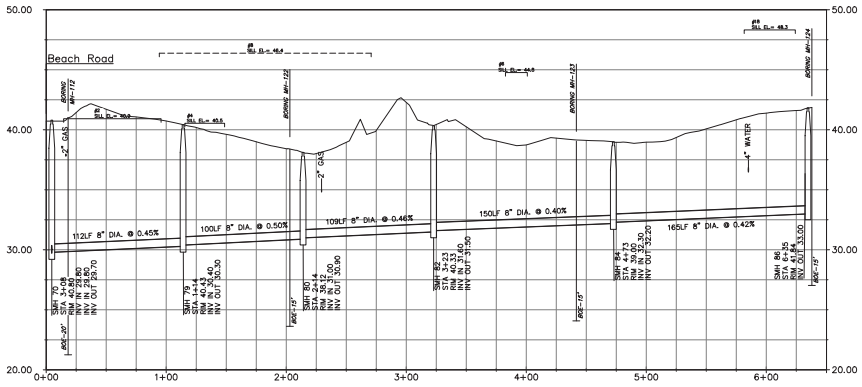
PLAN - COLE PLACE
SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PROFILE - COLE PLACE

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)



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PROJECT
MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
PLAN AND PROFILE SEWER COLE PLACE

SHEET NUMBER
04 C-226

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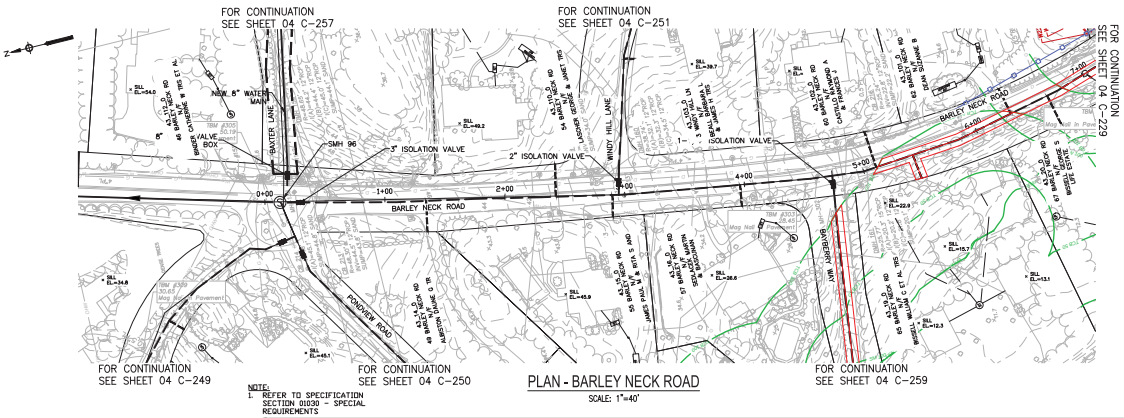
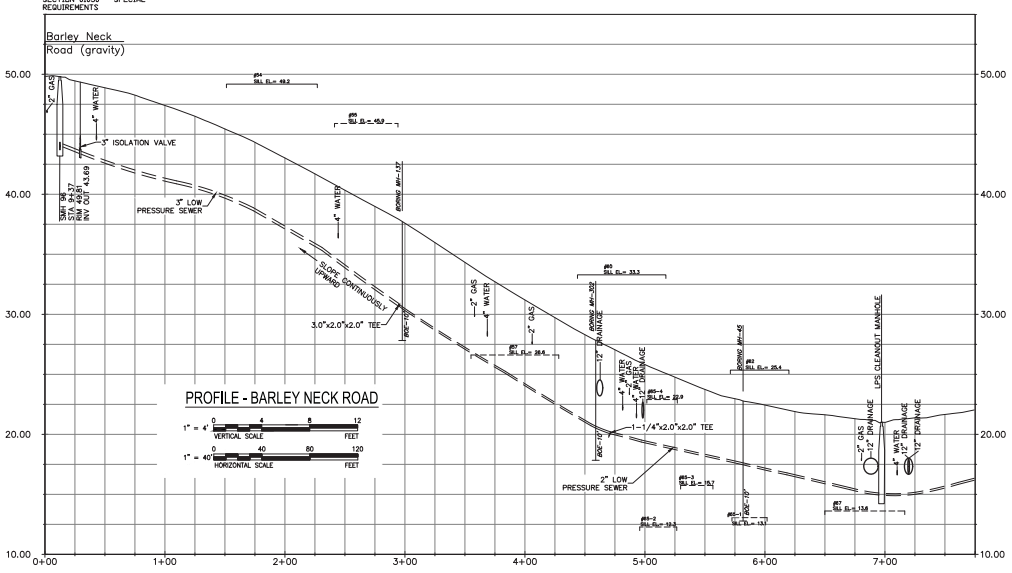


PLAN - BARLEY NECK ROAD

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - BARLEY NECK ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

AECOM

PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

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19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

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Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER BARLEY NECK ROAD

SHEET NUMBER

04 C-228

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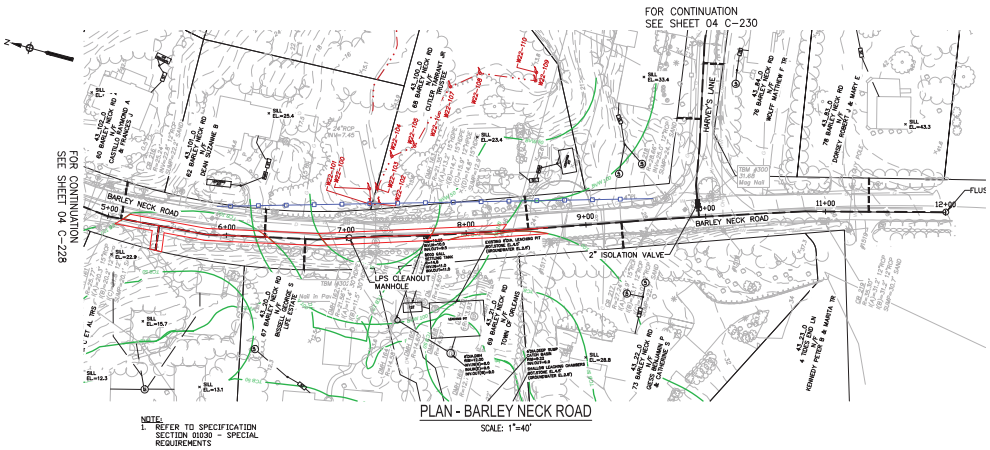
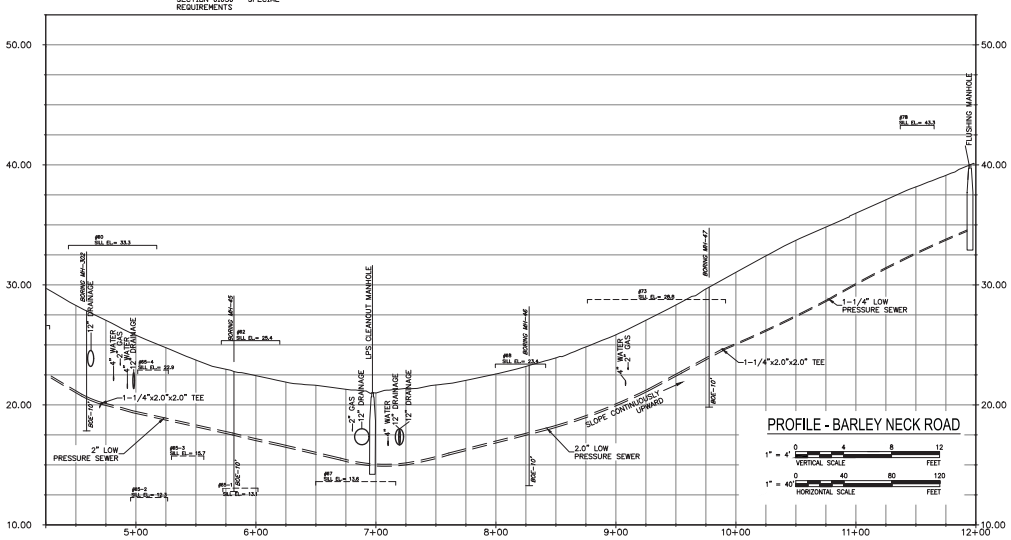


PLAN - BARLEY NECK ROAD

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - BARLEY NECK ROAD

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SHEET TITLE
PLAN AND PROFILE SEWER BARLEY NECK ROAD

SHEET NUMBER
04 C-229

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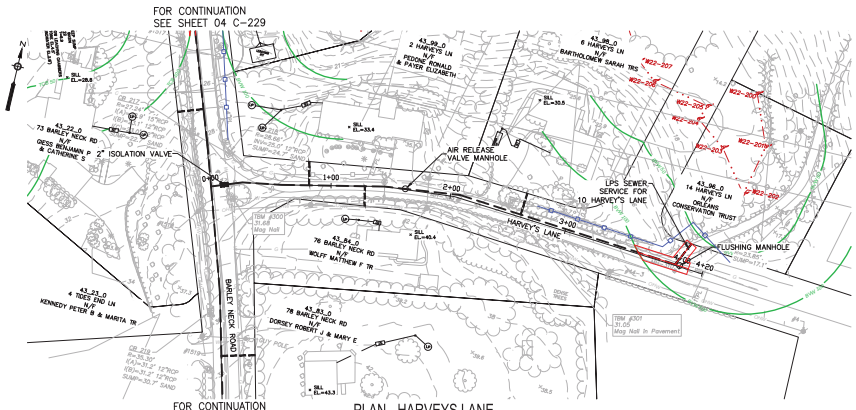
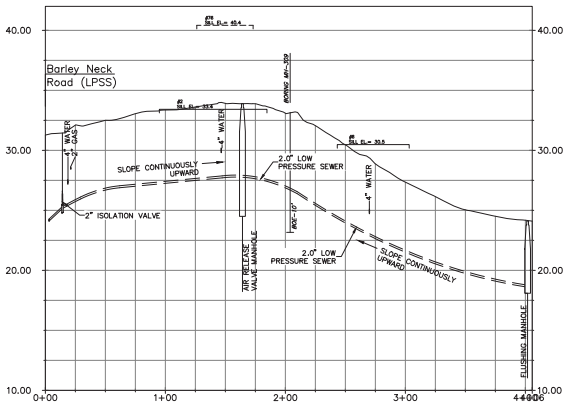


PLAN - HARVEYS LANE

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - HARVEYS LANE

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

AECOM

PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
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Proj Check:	T. HARRISON
Date:	JUNE 2022
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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER HARVEYS LANE

SHEET NUMBER

04 C-230

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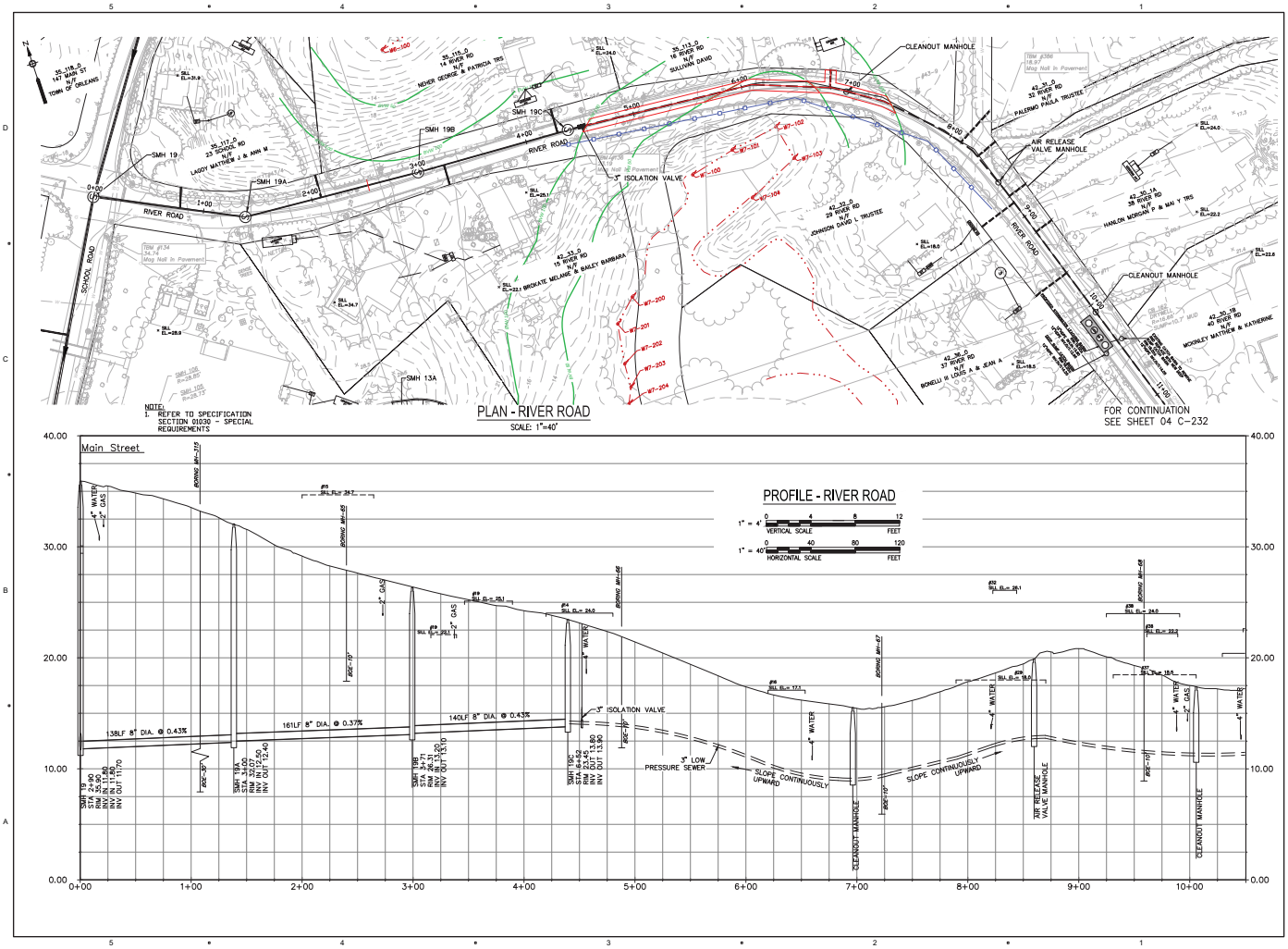

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Dept Check:	T. PARECE
Proj Check:	T. HARRISON
Date:	JUNE 2022
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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER RIVER ROAD

SHEET NUMBER

04 C-231

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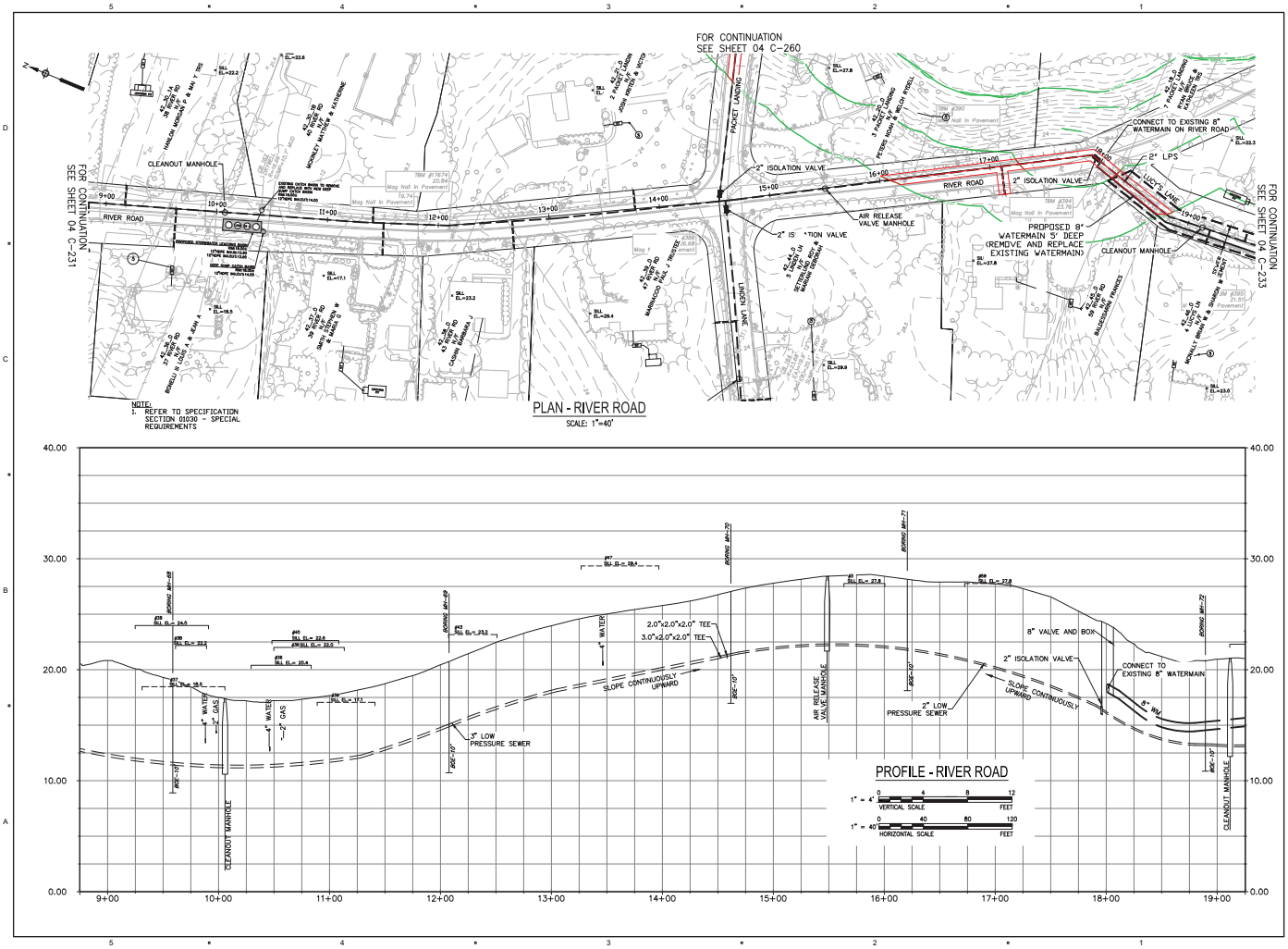

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PROJECT

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CONTRACT No. 2022-02
SRF No. 7150

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ORLEANS, MA 02653
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Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

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CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER RIVER ROAD

SHEET NUMBER

04 C-232

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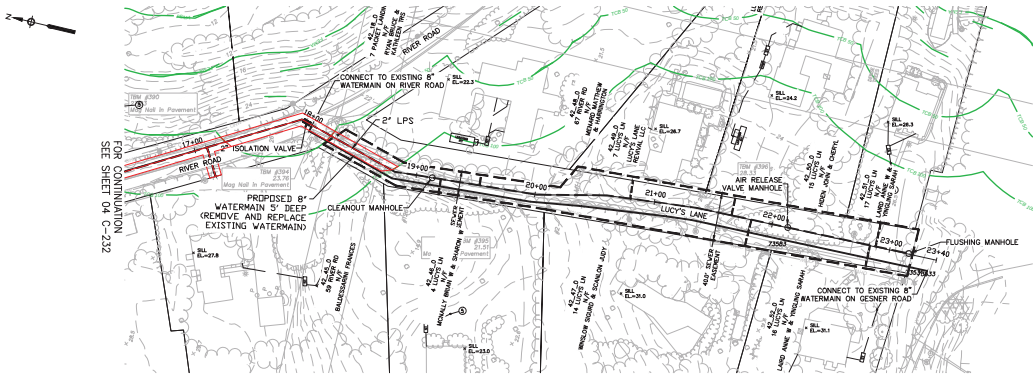
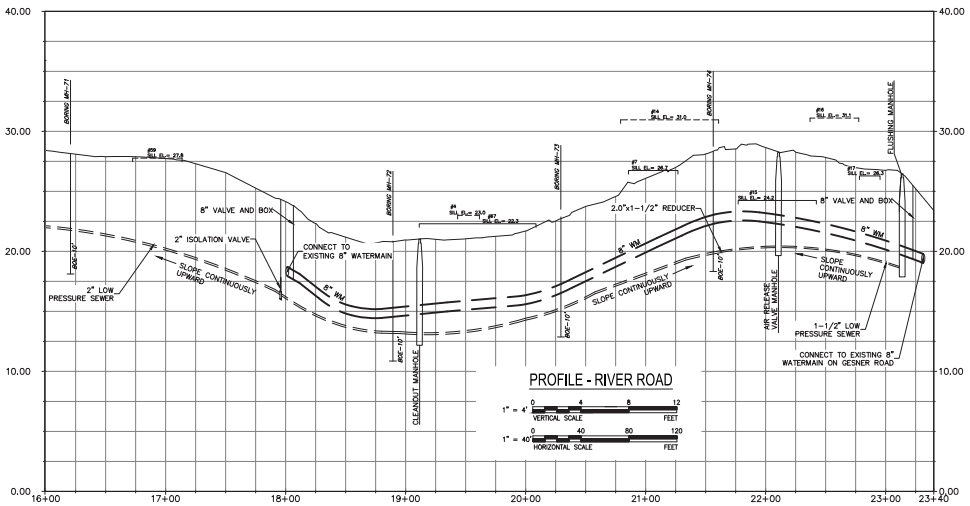


NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - RIVER ROAD
SCALE: 1"=40'



PROFILE - RIVER ROAD
1" = 4' VERTICAL SCALE
1" = 40' HORIZONTAL SCALE

AECOM

PROJECT
MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

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19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER
AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
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Designed By:	M. DONOGHUE
Drawn By:	S. GREBENNIKOV
Dept Check:	T. PARECE
Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
PLAN AND PROFILE SEWER RIVER ROAD

SHEET NUMBER
04 C-233

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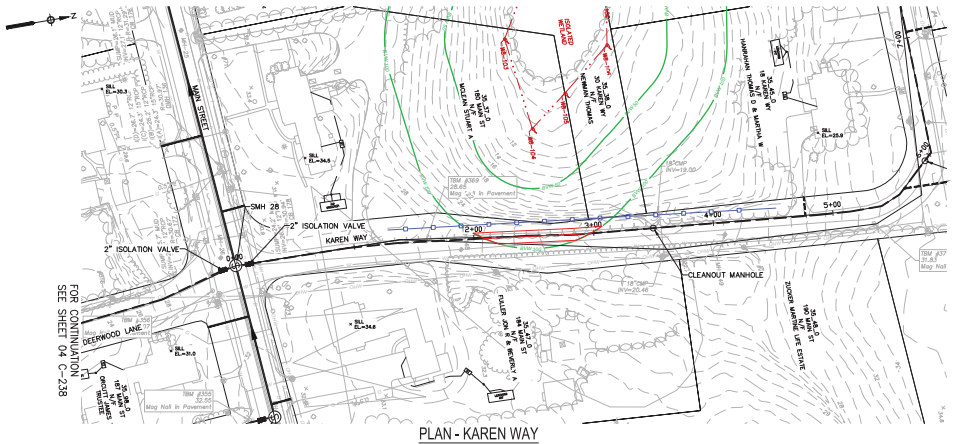
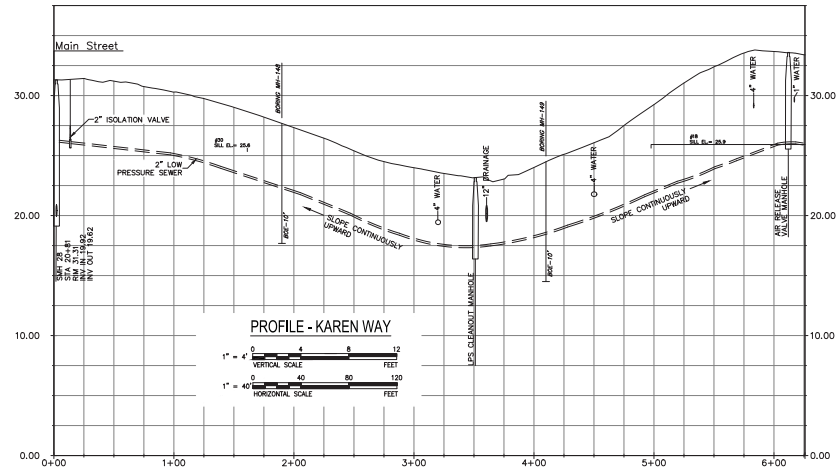


PLAN - KAREN WAY

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - KAREN WAY

1" = 4' VERTICAL SCALE

1" = 40' HORIZONTAL SCALE

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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER KAREN WAY

SHEET NUMBER

04 C-236

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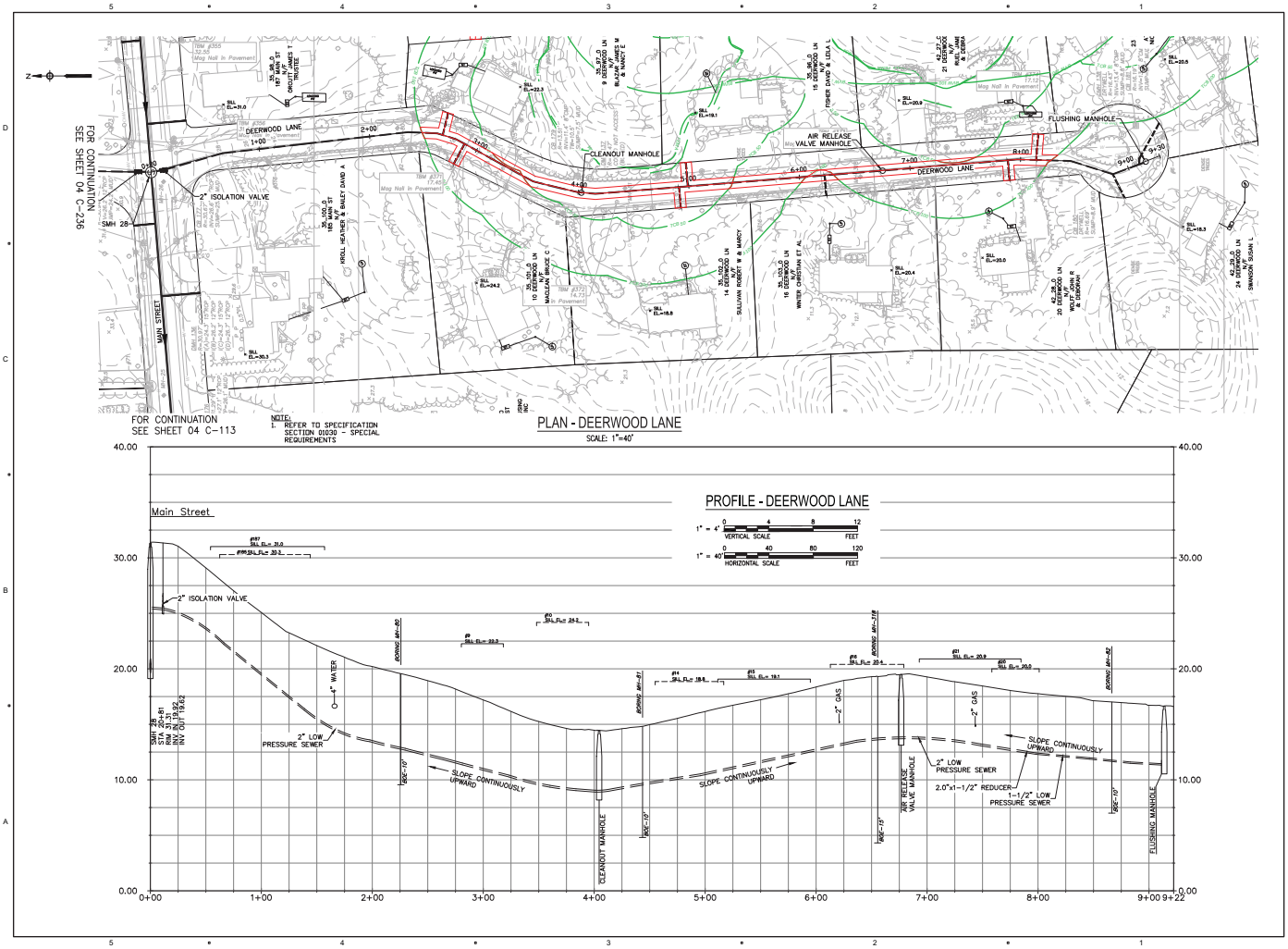

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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER DEERWOOD LANE

SHEET NUMBER

04 C-238

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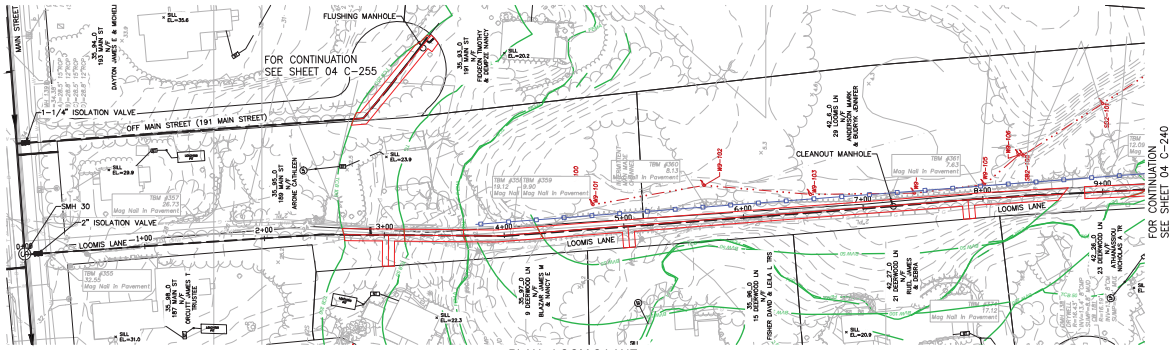
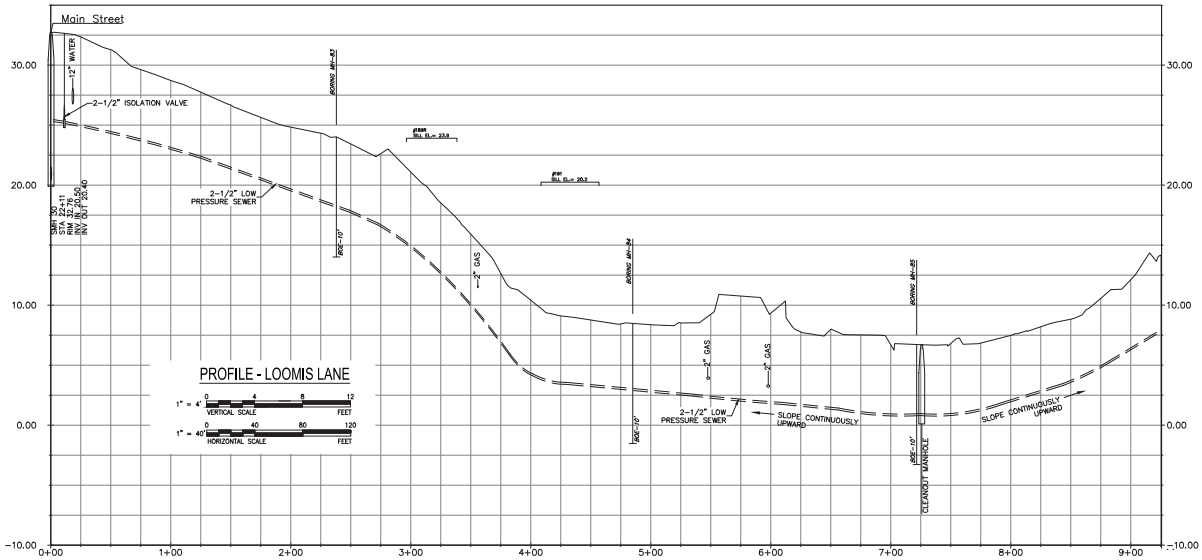


PLAN - LOOMIS LANE

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - LOOMIS LANE

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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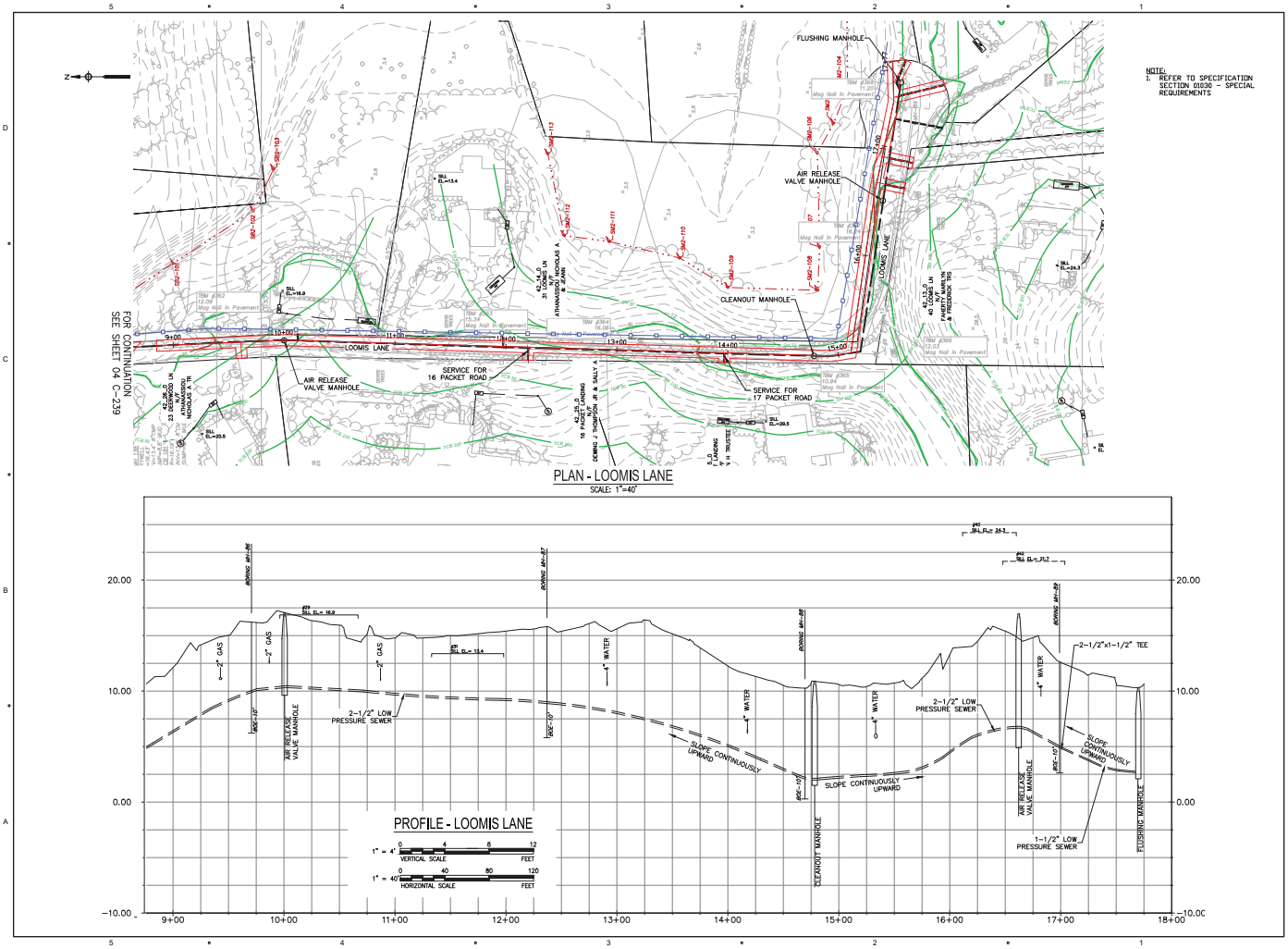
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER LOOMIS LANE

SHEET NUMBER

04 C-239



PLAN - LOOMIS LANE
SCALE: 1"=40'

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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER LOOMIS LANE

SHEET NUMBER

04 C-240

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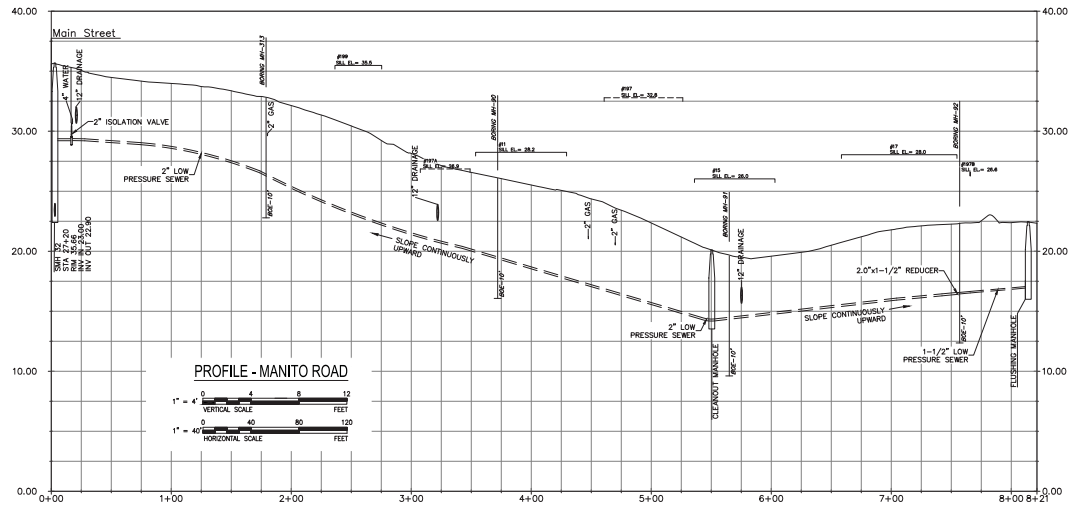
NOTE
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - MANITO ROAD
SCALE: 1"=40'



PROFILE - MANITO ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER MANITO ROAD

SHEET NUMBER

04 C-241

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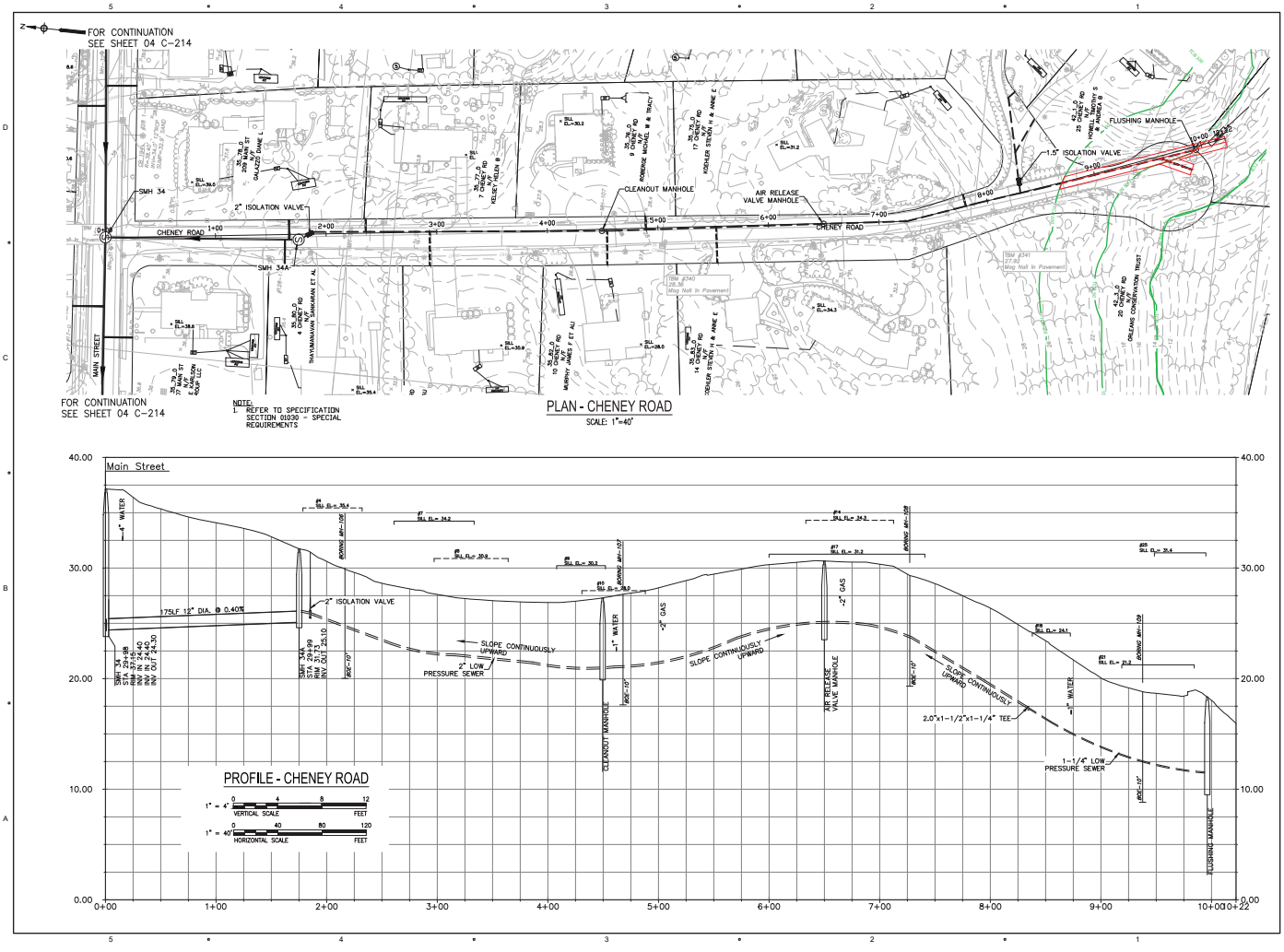

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PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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Proj Check:	T. HARRISON
Date:	JUNE 2022
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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER
CHENEY ROAD

SHEET NUMBER

04 C-242

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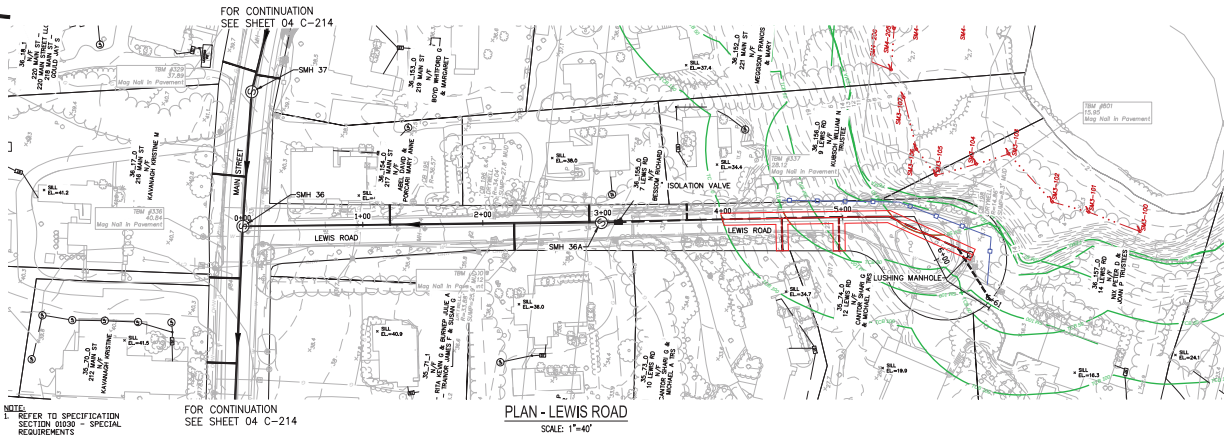
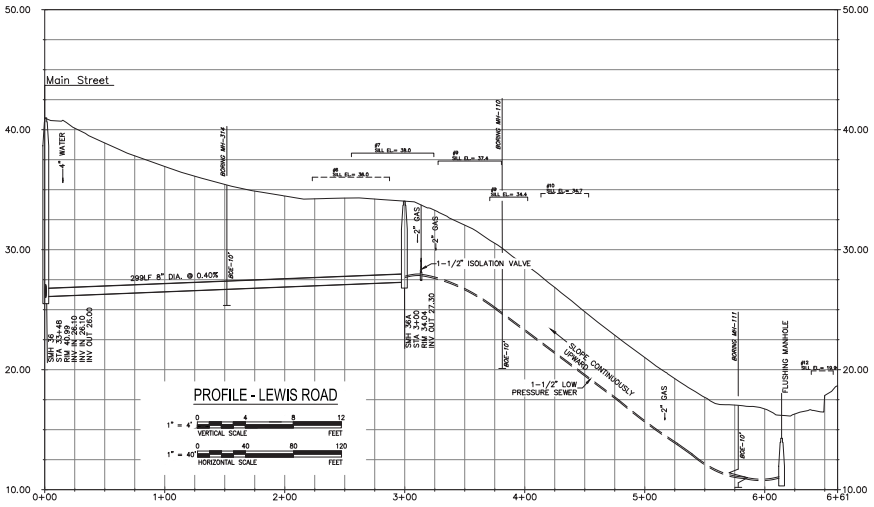


NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - LEWIS ROAD
SCALE: 1"=40'



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MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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SHEET TITLE

PLAN AND PROFILE SEWER LEWIS ROAD

SHEET NUMBER

04 C-243

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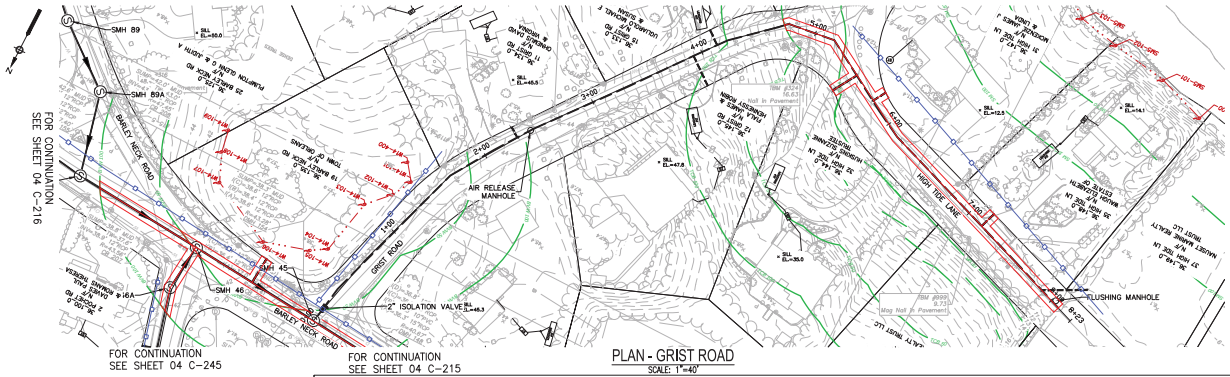
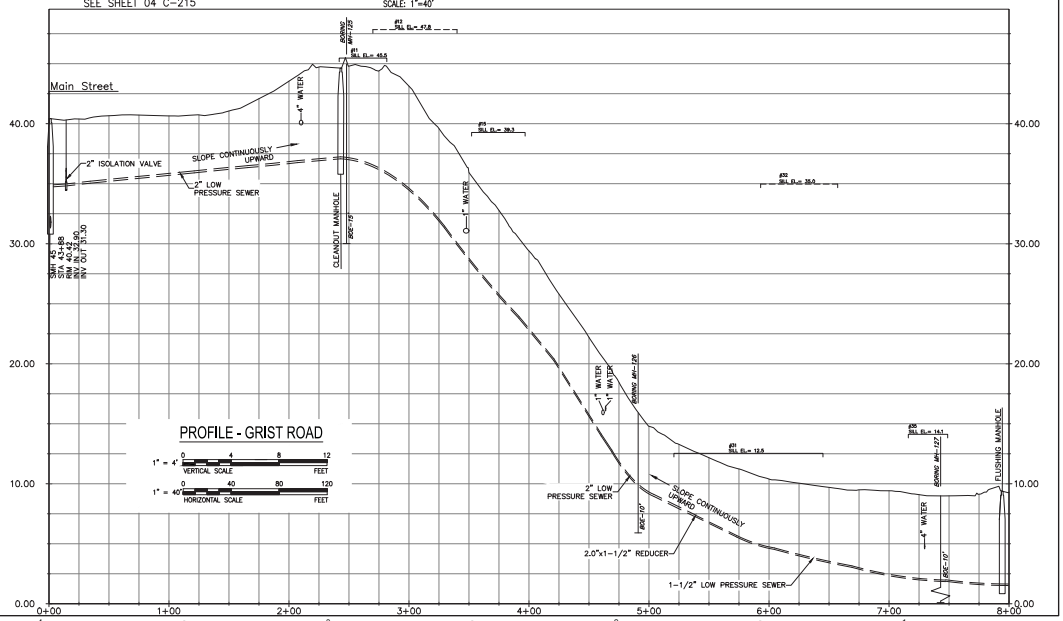


PLAN - GRIST ROAD
SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - GRIST ROAD
1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)
1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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SHEET TITLE
PLAN AND PROFILE SEWER GRIST ROAD

SHEET NUMBER
04 C-244

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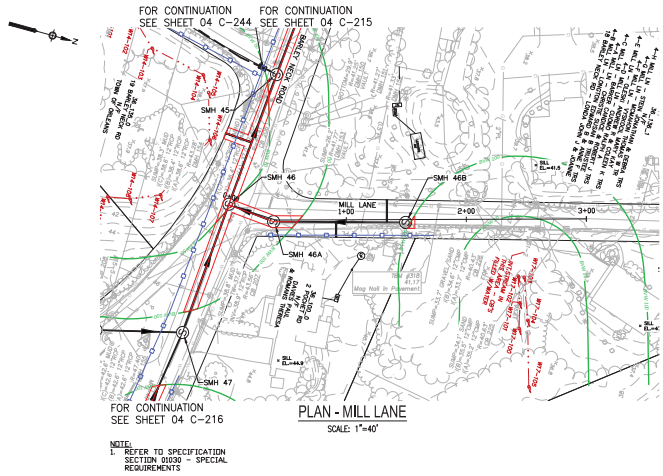
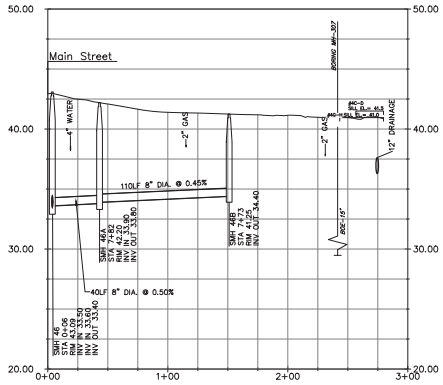


PLAN - MILL LANE

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - MILL LANE

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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Proj Check:	T. HARRISON
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SHEET TITLE

PLAN AND PROFILE SEWER MILL LANE

SHEET NUMBER

04 C-245

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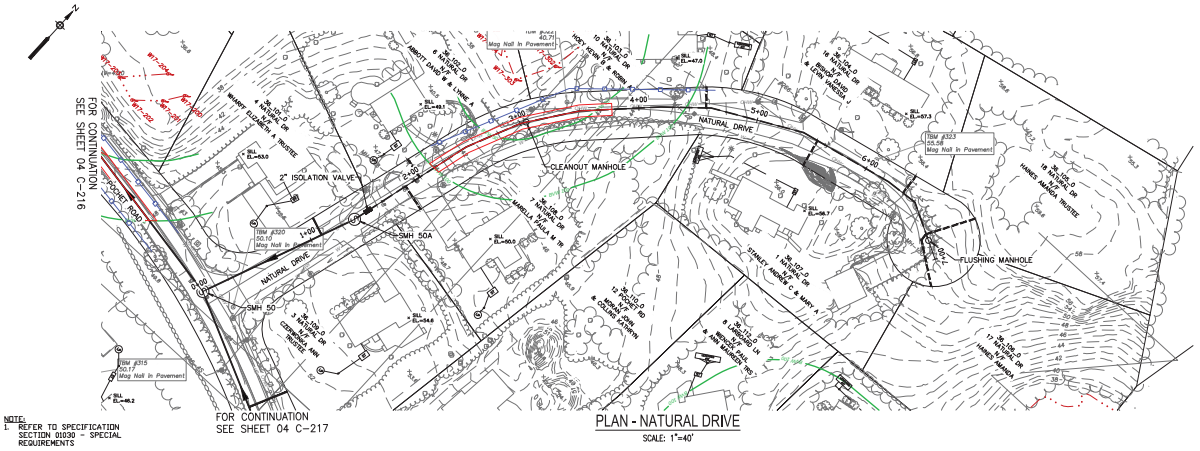
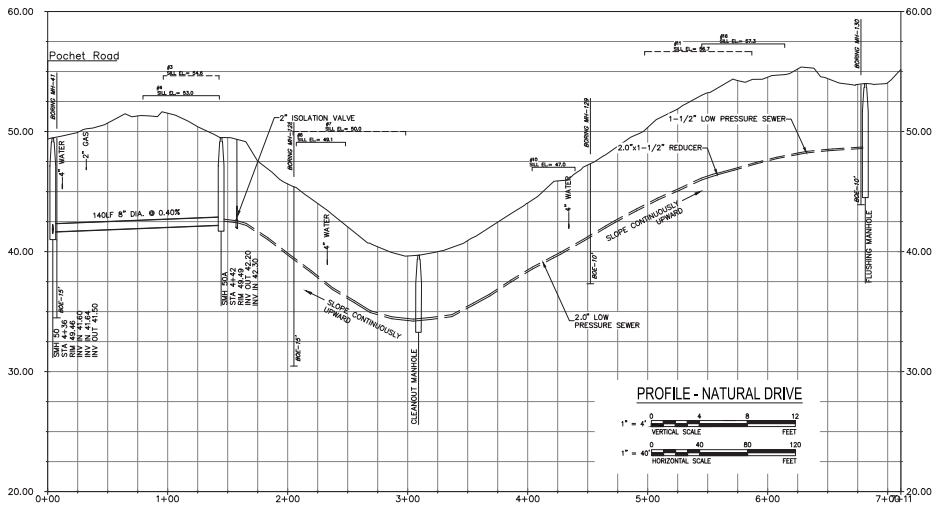


NOTE:
1. REFER TO SPECIFICATIOIN SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - NATURAL DRIVE
SCALE: 1"=40'



PROFILE - NATURAL DRIVE
1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)
1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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Proj Check:	T. HARRISON
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DISCIPLINE
CIVIL

SHEET TITLE
PLAN AND PROFILE SEWER NATURAL DRIVE

SHEET NUMBER
04 C-246

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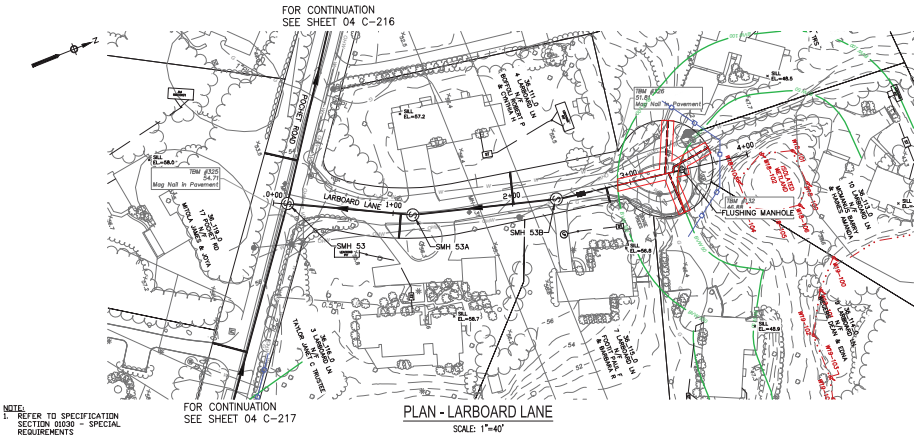
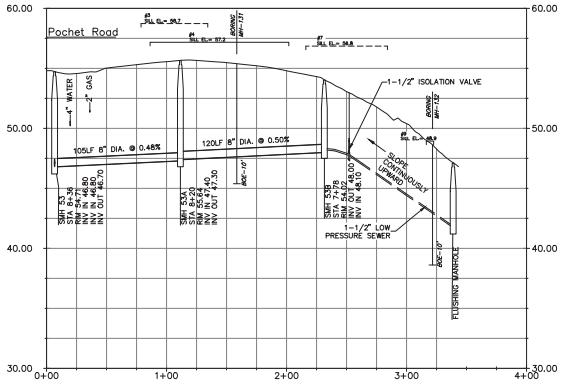


NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - LARBOARD LANE
SCALE: 1"=40'



PROFILE - LARBOARD LANE

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

AECOM

PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

OWNER

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (978) 905-2100
www.aecom.com

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PROJECT NUMBER

60652634

Designed By:	M. DONOGHUE
Drawn By:	S. GREBENNIKOV
Dept Check:	T. PARECE
Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER LARBOARD LANE

SHEET NUMBER

04 C-247

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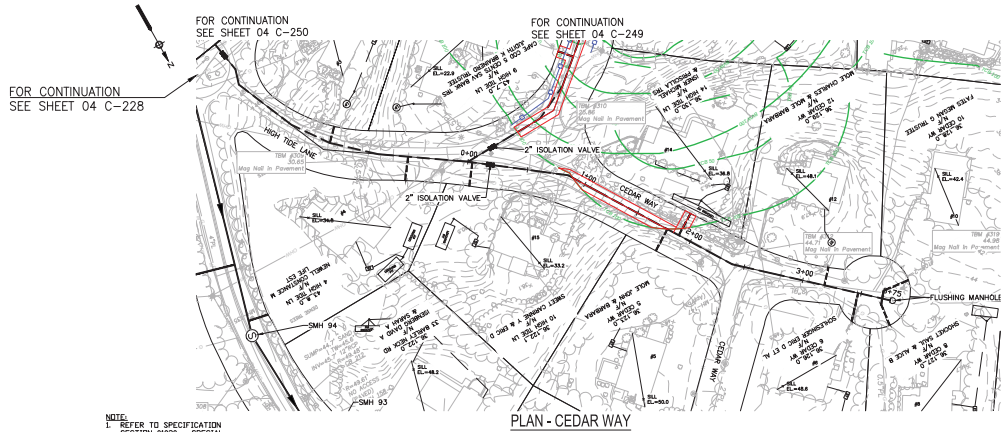
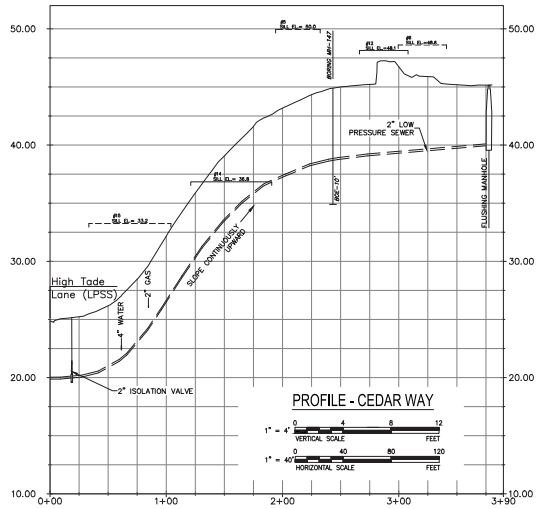


NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

PLAN - CEDAR WAY
SCALE: 1"=40'



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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER CEDAR WAY

SHEET NUMBER

04 C-248

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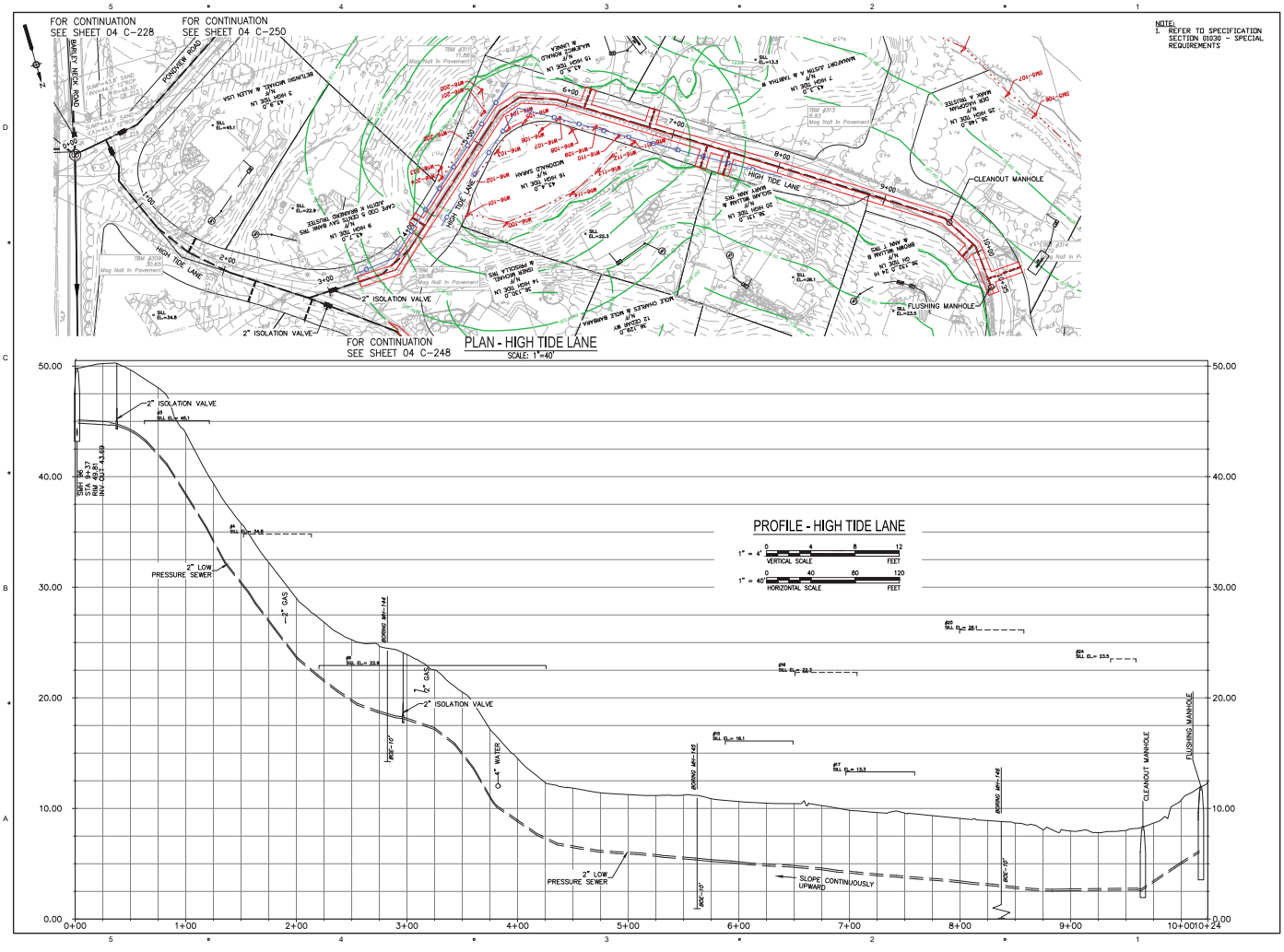

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DISCIPLINE
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SHEET TITLE
PLAN AND PROFILE SEWER HIGH TIDE LANE

SHEET NUMBER
04 C-249

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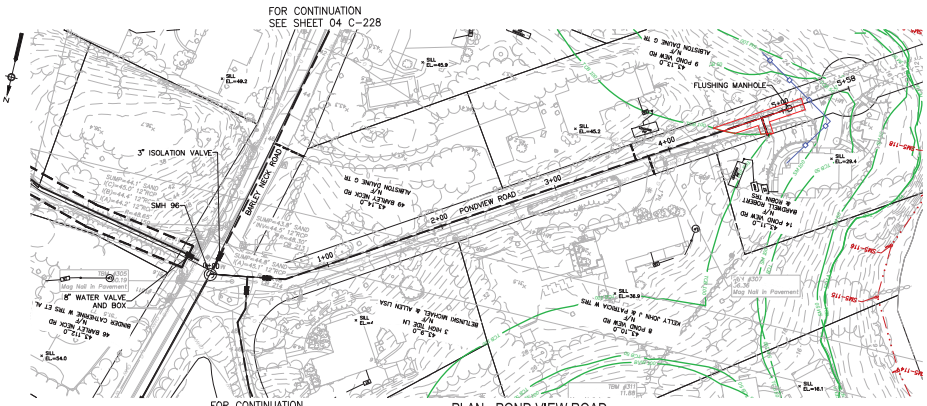
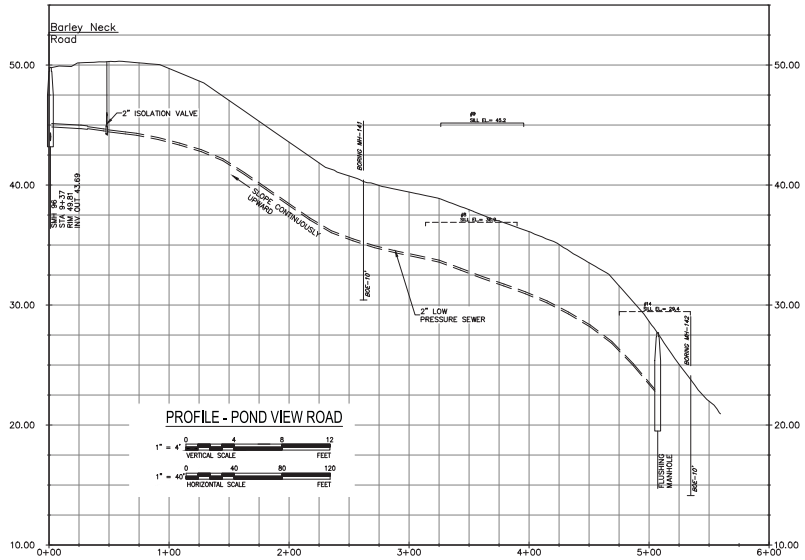


PLAN - POND VIEW ROAD
SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - POND VIEW ROAD
1" = 4' VERTICAL SCALE
1" = 40' HORIZONTAL SCALE

AECOM

PROJECT
MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
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Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
PLAN AND PROFILE SEWER POND VIEW ROAD

SHEET NUMBER
04 C-250

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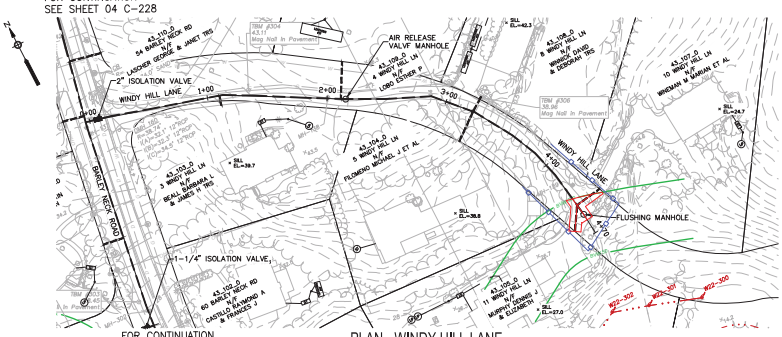
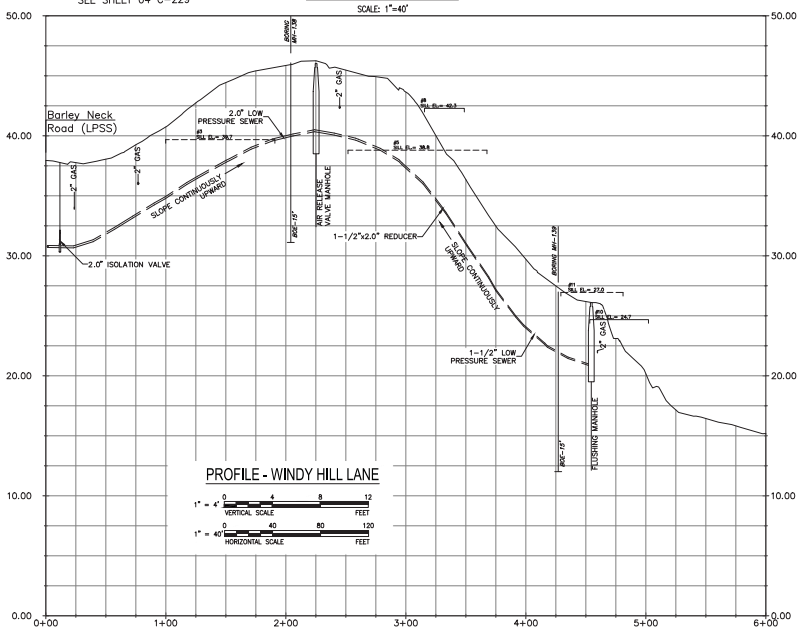


PLAN - WINDY HILL LANE

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - WINDY HILL LANE

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER WINDY HILL LANE

SHEET NUMBER

04 C-251

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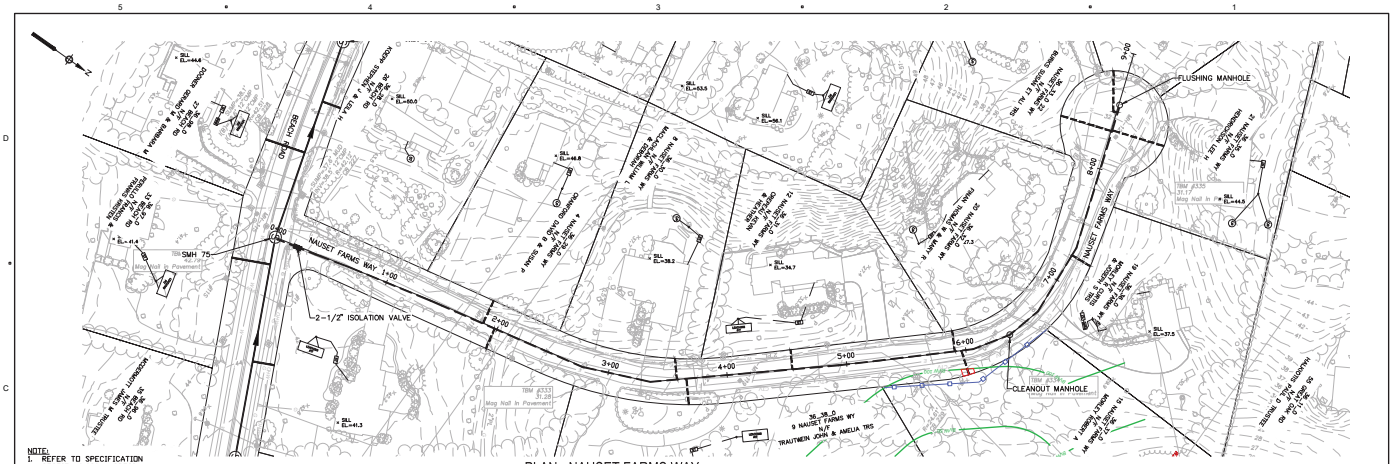
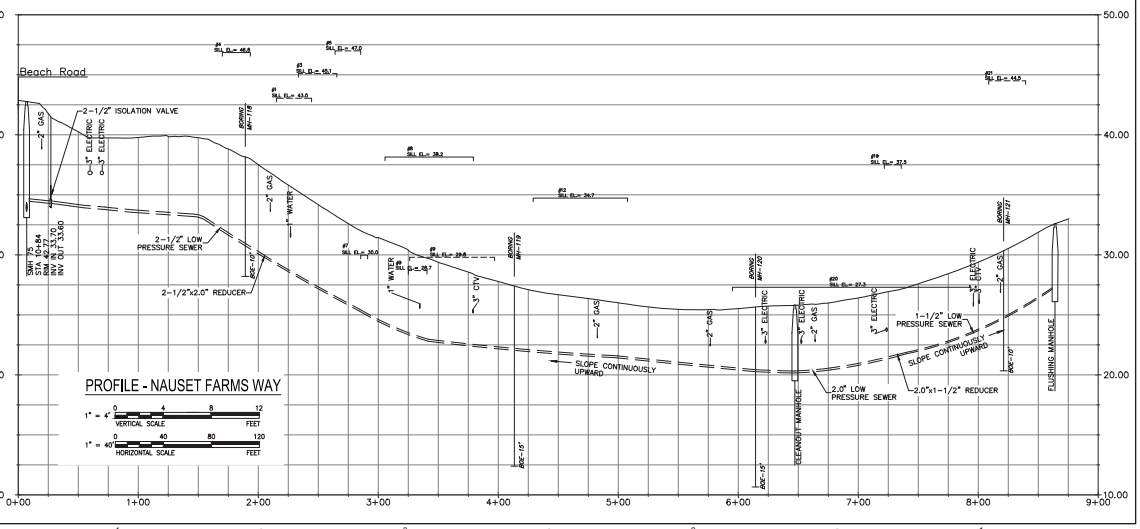


PLAN - NAUSET FARMS WAY

SCALE: 1"=40'



PROFILE - NAUSET FARMS WAY

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

AECOM

PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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Proj Check:	T. HARRISON
Date:	JUNE 2022
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DISCIPLINE

CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER NAUSET FARMS WAY

SHEET NUMBER

04 C-252

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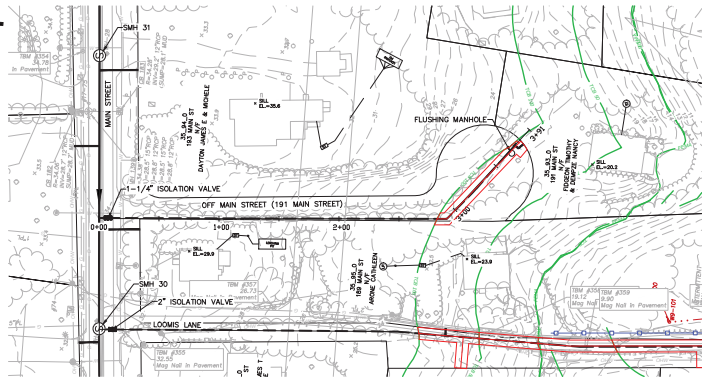
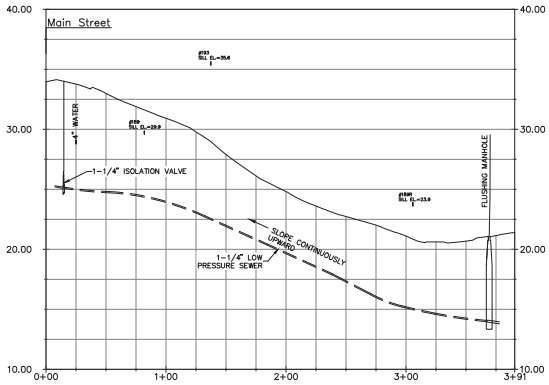


PLAN - OFF MAIN STREET
(191 MAIN STREET)
SCALE: 1"=40'



PROFILE - OFF MAIN STREET
(191 MAIN STREET)

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS

AECOM

PROJECT
MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

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Dept Check:	T. PARECE
Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE
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SHEET TITLE
PLAN AND PROFILE SEWER OFF MAIN STREET (191 MAIN STREET)

SHEET NUMBER
04 C-255

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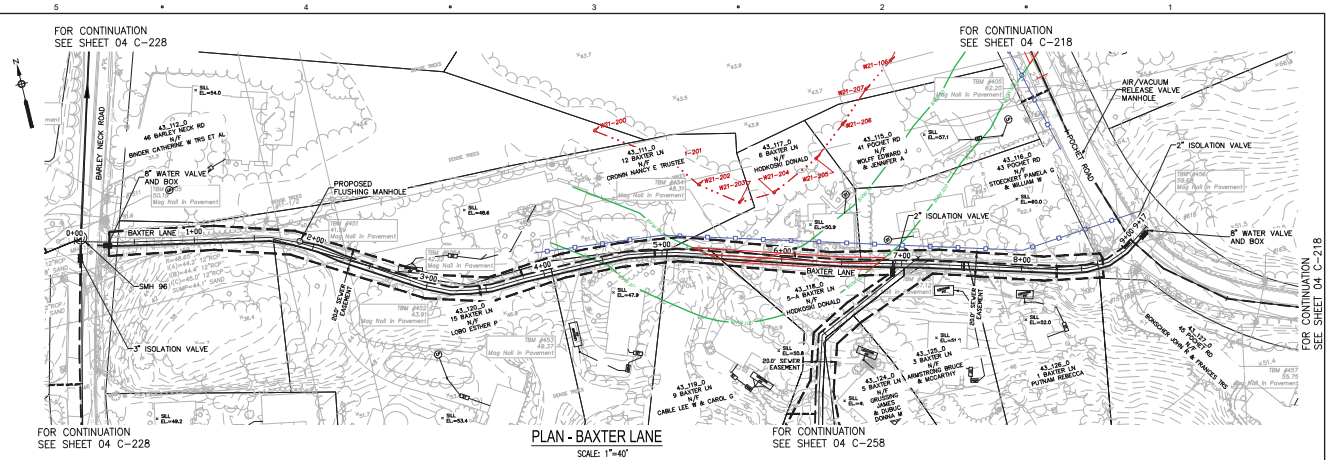
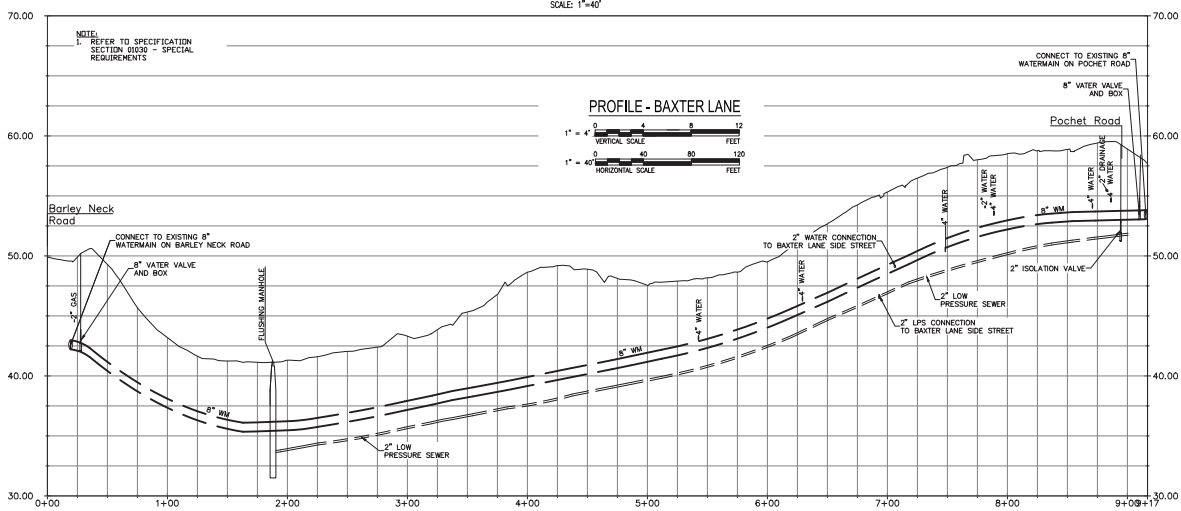


PLAN - BAXTER LANE
SCALE: 1"=40'



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SHEET TITLE

PLAN AND PROFILE SEWER
BAXTER LANE
1 OF 2

SHEET NUMBER

04 C-257

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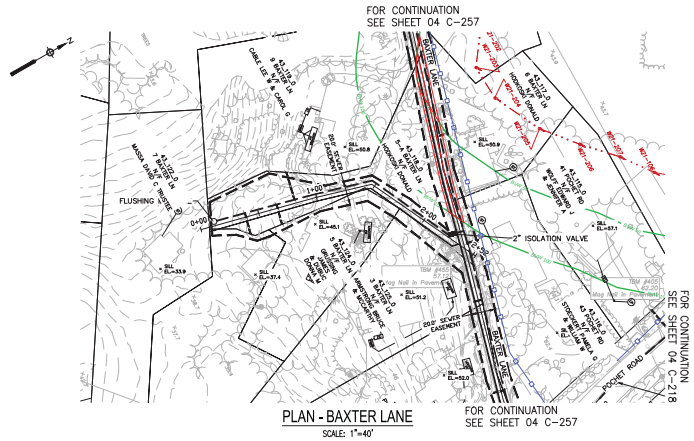
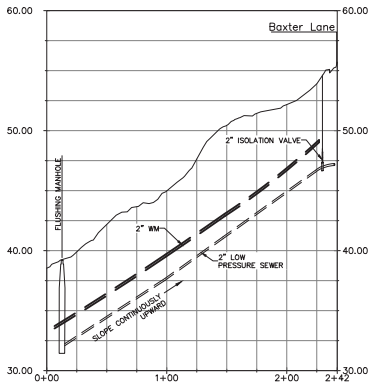


PLAN - BAXTER LANE

SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - BAXTER LANE

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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PROJECT

MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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SRF No. 7150

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CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER
BAXTER LANE
2 OF 2

SHEET NUMBER

04 C-258

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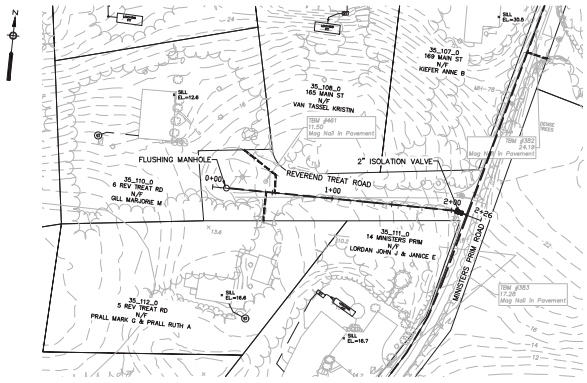
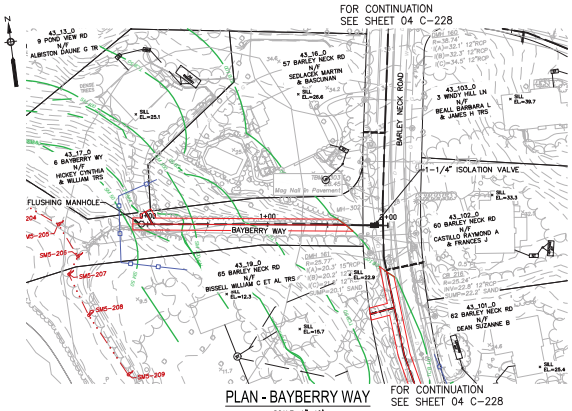


PLAN - REVEREND TREAT ROAD

SCALE: 1"=40'

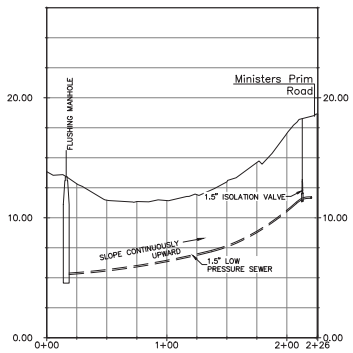


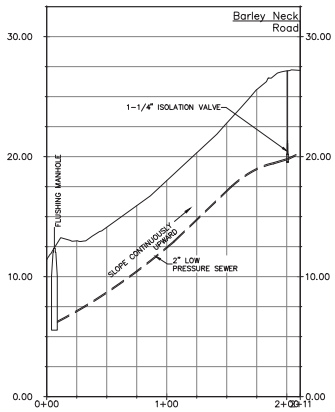
PLAN - BAYBERRY WAY

SCALE: 1"=40'

FOR CONTINUATION
SEE SHEET 04 C-228

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS





PROFILE - REVEREND TREAT ROAD
AND BAYBERRY WAY

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

AECOM

PROJECT
MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

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Proj Check:	T. HARRISON
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DISCIPLINE
CIVIL

SHEET TITLE
PLAN AND PROFILE SEWER REVEREND TREAT ROAD AND BAYBERRY WAY

SHEET NUMBER
04 C-259

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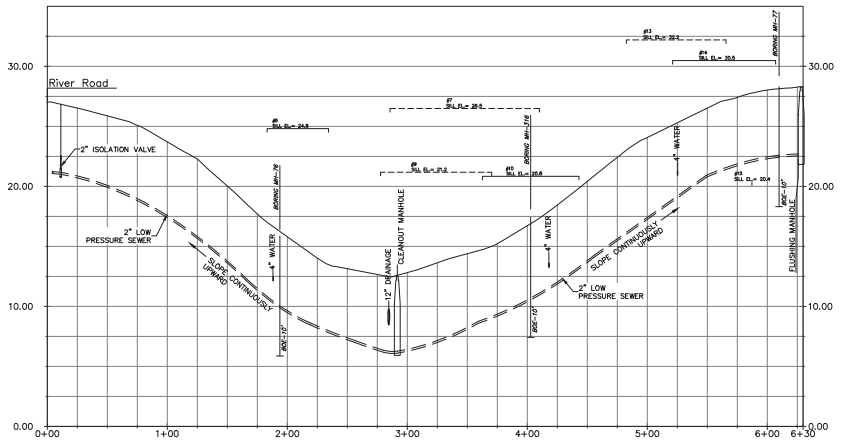
File name: C:\USERS\GREBENNIKOVS\ONEDRIVE - AECOM\02 PROJECTS\ORLEANS\02_CAD\00 C-DWG\2023.DWG

PLAN - PACKET LANDING
SCALE: 1"=40'

NOTE:
1. REFER TO SPECIFICATION SECTION 01030 - SPECIAL REQUIREMENTS



PROFILE - PACKET LANDING

1" = 4' VERTICAL SCALE 0 4 8 12 FEET
1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

AECOM

PROJECT
MEETINGHOUSE AREA COLLECTION SYSTEM AND PUMP STATIONS

CONTRACT No. 2022-02
SRF No. 7150

OWNER
TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER
AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (978) 905-2100
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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER
60652634

Designed By:	M. DONOGHUE
Drawn By:	S. GREBENNIKOV
Dept Check:	T. PARECE
Proj Check:	T. HARRISON
Date:	JUNE 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
PLAN AND PROFILE SEWER PACKET LANDING

SHEET NUMBER
04 C-260

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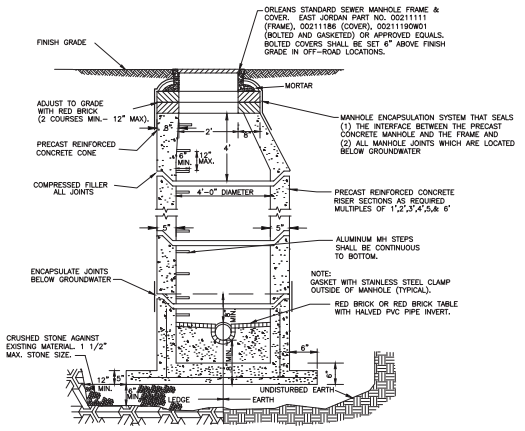
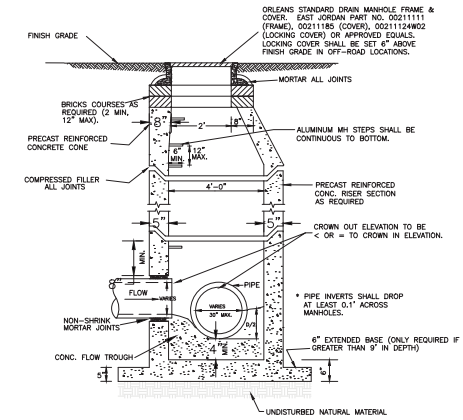
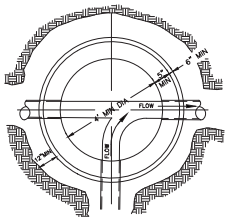


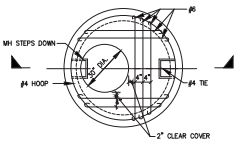
TYPICAL PRECAST CONCRETE SEWER MANHOLE
(NOT TO SCALE)



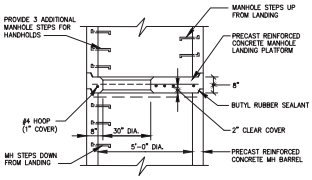
TYPICAL PRECAST CONCRETE DRAIN MANHOLE
ENTIRE STRUCTURE TO BE H20 LOADING
(NOT TO SCALE)



INVERT TABLE PLAN
(NOT TO SCALE)



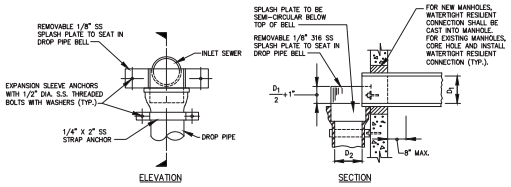
PLAN OF PRECAST SLAB



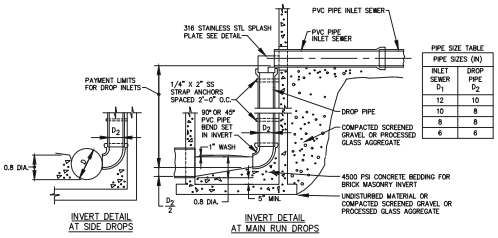
SECTION

NOTE:
LANDING PLATFORMS ARE TO BE INSTALLED AT THE MIDPOINT OF MANHOLES EXCEEDING 20' IN DEPTH.

PRECAST MANHOLE LANDING PLATFORM
NOT TO SCALE

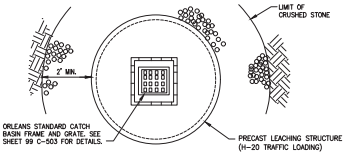


316 SS SPLASH PLATE DETAIL

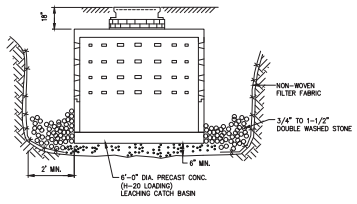


PIPE SIZE TABLE	
PIPE SIZES (IN)	
INLET SEWER D_1	DROP PIPE D_2
12	10
10	8
8	8
6	6

INSIDE DROP INLETS FOR PVC PIPE SEWERS
12 INCH DIAMETER AND SMALLER
NOT TO SCALE



PLAN



ELEVATION

LEACHING CATCH BASIN
NOT TO SCALE

AECOM

PROJECT

MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION
CONTRACT No. 2022-01
SRF No. 7150

OWNER

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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60652634

Designed By:	M. DONOGHUE
Drawn By:	S. NAPOLITANO
Dept Check:	C. BENZIGER
Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

DETAILS I

SHEET NUMBER

99 C-501

PATH FILENAME: L:\JOCS-PROJECT DATA\700000\60652634_CAPE AND ISLANDS\ETHINGHOUSE\PERMIT\60652634_CAD_DETAILS_C&D\DRAWINGS\99 C-501.DWG
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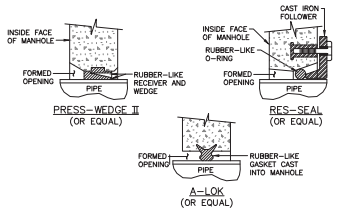
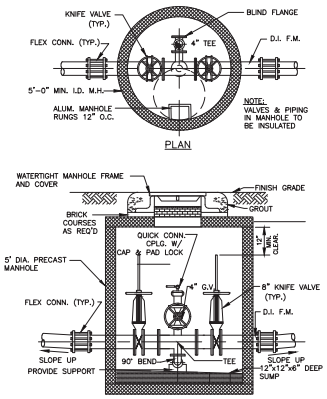
PLOT DATE: Thursday, September 15, 2022 10:00:00 AM

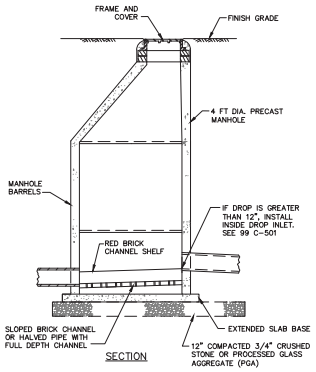


NOTE:
ALL GASKETS, SEALANTS, MORTAR ETC. SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS WRITTEN INSTRUCTIONS.

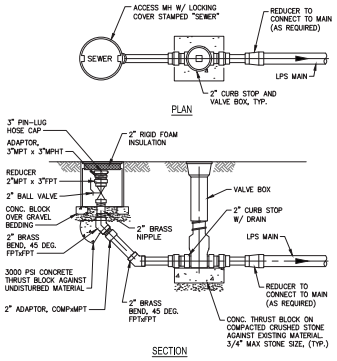
TYPICAL SLEEVE DETAILS
NOT TO SCALE



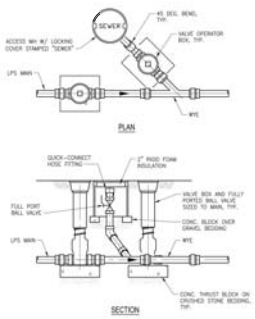
FORCE MAIN DRAIN MANHOLE



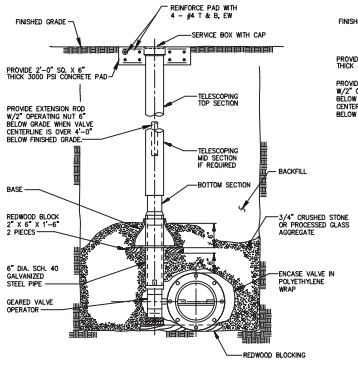
FORCE MAIN DISCHARGE INTO MANHOLE
NOT TO SCALE



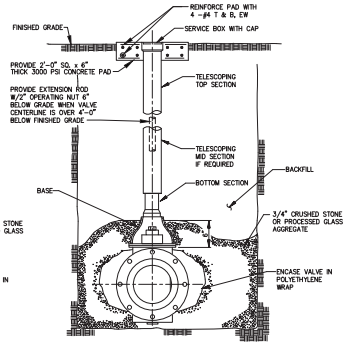
LOW PRESSURE SEWER
TERMINAL FLUSHING DETAIL
NOT TO SCALE



IN-LINE FLUSHING CONNECTION
ON LOW PRESSURE SEWER MAIN
NOT TO SCALE



BURIED PLUG VALVE
NOT TO SCALE



BURIED GATE VALVE
NOT TO SCALE

AECOM

PROJECT
MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION
CONTRACT No. 2022-01
SRF No. 7150

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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER
60652634

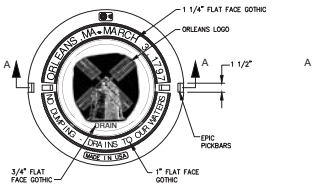
Designed By:	M. DONOGHUE
Drawn By:	S. NAPOLITANO
Dept Check:	C. BENZIGER
Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
DETAILS II

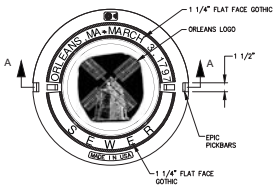
SHEET NUMBER
99 C-502

PLOT DATE: Thursday, September 15, 2022 7:14:04 AM



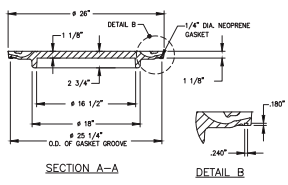
PLAN–DRAIN COVER

MFR: EJUSA
PART NO. 00211185
OR APPROVED EQUAL



PLAN–SEWER COVER

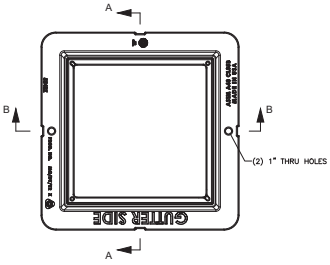
MFR: EJUSA
PART NO. 00211186
OR APPROVED EQUAL



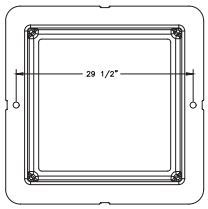
SECTION A–A

DETAIL B

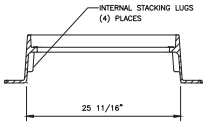
ORLEANS STANDARD
DRAIN AND SEWER MANHOLE COVER
(NOT TO SCALE)



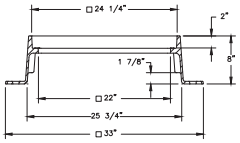
PLAN



BOTTOM



SECTION A–A



SECTION B–B

ORLEANS STANDARD 4–FLANGE
CATCH BASIN FRAME
(NOT TO SCALE)

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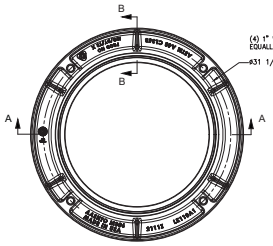
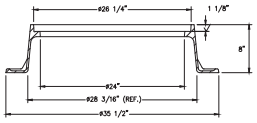
*3–FLANGE FRAME AVAILABLE
AS PART NO. 00554813



SECTION B–B



SECTION A–A

ORLEANS STANDARD
MANHOLE FRAME
(NOT TO SCALE)

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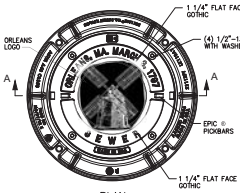
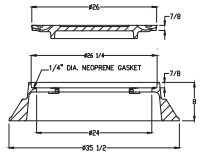
OR APPROVED EQUAL



PLAN



SECTION A–A

ORLEANS STANDARD BOLTED AND
GASKETED MANHOLE FRAME AND COVER
(NOT TO SCALE)

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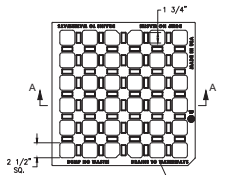
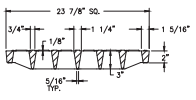
OR APPROVED EQUAL



PLAN



SECTION A–A

MFR: EJUSA
PART NO. 00552060
OR APPROVED EQUAL

ORLEANS STANDARD HEAVY
CATCH BASIN GRATE
(NOT TO SCALE)

AECOM

PROJECT
MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION
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SRF No. 7150

OWNER
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ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER
60652634

Designed By:	M. DONOGHUE
Drawn By:	S. NAPOLITANO
Dept Check:	C. BENZIGER
Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
DETAILS III

SHEET NUMBER
99 C-503

PATH:P:\DWG\...\LOCK\PROJECT PATH\REVISION\...\SHEET#\SHEET#\HOUSE\REPEAT\[C_CAD_SHEET_CAD]SHEET#\SHEET#.DWG
LAST SAVED: Thursday, September 15, 2022 11:55 AM
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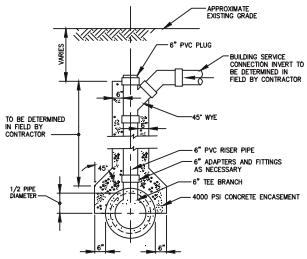
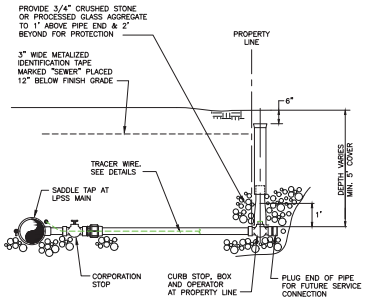


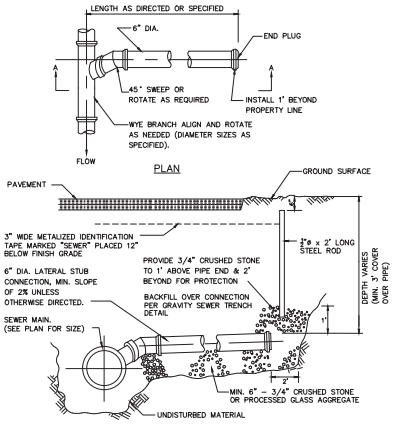
TYPICAL CHIMNEY DETAIL
FOR SEWER CONNECTION

NOT TO SCALE



TYPICAL LATERAL STUB CONNECTION
ON LOW PRESSURE SEWER MAIN

(NOT TO SCALE)

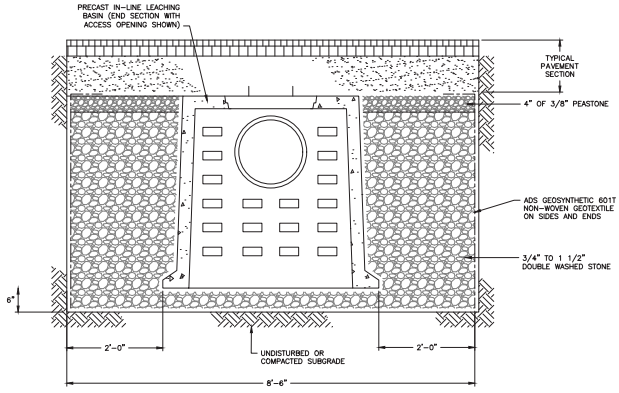


LATERAL CONNECTION MANHOLE

WHERE REQUIRED, A MANHOLE TO BE CONSTRUCTED ON A LATERAL CONNECTION. THIS MANHOLE SHALL CONFORM TO THE SAME STANDARDS AS THE MAIN SEWER MANHOLES. (SEE SEWER MANHOLE DETAILS.)

TYPICAL LATERAL STUB CONNECTION

(NOT TO SCALE)



PRECAST IN-LINE LEACHING BASIN

NOT TO SCALE

AECOM

PROJECT

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CONTRACT No. 2022-01
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Drawn By:	S. NAPOLITANO
Dept Check:	C. BENZIGER
Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

DETAILS IV

SHEET NUMBER

99 C-504

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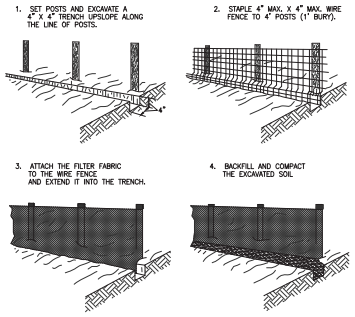
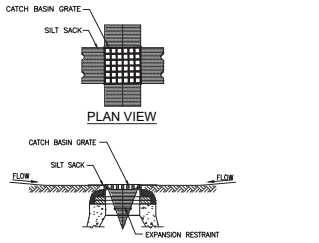


SILT FENCE WITH SILT SOCK

NOT TO SCALE

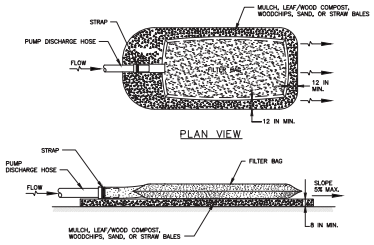


NOTES:

1. INSTALL SILT SACK IN ALL CATCH BASINS BEFORE COMMENCING WORK OR IN PAVED AREAS AFTER BINDER COURSE IS PLACED AND STRAW BALES HAVE BEEN REMOVED. GRATE TO BE PLACED OVER SILT SACK.
2. SILT SACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORMS.
3. EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED PROMPTLY AS NEEDED.

SILT SACK SEDIMENT TRAP

NOT TO SCALE



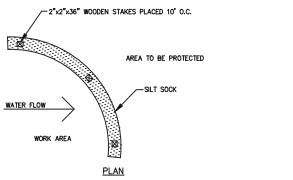
CONSTRUCTION SPECIFICATIONS

1. TIGHTLY SEAL SLEEVE AROUND THE PUMP DISCHARGE HOSE WITH A STRAP OR SIMILAR DEVICE.
2. PLACE FILTER BAG ON SUITABLE BASE (E.G., MULCH, LEAF/WOOD COMPOST, WOODCHIPS, SAND, OR STRAW BALES) LOCATED ON A LEVEL OR 5% MAXIMUM SLOPING SURFACE. DISCHARGE TO A STABILIZED AREA. EXTEND BASE A MINIMUM OF 12 INCHES FROM EDGES OF BAG.
3. CONTROL PUMPING RATE TO PREVENT EXCESSIVE PRESSURE WITHIN THE FILTER BAG IN ACCORDANCE WITH THE MANUFACTURER RECOMMENDATIONS. AS THE BAG FILLS WITH SEDIMENT, REDUCE PUMPING RATE.
4. REMOVE AND PROPERLY DISPOSE OF FILTER BAG UPON COMPLETION OF PUMPING OPERATIONS OR AFTER BAG HAS REACHED CAPACITY, WHICHEVER OCCURS FIRST. SPREAD THE DEWATERED SEDIMENT FROM THE BAG IN AN APPROVED UPLAND AREA AND STABILIZE WITH SEED AND MULCH BY THE END OF THE WORK DAY. RESTORE THE SURFACE AREA BENEATH THE BAG TO ORIGINAL CONDITION UPON REMOVAL OF THE DEVICE.
5. USE NONWOVEN GEOTEXTILE WITH DOUBLE STITCHED SEAMS USING HIGH STRENGTH THREAD. SIZE SLEEVE TO ACCOMMODATE A MAXIMUM 4 INCH DIAMETER PUMP DISCHARGE HOSE. THE BAG MUST BE MANUFACTURED FROM A NONWOVEN GEOTEXTILE THAT MEETS OR EXCEEDS MINIMUM AVERAGE ROLL VALUES (MARV) FOR THE FOLLOWING:

GRAB TENSILE	250 LB	ASTM D-4632
PUNCTURE	150 LB	ASTM D-4833
FLOW RATE	70 GAL/MIN/FT²	ASTM D-4491
PERMITTIVITY (SEC^{-1})	1.2 SEC^{-1}	ASTM D-4491
UV RESISTANCE	70% STRENGTH @ 500 HOURS	ASTM D-4355
APPARENT OPENING SIZE (AOS)	0.15–0.18 MM	ASTM D-4751
SEAM STRENGTH	90%	ASTM D-4632

6. REPLACE FILTER BAG IF BAG CLOGS OR HAS RIPS, TEARS, OR PUNCTURES. DURING OPERATION KEEP CONNECTION BETWEEN PUMP HOSE AND FILTER BAG WATER TIGHT. REPLACE BEDDING IF IT BECOMES DISPLACED.

SEDIMENTATION FILTER BAG

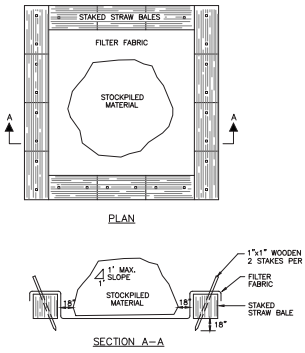


NOTES:

1. SEE SPECIFICATIONS FOR SILT SOCK AND COMPOST FILL MATERIAL REQUIREMENTS.

COMPOST SILT SOCK

NOT TO SCALE



NOTE:
DIMENSIONS OF STOCKPILE AREA MAY VARY DEPENDING ON QUANTITY OF EXCAVATION. AVOID OVERTOPPING OR SLOPES IN EXCESS OF 1:1

PLAN OF TEMPORARY STOCKPILE AREA

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PROJECT

MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION
CONTRACT No. 2022-01
SRF No. 7150

OWNER

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60652634

Designed By:	M. DONOGHUE
Drawn By:	S. NAPOLITANO
Dept Check:	C. BENZIGER
Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

DETAILS V

SHEET NUMBER

99 C-505

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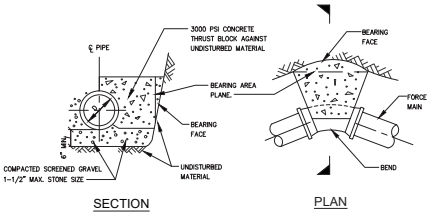
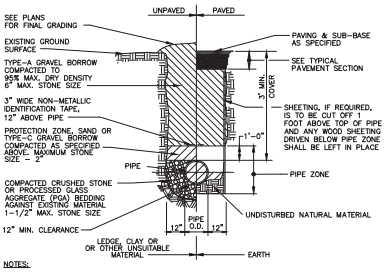


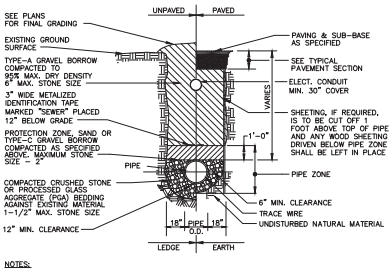
NOTES:
1. WHERE SO INDICATED ON PLANS, THE FORCE MAIN BENDS SHALL BE BACKED UP WITH A CONCRETE THRUST BLOCK BETWEEN THE PIPE AND UNDISTURBED MATERIAL.
2. REQUIRED BEARING AREA TO BE CALCULATED ON VERTICAL PLANE 90 DEG. TO RADIAL PLANE PASSING THROUGH MIDPOINT OF BEND.
3. MINIMUM BEARING AREA: 2.0 SQ.FT.
4. SEE PLANS FOR REQUIRED BEARING AREAS GREATER THAN MINIMUM.

FORCE MAIN THRUST BLOCK
NOT TO SCALE



NOTES:
1. GRAVEL BORROW SHALL CONFORM TO MASS HIGHWAY SPECIFICATION M1.03.0
2. CRUSHED STONE BEDDING SHALL CONFORM TO MASS HIGHWAY SPECIFICATION M2.01.1

TYPICAL H.D.P.E. DRAIN TRENCH DETAIL
NOT TO SCALE



NOTES:
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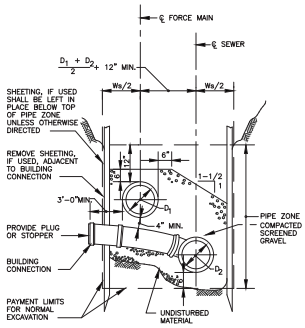
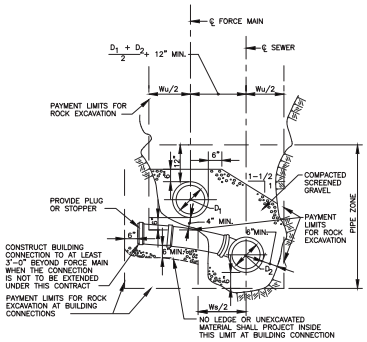
2. CRUSHED STONE BEDDING SHALL CONFORM TO MASS HIGHWAY SPECIFICATION M2.01.1

GRAVITY SEWER/FORCE MAIN/ ELECT. CONDUIT TRENCH DETAIL
NOT TO SCALE

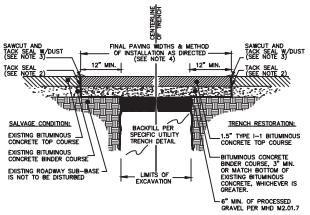


IN EARTH



IN ROCK

TRENCH SECTIONS FOR SEWER AND FORCE MAIN IN SAME TRENCH
NOT TO SCALE



1. ALL INSTALLATION AND MATERIAL SPECIFICATIONS PER MASS. HIGHWAY DEPARTMENT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, 1988 AS AMENDED.
2. ALL EXPOSED BITUMINOUS CONCRETE IS TO BE TACKED PER MHD PRIOR TO NEW BITUMINOUS CONCRETE INSTALLATION.
3. ALL EXPOSED JOINTS ARE TO BE SEALED WITH TACK AND STONE DUST.
4. ANY TOP COURSE APPLIED AT A WIDTH OF 6' WIDE OR GREATER IS TO BE PLACED BY MACHINE/BOX SPREADER WHEN & AS DIRECTED BY THE TOWN OF ORLEANS.

TYPICAL TRENCH REPAIR & PAVEMENT SECTION DETAIL
NOT TO SCALE

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Dept Check:	C. BENZIGER
Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
DETAILS VI

SHEET NUMBER
99 C-506

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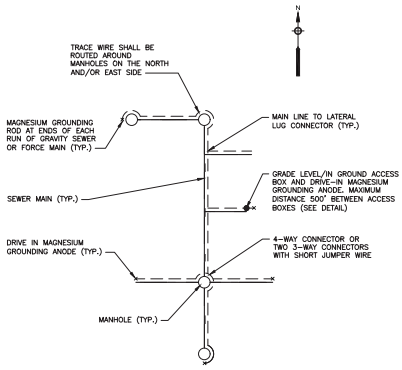

TRACER WIRE PLAN
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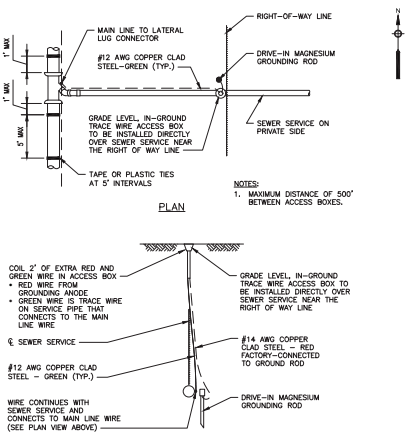

TRACER WIRE ACCESS BOX
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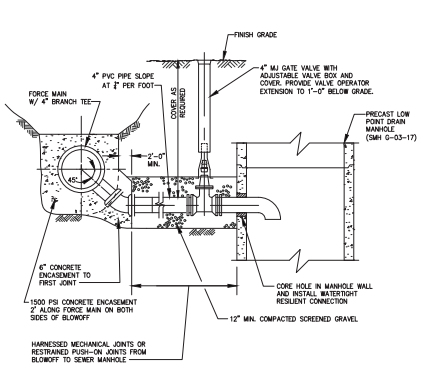

TYPICAL FORCE MAIN BLOW-OFF CONNECTION BELOW INVERT OF FORCE MAIN
NOT TO SCALE

AECOM

PROJECT

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Proj Check:	T. PARECE
Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

DETAILS VII

SHEET NUMBER

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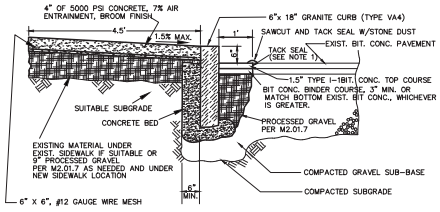
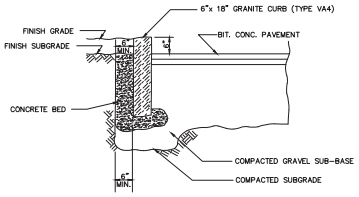


1. ALL EXPOSED BITUMINOUS CONCRETE IS TO BE TACKED PER MHD PRIOR TO NEW BITUMINOUS CONCRETE INSTALLATION.

CONCRETE SIDEWALK & GRANITE CURB DETAIL

NOT TO SCALE



GRANITE CURB DETAIL

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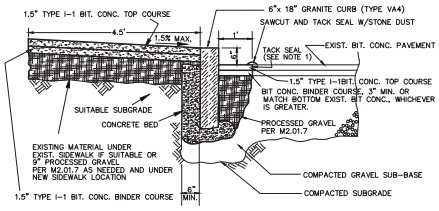

1. ALL EXPOSED BITUMINOUS CONCRETE IS TO BE TACKED PER MHD PRIOR TO NEW BITUMINOUS CONCRETE INSTALLATION.

BITUMINOUS CONCRETE SIDEWALK & GRANITE CURB DETAIL

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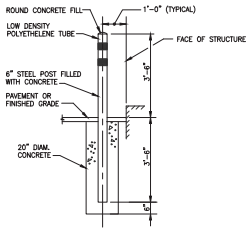

GUARD POST

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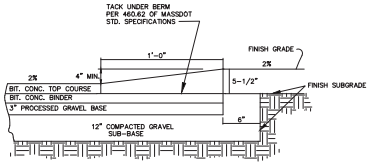

CAPE COD BERM

NOT TO SCALE

AECOM

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Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE

CIVIL

SHEET TITLE

DETAILS VIII

SHEET NUMBER

99 C-508

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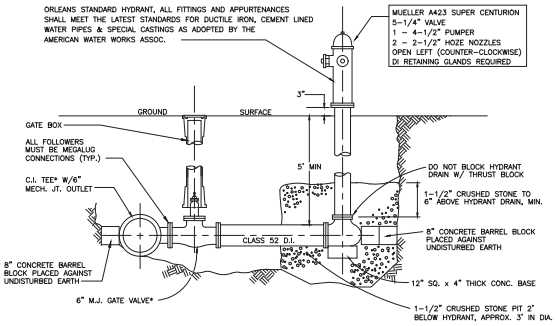
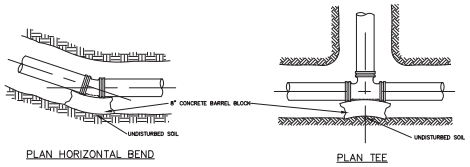
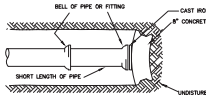


STANDARD HYDRANT DETAIL
(NOT TO SCALE)



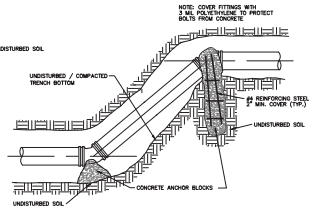
PLAN HORIZONTAL BEND

PLAN TEE



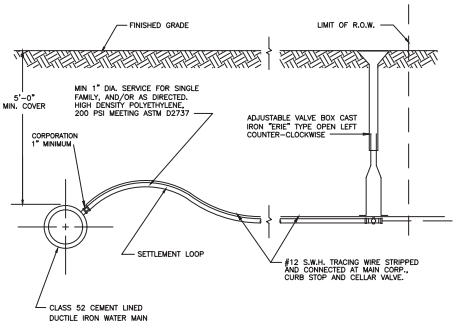
PLAN PLUG END OF LINE

THRUST BLOCK REQUIREMENTS	
FITTING	MIN BEARING AREA (SF)
8"X 1/8 BEND	12
12"X 8" TEE	12
10"X 8" TEE	10
8"X 8" TEE	9
8"X 6" TEE	5
8" CAP / PLUG	12
12"X 8" REDUCER	8
10"X 8" REDUCER	6
8" X 6" REDUCER	4
8" 22 1/2" & 45° BENDS	8
ALL TEES AND VALVES	10
HYDRANTS	9



ELEVATION – VERTICAL BENDS

WATER MAIN ANCHORAGE DETAILS
NOT TO SCALE



TYPICAL PERMANENT SERVICE CONNECTION
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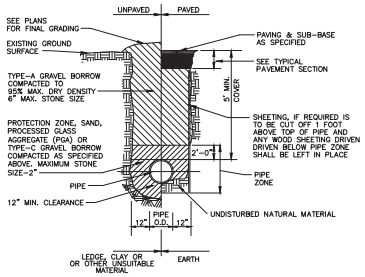
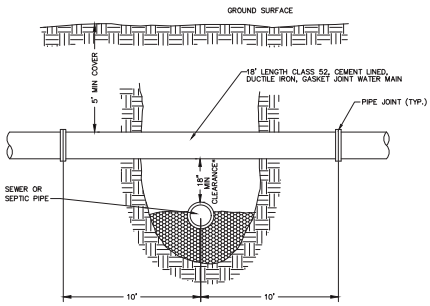


1. GRAVEL BORROW SHALL CONFORM TO MASS HIGHWAY SPECIFICATION M1.03.0
2. CRUSHED STONE BEDDING SHALL CONFORM TO MASS HIGHWAY SPECIFICATION M2.01.1

TYPICAL WATER TRENCH DETAIL
NOT TO SCALE



* WHEN THE CROSSING AS SHOWN IS LESS THAN 18" VERTICAL CLEARANCE THE UTILITY BEING INSTALLED MUST BE SLEEVED 10' ON BOTH SIDES OF THE CROSSING WITH SDR35 PVC PIPE. IF THE SEWER MAIN OR SERVICE CROSSES ABOVE THE WATERMAIN OR SERVICE, AGAIN THE UTILITY BEING INSTALLED MUST BE SLEEVED 10' ON BOTH SIDES OF THE CROSSING WITH SDR35 PVC PIPE. SEAL ENDS OF SDR35 PVC WITH CONCRETE

TYPICAL WATER CROSSING
NOT TO SCALE

AECOM

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Date:	OCTOBER 2022
Scale:	AS NOTED

DISCIPLINE
CIVIL

SHEET TITLE
DETAILS IX

SHEET NUMBER
99 C-509

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LAST SAVED: Friday, September 16, 2022 9:56 AM
PLOT DATE: Thursday, September 15, 2022 9:44:54 AM

Attachment C

Wetland Data Sheets

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W1-100 Upland Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Garlic mustard / Alliaria petiolate	10%	10%	No	FACU-
English ivy / Hedera helix	70%	70%	Yes	FACU
Grass spp. /	20%	20%	Yes	FACU
Saplings				
Morrows honeysuckle / Lonicera morrowii	20%	100%	Yes	NI
Climbing Woody Vines				
Trees				
Norway maple / Acer platanoides	25%	100%	Yes	FACU

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 4

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-9”	10YR 4/3	
B	9”-12”	10YR 4/4	
Refusal after 12”			

Remarks:

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE 83-
Wetland #: W1-100 Wetland Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grape Vine / Vitis spp.	50%	43%	Yes	NI (no indicator)
Multiflora rose / Rosa multiflora*	10%	9%	No	
Green briar / Smilax rotundifolia*	10%	9%	No	
Soft rush / Juncus effuses*	10%	9%	No	
Jewelweed / Impatiens capensis*	35%	30%	Yes	FACW
Saplings				
Arrowwood / Viburnum dentatum*	10%	50%	Yes	FAC
Red maple / Acer rubrum*	10%	50%	Yes	FAC
Climbing Woody Vines				
Trees				
Red maple / Acer rubrum*	30%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 4 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-10”	10 YR 2/1	
B	10”-20”	10 YR 3/2	

Remarks:
8% redox 7.5 YR 4/6

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _12”_____
- ❑ Depth to soil saturation in observation hole: _2”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: __Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W3-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Virginia Creeper / Pathenocussus quinquefolia	20%	29%	Yes	FACU
Poison Ivy / Toxicodendron radicans	50%	71%	Yes	FAC
Saplings				
Sweet pepperbush / Clethra alnifolia	20%	66%	Yes	FAC
Red oak / Quercus rubra	10%	33%	Yes	FACU-
Climbing Woody Vines				
Trees				
Norway maple / Acer platanoides	20%	66%	Yes	FACU
White oak / Quercus alba	10%	33%	Yes	FACU-

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 2 Number of dominant non-wetland indicator plants:4

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
Organic layer	0”-2”		
A	2”-20”	10YR 4/4	

Remarks:
No redox or depletions

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W3-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Green briar / Smilax rotundifolia*	10%	40%	Yes	FAC
Poison ivy / Toxicodendron radicans*	5%	20%	Yes	FAC
Sensitive fern / Onoclea sensibilis*	5%	20%	Yes	FACW
Cinnamon fern / Osmunda cinnamomeum*	5%	20%	Yes	FACW
Saplings				
Sweet pepperbush / Clethra alnifolia*	95%	100%	Yes	FAC
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 5 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-8”	10YR2/1	
B	8”-20”	10YR 2/2	

Remarks:
Depletions 10%
Redox 10%

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____10”_____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W4-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Morrow honeysuckle / Lonicera morrowii	80%	89%	Yes	FACU
Garlic Mustard / Alliaria petolata	10%	11%	No	FACU
Saplings				
Climbing Woody Vines				
Sweet pepperbush / Clethra alnifolia	10%	100%	Yes	FAC
Trees				
Red cedar / Juniperus virginiana	10%	100%	Yes	FACU

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 2

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-2”		
A	2”-8”	10YR 4/3	
B	8”-16”	10YR 3/3	

Remarks:
No redox or depletions

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W4-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Sensitive fern / Onoclea sensibilis*	40%	47%	Yes	FACW
Jewelweed / Impatens capensis*	40%	47%	Yes	FACW
Soft rush / Juncus effusus*	5%	6%	No	FACW
Saplings				
Sweet pepperbush / Clethra alnifolia*	10%	100%	Yes	FAC
Climbing Woody Vines				
Trees				
Red maple / Acer rubrum*	70%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants:4 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-8”	10YR 2/2	
B	8”-20”	10YR 2/3	

Remarks:
15% redox 7.5YR 4/6

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: ___8”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: ____Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W5-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Morrow honeysuckle / Lonicera morrowii	80%	89%	Yes	FACU
Garlic Mustard / Alliaria petolata	10%	11%	No	FACU
Saplings				
Climbing Woody Vines				
Sweet pepperbush / Clethra alnifolia	10%	100%	Yes	FAC
Trees				
Red cedar / Juniperus virginiana	10%	100%	Yes	FACU

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 2

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-2”		
A	2”-8”	10YR 4/3	
B	8”-16”	10YR 3/3	

Remarks:
No redox or depletions

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W5-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Green briar / Smilax rotundifolia	10%	100%	Yes	FAC
Saplings				
Sweet pepperbush / Clethra alnifolia	75%	75%	Yes	FAC
Highbush blueberry / Vaccinium corymbosum	25%	25%	Yes	FAC
Climbing Woody Vines				
Trees				
Red maple / Acer rubrum	25%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 4 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-1”		
A	1”-8”	10YR 2/2	
B	8”-16”	10YR 3/2	

Remarks:
8% redox 7.5YR 6/4
5% depletion 10YR 6/2

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: __13”_____
- ❑ Depth to soil saturation in observation hole: ____3”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W6-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Poison ivy / Toxicodendron radicans	15%	15%		
Multiflora rose / Rosa multiflora	60%	60%	Yes	FAC
Green briar / Smilax rotundifolia	25%	25%	Yes	FAC
Saplings				
Climbing Woody Vines				
Trees				
Red maple / Acer rubrum	60%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 3 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-20”	10YR 4/3	

Remarks:
No redox or depletions

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W6-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grape vine / Vitis novae-angliae*	10%	10%		
Multiflora rose / Rosa multiflora	20%	20%	Yes	FAC
Soft rush / Juncus effuses*	10%	10%		
Cinnamon fern / Osmunda cinnamomeum*	10%	10%		
Reed canary grass / Phalaris arundinacea*	50%	50%	Yes	FACW+
Saplings				
Sweet pepperbush / Clethra alnifolia*	25%	63%	Yes	FAC
Arrowwood / Viburnum dentatum*	15%	37%	Yes	FAC
Climbing Woody Vines				
Trees				
Red maple / Acer rubrum*	75%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 5 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-20”	10YR 2/1	

Remarks:
Mucky

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: ____8”_____
- ❑ Depth to soil saturation in observation hole: ____0”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: ____Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	yes	_____
Other indicators of hydrology present	yes	_____
Sample location is in a BVW	yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W7-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grass spp. (maintained lawn)	75%	68%	Yes	FACU
Morrow honeysuckle/ Lonicera morrowii	15%	13%	No	
Canada mayflower	10%	13%	No	
Poison ivy/ Toxicodendron radicans	10%	8%	No	
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 1

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-2”		
A	2”-10”	7.5 YR 3/3	
B	10”+	7.5 YR 4/4	

Remarks:

3. Other:

Conclusion: Is soil hydric? No

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W5-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Saplings				
x igh bush blueberry / Vaccinium corymbosum*	%Y7	H27	Res	FACW-
4 ed maple / Acer rubrum*	?07	z%7	Res	FAC
Climbing Woody Vines				
Trees				
4 ed maple / Acer rubrum*	5Y7	1007	Res	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: H Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants" yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the 4 equest for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site" yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey" yes no
4emarks:

2. Soil Description

x ori8on	Depth	Matri6 Color	Mottles Color
A	03-%03	10R4 %1	

4emarks:
Mucky

3. Other:

Conclusion: Is soil hydric" yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: ____z3_____
- ❑ Depth to soil saturation in observation hole: ___%3_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ O6idi8ed rhi8ospheres: _____
- ❑ Water-stained leaves: _____Res_____
- ❑ 4ecorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Res	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Res	____
Wetland hydrology present:		
x ydric soil present	Res	_____
Other indicators of hydrology present	Res	_____
Sample location is in a BVW	Res	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W9-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
English ivy / Hendra helix	60%	60%	Yes	FACU
Grass spp. /	30%	30%	Yes	FACU
Garelic mustard /Alliaria petiolate	10%	10%	No	
Poison ivy / Toxicodendron	10%	10%	No	
Saplings				
Climbing Woody Vines				
Trees				
Red Maple / Acer rubrum	50%	50%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants:2

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-8”	7.5 YR 4/4	
B	8”-16”	7.6 YR 4/6	

Remarks:
Sandy loam

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W9-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Common reed / Phragmites australis	90%	90%	Yes	FAC
Jewelweed / Impatens capensis	5%	5%	No	
Sensitive fern / Oncolclea sensibilis	5%	5%	No	
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-20”	10 YR 2/1	

Remarks:
Muck

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____10”_____
- ❑ Depth to soil saturation in observation hole: ___4”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grass spp.	100%	100%	Yes	FACU
Saplings				
Climbing Woody Vines				
Trees				
Pitch pine / Pinus rigida	25%	50%	Yes	FACU
White oak /Quercus alba	25%	50%	Yes	FACU

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 3

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-7”	10 YR 2/1	
B	7”-12”	10 YR 4/4	

Remarks:
Stone refusal after 12”
No redox or depletions

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W10-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Sensitive fern / Onoclea sensibilis	75%	75%	Yes	FACW
Soft rush / Juncus effuses	10%	10%	No	FACW
Mutiflora rose / Rosa multiflora	5%	5%	No	FAC
High bush blueberry / Vaccinium corymbosum	5%	5%	No	FACW
Sweet pepperbush / Clethra alnifolia	5%	5%	No	FAC
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-4”	10 YR 2/2	
B	4”-20”	10 YR 2/1	

Remarks:
10% depletions 10 YR 6/2
8% redox 10 YR 4/6

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W11-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Japanese barberry / Berberis thunbergi	15%	27%	Yes	FACU
Poison ivy / Toxicodendron radicans	20%	36%	Yes	FAC
Green briar/ Smilax rotundifolia	10%	18%	No	
Virginia creeper / Parthenocissus quinquefolia	10%	18%	No	
Saplings				
Norway maple	20%	100%	Yes	FACU
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 2

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-4”		
A	4”-16”	10 YR 3/3	

Remarks:
No redox or depletions

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W11-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
High bush blueberry / Vaccinium corymbosum	50%	62%	Yes	Yes
Sweet pepperbush / Celthra alnifolia	25%	31%	Yes	Yes
Arrowwood / Viburnum dentatum	5%	6%	No	
Saplings				
Climbing Woody Vines				
Trees				
Black tupelo / Nyssa sylvatica	30%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 3 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-4”		
A	4”-12”	10 YR 2/2	
B	12”-16”	10 YR 2/1	

Remarks:

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____10”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W12-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grass spp.	100%	100%	Yes	FACU
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 1

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-8”	10 YR 4/3	
B	8”-16”	10 YR 5/6	

Remarks:

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W12-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Sweet pepperbush / Clethra alnifolia	90%	72%	Yes	FAC
Arrowwood / Viburnum dentatum	10%	8%	No	
Green briar / Smilax rotundifolia	15%	12%	No	
High bush blueberry / Vaccinium corymbosum	10%	8%	No	
Saplings				
Climbing Woody Vines				
Trees				
Red maple / Acer rubrum	75%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 2 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-3”		
A	3”-16”	10 YR 2/1	

Remarks:
Muck

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____Yes _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W13-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
English ivy/ Hedera helix	50%	58%	Yes	FACU
Canada mayflower/ Miaanthemum canadense	10%	11%	No	
Garlic mustard/ Alliaria petiolate	20%	23%	Yes	FACU
Morrow honeysuckle/ Lonicera morrowii	15%	17%	No	
Saplings				
Climbing Woody Vines				
Trees				
Red maple/ Acer rubrum	75%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 2

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-3”		
A	3”-9”	7.5YR 3/2	
B	9”+	7.5 YR 4/2	

Remarks:
Sandy loam

3. Other:

Conclusion: Is soil hydric? No

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W13-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Green briar / Smilax rotundifolia	25%	55%	Yes	FAC
Poison ivy / Toxicodendron radicans	20%	45%	Yes	FAC
Saplings				
Red maple / Acer rubrum	15%	75%	Yes	FAC
American holly / Ipex Opaca	5%	25%	Yes	FACU
Climbing Woody Vines				
Trees				
Red maple / Acer rubrum	100%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 4 Number of dominant non-wetland indicator plants: 1

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-2”		
A	2”-12”	10 YR 2/2	
B	12”-16”	10 YR 3/2	

Remarks:
10 % Redox 7.5 YR 4/6

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____12”_____
- ❑ Depth to soil saturation in observation hole: ____6”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W14-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
English ivy/ Hedera helix	80%	50%	Yes	FACU
Garlic mustard/ Alliaria petiolate	10%	6%	No	FACU
Morrow honeysuckle/ Lonicera morrowii	50%	31%	Yes	FACU
Multiflora rose/ Rosa multiflora	10%	6%	No	FAC
Green briar / Smilax rotundifolia	10%	6%	No	FAC
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 2

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-2”		
A	2”-12”	10 YR 3/2	
B	12”+	10 YR 4/3	

Remarks:
No redox or depletions
Sandy loam

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W5- 1500 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Arrowwood / Viburnum dentatum	x0%	x0%	Yes	FACW
Green briar / Smila7 rotundifolia	H0%	H0%	Yes	FAC
Multiflora rose / 2 osa multiflora	50%	50%	No	
Saplings				
Climbing Woody Vines				
Trees				
2 ed maple / Acer rubrum	xR%	500%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 4 Number of dominant non1wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non1wetland plants? yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the 2 equest for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
2emarks:

2. Soil Description

z ori" on	Depth	Matri7 Color	Mottles Color
O	0"-2"		
A	H81 5H8	50 Y2 4/H	
B	5H81H08	50 Y2 - /4	

2emarks:
6% redo7 x.RY2 - /3

3. Other:

Conclusion: Is soil hydric? yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____68_____
- ❑ Depth to soil saturation in observation hole: _____- 8_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ O7idi" ed rhi" ospheres: _____
- ❑ Water1stained leaves: _____ _____Yes_____
- ❑ 2ecorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non1wetland indicator plants	Yes	____
Wetland hydrology present:		
z ydric soil present	Yes	_____
Other indicators of hydrology present	Yes	_____
Sample location is in a BVW	Yes	_____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W15-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grass spp.	100%	100%	Yes	FACU
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 1

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-6”	7.5 YR 5/4	

Remarks:
Refusal after 6”
Roadside fill

3. Other:

Conclusion: Is soil hydric? No

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W15-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Jewelweed / Impatiens capensis	50%	50%	Yes	FACW
Sensitive fern / Onoclea sensibilis	25%	25%	Yes	FACW
Arrowwood/ Viburnum dentatum	15%	15%	No	
Grape vine/ Vitis spp.	10%	10%	No	
Saplings				
Climbing Woody Vines				
Trees				
Willow spp./ Salix spp	15%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 3 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-1”		
A	1”-16”	10 YR 2/1	

Remarks:
Muck

3. Other:

Conclusion: Is soil hydric? Yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____12”_____
- ❑ Depth to soil saturation in observation hole: ___5”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	____
Other indicators of hydrology present	Yes	____
Sample location is in a BVW	Yes	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W14-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grass spp.	90%	69%	Yes	FACU
Dandelion/ Taraxacum spp.	15%	11%		
Garlic mustard/ Alliaria petiolate	15%	11%		
Mugwort/ Artemisia spp.	10%	8%		
Saplings				
Climbing Woody Vines				
Trees				
Red maple/ Acer rubrum	30%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 1

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-8”	7.5 YR 3/2	
B	8”-16”	7.5 YR 4/6	

Remarks:

3. Other:

Conclusion: Is soil hydric? No

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants ____	Yes = to	
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W16-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Sensitive fern / Onoclea sensibilis	40%	28%	Yes	FACW
Cat tail / Typha spp.	60%	44%	Yes	FACW+
Soft rush / Juncus effuses	15%	11%	No	
Grape vine / Vitis spp.	10%	7%	No	
Jewelweed / Impatiens capensis	15%	11%	No	
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 2 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-16”	10 YR 2/1	

Remarks:
10% redox 7.5 YR 4/6
muck

3. Other:

Conclusion: Is soil hydric? Yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	____
Other indicators of hydrology present	Yes	____
Sample location is in a BVW	Yes	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W17-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
English ivy/ Hedra helix	20%	29%	Yes	FACU
Poison Ivy / Toxicodendron radicans	50%	71%	Yes	FAC
Saplings				
Red oak / Quercus rubra	20%	100%	Yes	FACU-
Climbing Woody Vines				
Trees				
Norway maple / Acer platanoides	40%	100%	Yes	FACU

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 3

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-2”		
A	2”-10”	10 YR 3/4	
B	10”+	10 YR 4/4	

Remarks:
No redox or depletions

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W17-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Jewelweed/ Impatiens capensis	75%	47%	Yes	FACW
Soft rush/ Juncus effuses	10%	6%	No	
Green briar/ Smilax rotundifolia	40%	24%	Yes	FAC
Arrowwood/ Viburnum dentatum	20%	12%	No	
Grape vine/ Vitis spp.	15%	9%	No	
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 2 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-2”		
A	2”-10”	10 YR 2/2	
B	10”-16”	10 YR 3/2	

Remarks:
Redox 10% 7.5YR 4/6

3. Other:

Conclusion: Is soil hydric? Yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____Yes _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	____
Other indicators of hydrology present	Yes	____
Sample location is in a BVW	Yes	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W18-100 Upland Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Garlic mustard / Alliaria petiolate	10%	10%	No	FACU-
English ivy / Hedera helix	70%	70%	Yes	FACU
Grass spp. /	20%	20%	Yes	FACU
Saplings				
Morrows honeysuckle / Lonicera morrowii	20%	100%	Yes	NI
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 3

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-8”	10YR 4/3	
B	8”-16”	10YR 4/4	
”			

Remarks:

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W18-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Sensitive fern/ Onoclea sensibilis	30%	40%	Yes	FACW
Arrowwood/ Viburnum dentatum	45%	60%	Yes	FACW
Saplings				
Climbing Woody Vines				
Trees				
Willow spp./ Salix spp.	25%	100%	Yes	FACW

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 3 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-10”	10 YR 2/1	
B	10”-16”	10 YR 3/2	

Remarks:

3. Other:

Conclusion: Is soil hydric? Yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: ___10”_____
- ❑ Depth to soil saturation in observation hole: __4”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	____
Other indicators of hydrology present	Yes	____
Sample location is in a BVW	Yes	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W20-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grass sp. (maintained lawn)	100%	100%	Yes	FACU
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 1

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-10”	10 YR 4/3	
B	10”+	7.5YR 5/4	

Remarks:

3. Other:

Conclusion: Is soil hydric? Yes No

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	____
Wetland hydrology present:		
Hydric soil present	____	____
Other indicators of hydrology present	____	____
Sample location is in a BVW	____	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W20-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Sweet pepperbush/ Clethra alnifolia	50%	36%	Yes	FAC
Arrowwood/ Viburnum dentatum	25%	18%	No	
Sensitive fern/ Ococlea sensibilis	25%	18%	No	
Soft rush/ Juncus effuses	10%	7%	No	
Cat tails/ Typha spp.	35%	24%	Yes	FACW+
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 2 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
0”-16”	10 YR 2/1		

Remarks:
Muck

3. Other:

Conclusion: Is soil hydric? Yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____10”_____
- ❑ Depth to soil saturation in observation hole: __4”_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other): _____ _____ _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	____
Other indicators of hydrology present	Yes	____
Sample location is in a BVW	Yes	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W12-200 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Grass spp.	200%	200%	Yes	FACU
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 2

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-8”	10 YR 4/3	
B	8”-16”	10 YR 5/6	

Remarks:

3. Other:

Conclusion: Is soil hydric? no

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W21-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Arrowwood/ Viburnum dentatum	90%	69%	Yes	FACW
Sensitive fern/ Onoclea sensibilis	10%	7%		
Sweet pepperbush/ Clethra alnifolia	10%	7%		
Green briar/ Smilax rotundifolia	20%	15%		
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants:1 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
O	0”-2”		
A	2”-16”	10 YR 2/2	

Remarks:
Mucky

3. Other:

Conclusion: Is soil hydric? Yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____ _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	____
Other indicators of hydrology present	Yes	____
Sample location is in a BVW	Yes	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W22-100 Up Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
English ivy/ Hedera helix	40%	36%	Yes	FACU
Mugwort/ Artemisia spp.	40%	36%	Yes	FACU
Grass spp.	20%	18%	No	
Green briar/ Smilax rotundifolia	10%	9%	No	
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 2

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
A	0”-10”	7.5 YR 3/3	
B	10”+	7.5 YR 4/3	

Remarks:

3. Other:

Conclusion: Is soil hydric? No

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	____	No
Wetland hydrology present:		
Hydric soil present	____	No
Other indicators of hydrology present	____	No
Sample location is in a BVW	____	No

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W44-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Sweet fern/ Comptonia peregrina	4%7	1Y7	No	
Jewelweed/ Impatiens capensis	%07	567	Res	FACW
Elderberry/ Sambucus canadensis	4%7	1Y7	No	
Grape vine/ Vitis spp.	407	1?7	No	
Multiflora rose/ Hosa multiflora	107	z7	No	
Green briar/ Smilax rotundifolia	107	z7	No	
Saplings				
Climbing Woody Vines				
Trees				

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 1 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants" Res

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Hequest for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site" yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey" yes no
Hemarks:

2. Soil Description

8 ori2on	Depth	Matrix Color	Mottles Color
A	0"-8"	10 YR 3/2	
B	Y:-163	10 RH ?/4	

Hemarks:
Loamy muck
Y7 redox z.%RH ?/6

3. Other:

Conclusion: Is soil hydric" Res

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: ____143_____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidi2ed rhi2ospheres: _____
- ❑ Water-stained leaves: _____ Res_____
- ❑ Hecorded Data (streams, lake, or tidal gauge; aerial photo; other): _____ _____ _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Res	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Res	____
Wetland hydrology present:		
8 ydric soil present	Res	____
Other indicators of hydrology present	Res	____
Sample location is in a BVW	Res	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W23-100 Wet Plot
Check all that apply:

- ❑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ❑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ❑ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number:		Transect Number:	Date of Delineation:
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Ground Cover				
Arrowwood/ Viburnum dentatum	40%	28%	Yes	FACW
Poison ivy/ Toxicodendron radicans	75%	53%	Yes	FAC
Sweet pepperbush/ Clethra alnifolia	30%	21%	Yes	FAC
Green briar/ Smilax rotundifolia	10%	10%	No	
Saplings				
Climbing Woody Vines				
Trees				
Red maple/ Acer rubrum	75%	100%	Yes	FAC

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 4 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number:
soil type mapped:
hydric soil inclusions:

Are field observations consistent with soil survey? yes no
Remarks:

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
0”-6”	10 YR 2/2		
6”-16”	10 YR 4/2		

Remarks:
10% Redox 7.5 YR 5/6

3. Other:

Conclusion: Is soil hydric? Yes

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Depth to free water in observation hole: _____
- ❑ Depth to soil saturation in observation hole: _____
- ❑ Water marks: _____
- ❑ Drift lines: _____
- ❑ Sediment Deposits: _____
- ❑ Drainage patterns in BVW: _____
- ❑ Oxidized rhizospheres: _____
- ❑ Water-stained leaves: _____Yes_____
- ❑ Recorded Data (streams, lake, or tidal gauge; aerial photo; other):
  _____
  _____
  _____
- ❑ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	Yes	____
Wetland hydrology present:		
Hydric soil present	Yes	____
Other indicators of hydrology present	Yes	____
Sample location is in a BVW	Yes	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Orleans Prepared by: BSC Group, Inc. Paul Mancuso Project location: Orleans, MA DEP File #: SE
Wetland #: W9- 10hh Wet Plot
CkecV all tkat apply:

- ❑ geretation alone presuq ed ade(uate to delineate BgW boundary: fill out Section I only
- ❑ geretation and otker indicators of kydrolory used to delineate BgW boundary: fill out Sections I and II
- ❑ Metkod otker tkan doq inance test used)attack additional inforq ationv

Section I.

geretation	ObserNation Plot L uq ber:		Transect L uq ber:	Date of Delineation:
A. Saq ple &ayer / Plant Species)by coq q on*scientific naq ev	B. Percent CoNer)or basal Areav	C. Percent Doq inance	D. Doq inant Plant)yes or nov	E. Wetland Indicator Caterory%
Ground Cover				
Coq q on reed* Pkramq ites australis	YhJ	YhJ	5es	FACW
Poison iNy* To?icodendron radicans	RJ	RJ		
Hewelweed* Iq patiens capensis	RJ	RJ		
Saplings				
Climbing Woody Vines				
Trees				

%dUse an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.

Vegetation conclusion:

L uq ber of doq inant wetland indicator plants: 0 L uq ber of doq inant non1wetland indicator plants: h

Is tke nuq ber of doq inant wetland plants e(ual to or rreater tkan tke nuq ber of doq inant non1wetland plantsz 5es

If Neretation alone is presuq ed ade(uate to delineate tke BgW boundary, subq it tkis forq witk tke x e(uest for Deterq ination of Applicability or L otice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is tkere a publisked soil surNey for tkis sitez yes no
title*date:
q ap nuq ber:
soil type q apped:
kydric soil inclusions:

Are field obserNations consistent witk soil surNeyz yes no
x eq arVs:

2. Soil Description

” ori2on	Deptk	Matri? Color	Mottles Color
A	0”-16”	10 YR 2/2	

x eq arVs:
MucVy

3. Other:

Conclusion: Is soil kydricz 5es

Other Indicators of Hydrology: (check all that apply & describe)

- ❑ Site Inundated: _____
- ❑ Deptk to free water in obserNation kole: _____0h4_____
- ❑ Deptk to soil saturation in obserNation kole: ____R4_____
- ❑ Water q arVs: _____
- ❑ Drift lines: _____
- ❑ Sediq ent Deposits: _____
- ❑ Drainame patterns in BgW: _____
- ❑ O?idi2ed rki2ospkeres: _____
- ❑ Water1stained leaNes: ___5es_____
- ❑ x ecorded Data)streaq s, laVe, or tidal maume; aerial pkoto; otkerv. _____ _____ _____
- ❑ Otker: _____

Vegetation and Hydrology Conclusion

	5es	Lo
L uq ber of wetland indicator plants ≥ # of non1wetland indicator plants	5es	____
Wetland hydrology present:		
” ydric soil present	5es	____
Otker indicators of kydrolomy present	5es	____
Sample location is in a BVW	5es	____

Submit this form with the Request for Determination of Applicability or Notice of Intent.

Attachment D

Property Owner and Abutter Information
Affidavit of Service
Notification to Abutters

NOTIFICATION TO ABUTTERS UNDER THE MASS. WETLANDS PROTECTION ACT

In accordance with the second paragraph of the Massachusetts General Laws Chapter 131 Section 40, the Orleans Wetlands Protection Bylaw (Chapter 160), and the Town of Orleans Wetlands Regulations 196A, you are hereby notified of the following:

A. The name of the applicant is the Town of Orleans (c/o John Kelly)

B. The applicant has filed a Notice of Intent with the Conservation Commission for the Town of Orleans seeking permission to remove, fill, dredge or alter an Area Subject to Protection under the Wetlands Protection Act (General Laws Chapter 131, Section 40), the Orleans Wetlands Protection Bylaw (Chapter 160), and the Town of Orleans Wetlands Regulations 196A. The proposed project involves the construction of service connections, a combination of gravity sewers and low-pressure sewers, a force main, and a sewage pumping station to service the Meetinghouse Pond area.

C. The address of the lot where the activity is proposed is: multiple locations in the Meetinghouse Pond area, including the following roads:

Uncle Vicks Way	Loomis Lane
Monument Road	Manito Road
Finlay Road	Cheney Road
Main Street	Lewis Road
Barley Neck Road	Grist Road
Pochet Road	Mill Lane
Great Oak Road	Natural Drive
Pine Ridge Road	Larboard Lane
Beach Road	Cedar Lane
Cole Place	High Tide Lane
Harveys Lane	Pond View Road
River Road	Windy Hill Lane
Lucy's Lane	Nauset Farms Way
Karen Way	Baxter Lane
Deerwood Lane	Bayberry Way
	Packet Landing

D. Copies of the Notice of Intent may be examined at the Town of Orleans Conservation Commission, (508) 240-3700 x2425, Orleans Town Hall, 19 School Road. Orleans, MA 02653, between the hours of:

8:30 AM - 4:30 PM – Monday - Friday

E. Copies of the Notice of Intent may be obtained from either (check one):

_____ the applicant __X__ or the applicant's representative (Jennifer Doyle-Breen (AECOM))

by calling this telephone number 978-905-2968 between the hours of

9am and 5pm__ on the following days of the week: Monday-Friday.

F. Information regarding the date, time and place of the public hearing may be obtained from: Town of Orleans Conservation Commission by calling this telephone number (508) 240-3700 x 2425 between the hours of 8:30 AM - 4:30 PM.

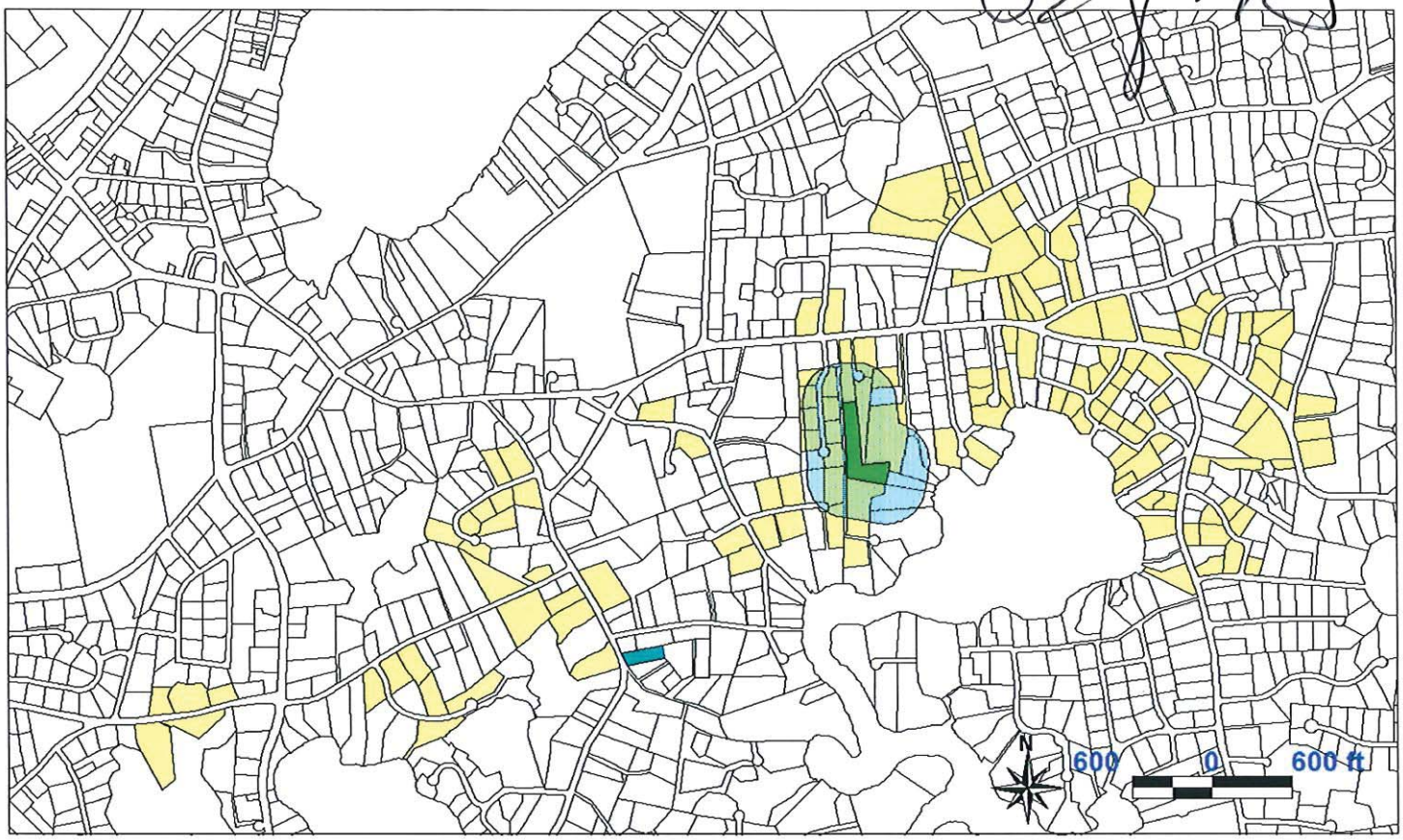
NOTE: Notice of the public hearing, including its date, time, and place will be published at least five (5) business days in advance in the Cape Codder **in a public legal notice.**

NOTE: Notice of the public hearing, including its date, time, and place will be posted in Town Hall not less than forty-eight (48) hours in advance (do not count Saturdays, Sundays and holidays.) To view the agenda, please visit https://www.town.orleans.ma.us/conservation

NOTE: You may also contact the Orleans Conservation Commission or the nearest Department of Environmental Protection Regional Office for more information about this application or the Wetlands Protection Act. DEP administrative jurisdiction over Orleans is the Southeast Region: (SERO) 20 Riverside Drive, Lakeville, MA 02347 (508-946-2700).

TOWN OF ORLEANS, MA
BOARD OF ASSESSORS
19 School Rd., Orleans, MA 02653

Abutters List Within 300 feet of Parcel 42/6/0



Key	Parcel ID	Owner	Location	Mailing Street	Mailing City	ST	ZipCd/Country
1633	27-72-0-R	WALDRON TIMOTHY J & NANCY J	34 GREAT OAK RD	34 GREAT OAK RD	ORLEANS	MA	02653
2642	35-37-0-R	MCLEAN STUART A C/O MCLEAN STUART A TRUSTEE	180 MAIN ST	15 CLIFFORD AVE	PELHAM	NY	10803
2652	35-47-0-R	FULLER JON R & BEVERLY A	184 MAIN ST	PO BOX 667	E ORLEANS	MA	02643
2661	35-56-0-R	OLLIVIER VINCENT A & GALLIGAN KEVIN	22 GREAT OAK RD	22 GREAT OAK RD	ORLEANS	MA	02653
2662	35-57-0-R	OLLIVIER VINCENT A	24 GREAT OAK RD	22 GREAT OAK RD	ORLEANS	MA	02653
2663	35-58-0-R	QUACKENBUSH STEVEN & ALISON A	26 GREAT OAK RD	64 OVERLOOK DR WEST	FRAMINGHAM	MA	01701
2664	35-59-0-R	CHAREST KEITH & CHAREST CRAIG	2 PINE RIDGE LN	22 IROQUOIS LN	WILBRAHAM	MA	01095
2665	35-60-0-R	CAREY ROBERT R & BARBARA S	6 PINE RIDGE LN	23 HOE SHOP RD	BERNARDSTON	MA	01337
2666	35-61-0-R	COUGHLAN KATHLEEN & CONLAN BRE	8 PINE RIDGE LN	113 MAIN ST	ORLEANS	MA	02653
2667	35-62-0-R	HAGENBUCKLE CHERYL C/O CHERYL CEREPANYA	5 PINE RIDGE LN	4536 E MILLER CANYON RD	HEREFORD	AZ	85615
2668	35-63-0-R	SCHOUR ELLEN& MCCUTCHEON BRUCE	30 GREAT OAK RD	30 GREAT OAK RD	ORLEANS	MA	02653
5934	35-64-0-E	ORLEANS CONSERVATION TRUST	25 GREAT OAK RD	203 S ORLEANS RD	ORLEANS	MA	02653
2684	35-73-0-R	CANTOR SHARI G & MICHAEL A TRS SHARI G CANTOR 2014 QUAL TRUST	10 LEWIS RD	39 COLONY RD	W HARTFORD	CT	06117
2685	35-74-0-R	CANTOR SHARI G & MICHAEL A TRS SHARI G CANTOR 2014 QUAL TRUST	12 LEWIS RD	39 COLONY RD	W HARTFORD	CT	06117
2707	35-89-0-R	RIVAL LAURA & RIVAL DALE TRS RIVAL REALTY TRUST	197 MAIN ST	261 HIGH ST	MANCHESTER	CT	06040

Key	Parcel ID	Owner	Location	Mailing Street	Mailing City	ST	ZipCd/Country
2709	35-91-0-R	ALEKNA CATHERINE	197-B MAIN ST	PO BOX 961	ORLEANS	MA	02653
2711	35-93-0-R	DEMPZE NANCY & NOTIS-MCCONARTY EDWARD TRS	191 MAIN ST	C/O RIX 118 COMSTOCK RD	WOODSIDE	CA	94062
2712	35-94-0-R	DAYTON JAMES E & MICHELE	193 MAIN ST	193 MAIN ST	ORLEANS	MA	02653
2713	35-95-0-R	ARONE CATHLEEN	189 MAIN ST	189 MAIN ST	ORLEANS	MA	02653
2714	35-96-0-R	FISHER DAVID & LEILA L TRS DAVID E FISHER LIVING TR	15 DEERWOOD LN	PO BOX 291	E ORLEANS	MA	02643
2715	35-97-0-R	BLAZAR JAMES M & NANCY E	9 DEERWOOD LN	555 SOUTH AVE EAST APT 434	CRANFORD	NJ	07016
2718	35-101-0-R	MACLEAN BRUCE C	10 DEERWOOD LN	PO BOX 964	E ORLEANS	MA	02643
2719	35-102-0-R	SULLIVAN ROBERT W & MARCY	14 DEERWOOD LN	606 ALHAMBRA LN N	PONTE VEDRA BEACH	FL	32082
2720	35-103-0-R	WINTER CHRISTIAN ET ALI	16 DEERWOOD LN	64 BOUTON RD	S SALEM	NY	10590
2731	35-115-0-R	NEHER GEORGE & PATRICIA TRS GEORGE & PATRICIA NEHER LIV TR	14 RIVER RD	PO BOX 275	E ORLEANS	MA	02643
2734	36-2-0-R	SMITH III GEORGE C & COE JEAN	31 GREAT OAK RD	31 GREAT OAK RD	ORLEANS	MA	02653
2735	36-3-0-R	HIGGINS GLENN R	37 GREAT OAK RD	37 GREAT OAK RD	ORLEANS	MA	02653
2745	36-14-0-R	HAYNIE JOHN JR & DONNA M	18 COLE PL	23 FRANCES RD	HARWICH	MA	02645
2746	36-15-0-R	FULCHER GENE A & GENEVIEVE L	15 COLE PL	PO BOX 1476	ORLEANS	MA	02653
2747	36-16-0-R	DALY WILLIAM & MONA G TRS 6 COLE PLACE NOMINEE TRUST	6 COLE PL	6 COLE PLACE	ORLEANS	MA	02653
8822	36-18-1-R	220 MAIN STREET LLC	220 MAIN ST	PO BOX 1551	E ORLEANS	MA	02643
8823	36-18-2-R	GOULD JAY S	218 MAIN ST	218 MAIN ST	ORLEANS	MA	02653
8824	36-18-3-R	GOULD JAY S	218 MAIN ST	218 MAIN ST	ORLEANS	MA	02653
2750	36-19-0-R	ONEBUFFALO LLC	222 MAIN ST	PO BOX 189	ORLEANS	MA	02653
2751	36-20-0-R	MACKENZIE DONALD W	224 MAIN ST	PO BOX 406	E ORLEANS	MA	02643
2752	36-22-0-R	SCHEEL LAURA V	2 BEACH RD	PO BOX 417	E ORLEANS	MA	02643
10106	36-23-1-R	ASANTUGRUL SIBEL	8 BEACH RD	PO BOX 1988	ORLEANS	MA	02653
10107	36-23-2-R	CYGNET LANE GROUP LLC	8 BEACH RD	300 HEBRON AVE SUITE 215	GLASTONBURY	CT	06033
10108	36-23-3-R	BUDRYK JENNIFER M	8 BEACH RD	PO BOX 1255	E ORLEANS	MA	02643
10109	36-23-4-R	BURZLAFF KRAIG & JULIE	8 BEACH RD	1353 WILD PINE CT	TRINITY	FL	34655
10110	36-23-5-R	SCHENFELD STEVEN E & SHARI D	8 BEACH RD	34 GARLEN RD	KATONAH	NY	10536
2770	36-37-0-R	MORLEY ROBERT A C/O R CURTIS MORLEY	15 NAUSET FARMS WY	5 CHANDLER DR	LONDONDERRY	NH	03053
2823	36-84-0-R	FERRARA MARGARET M TRUSTEE MARGARET M FERRARA FAM REAL TR	5 BRICK HILL RD	5 BRICK HILL RD	ORLEANS	MA	02653
2824	36-85-0-R	SILVERMAN MYRNA A & LEE H TRS MYRNA A SILVERMAN RES TRUST	6 BRICK HILL RD	2235 HARMAIN RD	PITTSBURGH	PA	15235
2839	36-100-0-R	DAVIES PAUL & ROMANS THERESA	2 POCHET RD	PO BOX 717	E ORLEANS	MA	02643
2840	36-101-0-R	WHARFF ELIZABETH A TRUSTEE ELIZABETH A WHARFF TRUST	4 NATURAL DR	77 CHANDLER ST UNIT 2	BOSTON	MA	02116
2841	36-102-0-R	ABBOTT DAVID W & LYNNE A	6 NATURAL DR	50 GINLEY RD	WALPOLE	MA	02081
2842	36-103-0-R	HOEY KEVIN B & ROBIN A	10 NATURAL DR	53 PILGRIM RD	MARBLEHEAD	MA	01945
2847	36-108-0-R	MARELLA PAULA M TR THE NATURAL DRIVE REALTY TRUST	7 NATURAL DR	660 UNION ST #2C	BRAINTREE	MA	02184
2851	36-112-0-R	WIENCEK PAUL & ANN MAUREEN TRS WIENCEK REALTY TRUST	8 LARBOARD LN	15 ROSSI LN	ASHLAND	MA	01721
2852	36-113-0-R	MCMANUS BARRY & HAINES AMANDA	10 LARBOARD LN	276 COUNTY RD	BOURNE	MA	02532
2853	36-114-0-R	WIEGERS DEAN & EDNA	9 LARBOARD LN	9 LARBOARD LN	ORLEANS	MA	02653
2854	36-115-0-R	FOOTIT PAUL F & BARBARA R C/O FOOTIT BARBARA R & PAUL F	7 LARBOARD LN	7 MEETINGHOUSE LN	WILBRAHAM	MA	01095
2855	36-116-0-R	TAYLOR JANET C TRUSTEE	3 LARBOARD LN	PO BOX 97	E ORLEANS	MA	02643
2856	36-117-0-R	23 POCHET LLC	23 POCHET RD	110 BROAD ST UNIT 903	BOSTON	MA	02110
2860	36-121-0-R	SANT JENIFER & REIN CHRISTINE 30 BARLEY NECK RD REALTY TR	30 BARLEY NECK RD	8 THOMPSON COURT	NATICK	MA	01760

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2863	36-123-0-R	MOLE JOHN D & BARBARA L TRS MOLE REALTY TRUST	5 CEDAR WY	311 LOWELL AVE	NEWTON	MA	02460
2865	36-125-0-R	PLIMPTON GLENN G & JUDITH A	25 BARLEY NECK RD	25 BARLEY NECK RD	ORLEANS	MA	02653
2870	36-130-0-R	ISNER MICHAEL & PRISCILLA TRS MICHAEL & PRISCILLA ISNER LVTR	14 HIGH TIDE LN	PO BOX 363	E ORLEANS	MA	02643
2871	36-131-0-R	SICLARI WILLIAM & MARY ANN C C/O SICLARI WILLIAM & MARY ANN	20 HIGH TIDE LN	16120 EDGEMONT DR	FT MYERS	FL	33908
2872	36-132-0-R	BROWN WILLIAM B & ANN T TRS WILLIAM & ANN BROWN NOM TRUST	24 HIGH TIDE LN	PO BOX 1384	E ORLEANS	MA	02643
2873	36-133-0-R	UGLIAROLO MICHAEL E & SUSAN C/O UGIAROLO MICHAEL E & SUSAN	15 GRIST RD	6 MOSS RUN	WHITE PLAINS	NY	10605
2874	36-134-0-R	OHNEMUS DAVID & VIRGINIA	11 GRIST RD	11 GRIST RD	ORLEANS	MA	02653
5941	36-135-0-E	TOWN OF ORLEANS	19 BARLEY NECK RD	19 SCHOOL RD	ORLEANS	MA	02653
9557	36-136-1-R	LONDA JOHN J & JOANNE	18 BARLEY NECK RD	PO BOX 1045	E ORLEANS	MA	02643
9559	36-136-A-R	CHRISTIE SUSAN B TRUSTEE FLATLAND REALTY TRUST	4-A MILL LN	PO BOX 945	E ORLEANS	MA	02643
9558	36-136-B-R	LONGTON EDWARD B & ANNE F TRS C/O BRADBURY JO ANNE TRUSTEE	4-B MILL LN	PO BOX 254	E ORLEANS	MA	02643
9560	36-136-C-R	BARKER CANDICE & ROBERT J TRS CANDICE BARKER 2015 LVG TRST	4-C MILL LN	PO BOX 354	E ORLEANS	MA	02643
9561	36-136-D-R	CUOMO RALPH A C/O CUOMO RALPH A TRUSTEE	4-D MILL LN	PO BOX 667	E ORLEANS	MA	02643
9562	36-136-E-R	OLESKI ANDREW R & COLEEN K TRS ANDREW & COLEEN OLESKI LIV TRS	4-E MILL LN	PO BOX 546	E ORLEANS	MA	02643
9563	36-136-F-R	VYSKOCIL MARY KAY	4-F MILL LN	80 EAST END AVE #18A	NEW YORK	NY	10028
9564	36-136-G-R	MCMAHON THOMAS W TR T MAC REALTY TRUST	4-G MILL LN	70 CACHE CAY DR	VERO BEACH	FL	32963
9565	36-136-H-R	STEIN JONATHAN & DEBRA TRS DEBRA H REVOCABLE TRUST	4-H MILL LN	31 CHESTNUT ST	WELLESLEY	MA	02481
10167	36-137-1-R	CONROY GARY & GREEN WILLIAM TR CRAZY FINGERS REALTY TRUST	6 BARLEY NECK VILLAGE LN	118 HUNTINGTON AVE UNIT 2102	BOSTON	MA	02116
10168	36-137-2-R	GREEN WILLIAM & CONROY GARY TR CRAZY FINGERS REALTY TRUST	8 BARLEY NECK VILLAGE LN	118 HUNTINGTON AVE APT 2102	BOSTON	MA	02116
10169	36-137-3-R	NELSON ROSEMARY KING	10 BARLEY NECK VILLAGE LN	PO BOX 407	E ORLEANS	MA	02643
10170	36-137-4-R	FURST ROBERT E & JUDITH M	5 BARLEY NECK VILLAGE LN	PO BOX 992	E ORLEANS	MA	02643
10171	36-137-5-R	HURLEY DAVID J & ELAINE J	3 BARLEY NECK VILLAGE LN	PO BOX 776	E ORLEANS	MA	02643
10172	36-137-6-R	PETTENGILL JOHN R TRUSTEE JOHN R PETTENGILL REVOC TR	1 BARLEY NECK VILLAGE LN	1 CARANDO DR	SPRINGFIELD	MA	01104
2876	36-137-7-R	BUFFER ZONE PROPERTIES LLC	5 BEACH RD	100 MAIN ST APT 2G	TUCKAHOE	NY	10707
2877	36-138-0-R	WARE MARY &CHAPPELL BEVERLY TR	15 BARLEY NECK RD	PO BOX 55	E ORLEANS	MA	02643
2883	36-144-0-R	HUSKINS SUZANNE TRUSTEE MEETINGHOUSE POND PROPERTY TR	32 HIGH TIDE LN	PO BOX 995	E ORLEANS	MA	02643
2884	36-145-0-R	FIALA JAMES & HENNESSY ROBIN	12 GRIST RD	131 DAVIS AVE #2	BROOKLINE	MA	02445
2885	36-146-0-R	DER HAGOPIAN MARK A TRUSTEE M & M LUCKY OYSTER REALTY TR	25 HIGH TIDE LN	651 BOYLSTON ST	BOSTON	MA	02116
2886	36-147-0-R	MCKENZIE JAMES J & LINDA	31 HIGH TIDE LN	19 BELKNAP RD	MEDFIELD	MA	02052
2887	36-148-0-R	WAUGH ELIZABETH ESTATE OF	35 HIGH TIDE LN	31 MUSSEL POINT WY	MAGNOLIA	MA	01930
2890	36-151-0-R	AOKI JOHN M & TERRIE E	223 MAIN ST	61 FALMOUTH RD	SCARSDALE	NY	10583
2892	36-153-0-R	BOYD WHITFORD G & MARGARET	219 MAIN ST	PO BOX 1487	ORLEANS	MA	02653
2895	36-156-0-R	KUBSCH WILLIAM N TRUSTEE KUBSCH FAMILY REVOCABLE TRUST	9 LEWIS RD	PO BOX 371	E ORLEANS	MA	02643
2896	36-157-0-R	NIX PETER D & JOAN P TRUSTEES NIX FAMILY TRUST	14 LEWIS RD	14 LEWIS RD	ORLEANS	MA	02653
3309	41-40-0-R	WILCOX ROBERT B	4 UNCLE VICKS WY	PO BOX 501	ORLEANS	MA	02653
3310	41-41-0-E	TOWN OF ORLEANS	5 MISTY LN	19 SCHOOL RD	ORLEANS	MA	02653
3315	41-46-0-R	KANG YUN-SUN & LEE YOUNG-JOO	24 UNCLE VICKS WY	7006 ALICENT PLACE	MCLEAN	VA	22101
3316	41-47-0-R	MOORE NANCY J	30 UNCLE VICKS WY	PO BOX 1426	ORLEANS	MA	02653
3318	41-49-0-R	REYNOLDS JANICE G TRUSTEE JANICE G REYNOLDS REVC TRUST	29 UNCLE VICKS WY	29 UNCLE VICKS WY	ORLEANS	MA	02653
3319	41-50-0-R	MARVEL STANLEY W & LORETTA B	27 UNCLE VICKS WY	27 UNCLE VICKS WY	ORLEANS	MA	02653
3320	41-51-0-R	WERNER WILLIAM J & RAYMOND F	15 UNCLE VICKS WY	513 S MOUNTAIN RD	NEW CITY	NY	10956

Key	Parcel ID	Owner	Location	Mailing Street	Mailing City	ST	ZipCd/Country
3321	41-52-0-R	OLIVEIRA CRAIG & ERICA TASHA	9 UNCLE VICKS WY	9 UNCLE VICKS WAY	ORLEANS	MA	02653
3322	41-53-0-R	CINCOTTA ANTHONY J & LYNN C	24 MONUMENT RD	24 MONUMENT RD	ORLEANS	MA	02653
3325	41-57-0-R	MALONEY JAMES ET ALI TRS MALONEY REALTY TRUST	54 POND RD	390 CHERRY ST	NEWTON	MA	02465
3328	41-58-3-R	YOUNG WILLIAM & PAINE ALLISON	44 POND RD	PO BOX 1458	WELLFLEET	MA	02667
3402	41-122-0-R	ALLARD STEVEN J & MARY ANN TRS ALLARD LIVING TRUST	4 LAKE FARM LN	1050 GEORGE ST APT 9D	NEW BURNSWICK	NJ	08901
3403	41-123-0-R	BOOTH KEVIN R & BARBARA J	3 LAKE FARM LN	15 BEAVER DAM RD	UPPER SADDLE RIVER	NJ	07458
3404	41-124-0-R	OKEEFE BRENDAN J & MELANIE J	25 POND RD	25 POND RD	ORLEANS	MA	02653
3413	41-133-0-R	DOANE ELEANOR A & ROBERT R	49 POND RD	49 POND RD	ORLEANS	MA	02653
3415	42-1-0-R	HOWELL TIMOTHY S & ANDREA B TIM & ANDREA HOWELL 2020 LIVTR	25 CHENEY RD	PO BOX 1208	E ORLEANS	MA	02643
5974	42-3-0-E	ORLEANS CONSERVATION TRUST	20 CHENEY RD	203 S ORLEANS RD	ORLEANS	MA	02653
3419	42-6-0-R	ANDERSON MARK& BUDRYK JENNIFER	29 LOOMIS LN	PO BOX 1432	E ORLEANS	MA	02643
3425	42-13-0-R	FAHERTY MARILYN& FREDERICK TRS MARILYN J FAHERTY LIV TRUST	40 LOOMIS LN	2 HUCKLEBERRY LN	ACTON	MA	01720
3426	42-14-0-R	ATHANASSIOU NICHOLAS A & JEANN MCNETT	31 LOOMIS LN	PO BOX 882	E ORLEANS	MA	02643
3427	42-15-0-R	TYNG STEPHEN H TRUSTEE STEPHEN & BARBARA TYNG LIV TR	17 PACKET LANDING	PO BOX 621	E ORLEANS	MA	02643
3431	42-19-0-R	PETRINO RICHARD E & PATRICIA R	9 PACKET LANDING	12 SLEEPY HOLLOW RD	KINNELON	NJ	07405
3432	42-20-0-R	PETERS NOAH & WELCH RYDELL	3 PACKET LANDING	3 PACKET LANDING	ORLEANS	MA	02653
3434	42-22-0-R	DEFANTI KATHLEEN H TRUSTEE 6 PACKET LANDING REAL EST TR	6 PACKET LANDING	6 PACKET LANDING	ORLEANS	MA	02653
3435	42-23-0-R	KATHERMAN JUDITH T	10 PACKET LANDING	PO BOX 79	E ORLEANS	MA	02643
3437	42-25-0-R	DEWING J THOMPSON JR & SALLY A	16 PACKET LANDING	16 PACKET LANDING	ORLEANS	MA	02653
3438	42-26-0-R	ATHANASSIOU NICHOLAS A TR 23 DEERWOOD NOMINEE TRUST	23 DEERWOOD LN	PO BOX 882	E ORLEANS	MA	02643
3439	42-27-0-R	RUEL JAMES & DEBRA	21 DEERWOOD LN	5 ABBOTTSFORD	AVON	CT	06001
3440	42-28-0-R	WOLFF JOHN R & DEBORAH	20 DEERWOOD LN	31 BASSWOOD CIRCLE	CHANHASSEN	MN	55317
3446	42-32-0-R	JOHNSON DAVID L TRUSTEE DLJ 29 RIVER RD REALTY TRUST	29 RIVER RD	79 SUGARLOAF DR	WILTON	CT	06897
3456	42-44-0-R	SETTERLUND ROY&MARIANI DEBORAH	5 LINDEN LN	5 LINDEND LN	ORLEANS	MA	02653
3457	42-45-0-R	BALDESSARINI FRANCES C/O BALDESSARINI FRANCES O & R	59 RIVER RD	49 NEHOIDEN RD	WABAN	MA	02468
3474	42-63-0-R	STEIN JOHN A ET ALI	41 MONUMENT RD	41 MONUMENT RD	ORLEANS	MA	02653
3486	42-76-0-R	SCANLON JUDITH ANN TRUSTEE SCANLON REALTY TRUST	40 MONUMENT RD	40 MONUMENT RD	ORLEANS	MA	02653
3488	42-77-2-R	SCHAEFER GRACE	46 MONUMENT RD	46 MONUMENT RD	ORLEANS	MA	02653
3490	42-77-4-R	WINSLOW SIGURD A ET AL TRS WINSLOW SCANLON REALTY TRUST	40-A MONUMENT RD	PO BOX 647	ORLEANS	MA	02653
3493	42-80-2-R	RIMBACH JONATHAN L	6 APPLE WY	60 PURITAN DR	BREWSTER	MA	02631
3515	43-4-0-R	MCDONALD SARAH	16 HIGH TIDE LN	6121 ETERNAL OCEAN PL	CLARKSVILLE	MD	21029
3516	43-5-0-R	MAJEWICZ RONALD & LINNEA	15 HIGH TIDE LN	4553 YACHT HARBOR DR	NAPLES	FL	34112
3518	43-7-0-R	CAPE COD 5 CENTS SAV BANK TRS JUDITH K BRAINERD TRUST	9 HIGH TIDE LN	PO BOX 20	ORLEANS	MA	02653
3521	43-10-0-R	KELLY JOHN J & PATRICIA W TRS JOHN & PATRICIA KELLY FAM TR	8 POND VIEW RD	PO BOX 685	E ORLEANS	MA	02643
3522	43-11-0-R	BARDWELL ROBERT & ROBIN TRS MARY H BARDWELL IRR FAM TRUST	14 POND VIEW RD	PO BOX 138	E ORLEANS	MA	02643
3527	43-16-0-R	SEDLACEK MARTIN & BASCUNAN CARMEN P	57 BARLEY NECK RD	57 BARLEY NECK RD	ORLEANS	MA	02653
3528	43-17-0-R	HICKEY CYNTHIA & WILLIAM TRS HICKEY TRUST	6 BAYBERRY WY	54 OAK RIDGE CIRCLE	WEYMOUTH	MA	02188
3529	43-19-0-R	BISSELL WILLIAM C ET AL TRS GEORGE S BISSELL REALTY TRUST	65 BARLEY NECK RD	PO BOX 562	E ORLEANS	MA	02643
3531	43-22-0-R	GIESS BENJAMIN P & CATHERINE S	73 BARLEY NECK RD	47 TEMPLE RD	WELLESLEY	MA	02482
5984	43-96-0-E	ORLEANS CONSERVATION TRUST	14 HARVEYS LN	203 S ORLEANS RD	ORLEANS	MA	02653
3604	43-98-0-R	BARTHOLOMEW SARAH TRS SARAH BARTHOLOMEW TRUST	6 HARVEYS LN	6 HARVEYS LN	ORLEANS	MA	02653

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3605	43-99-0-R	PEDONE RONALD &PAYER ELIZABETH RONALD J PEDONE REV LIV TRUST	2 HARVEYS LN	3309 GUMWOOD DR	HYATTSVILLE	MD	20783
3607	43-101-0-R	DEAN SUZANNE B	62 BARLEY NECK RD	171 THORNDIKE ST	BROOKLINE	MA	02446
3610	43-104-0-R	FILOMENO MICHAEL J & FILOMENO THOMAS J	5 WINDY HILL LN	44 WILDWOOD GLEN	LONGMEADOW	MA	01106
3611	43-105-0-R	MURPHY DENNIS J & ELIZABETH	11 WINDY HILL LN	PO BOX 1546	E ORLEANS	MA	02643
3613	43-107-0-R	WINEMAN M MARIAN ET ALI	10 WINDY HILL LN	3611 45TH AVE	W SEATTLE	WA	98199
3614	43-108-0-R	WINNICK DAVID & DEBORAH TRS DAVID & DEBORAH WINNICK RES TR	8 WINDY HILL LN	8 WINDY HILL LN	ORLEANS	MA	02653
3617	43-111-0-R	CRONIN NANCY E TRUSTEE NANCY E CRONIN REVOC TRUST	12 BAXTER LN	76 POWDER HILL RD	BEDFORD	NH	03110
3620	43-114-0-R	MCGONAGLE JAMES &PAUL MARYBETH	31 POCHET RD	3 ICE HOUSE LN	NATICK	MA	01760
3621	43-115-0-R	WOLFF EDWARD J & JENNIFER A	41 POCHET RD	23 BUCKINGHAM RD	MILTON	MA	02186
3639	43-134-0-R	MUDD CAROLINE B TRUSTEE THE 46 POCHET RD TRUST	46 POCHET RD	269 CENTER ST	N EASTON	MA	02356
3640	43-135-0-R	FULCHER FREDERICK &TAGLIAFERRI C/O FULCHER FREDERICK &TAGLIAF	40 POCHET RD	40 POCHET RD	ORLEANS	MA	02653
4041	48-2-0-R	TREESE JAMES R	90 FINLAY RD	90 FINLAY RD	ORLEANS	MA	02653
4042	48-3-0-R	MURPHY BRYAN T	94 FINLAY RD	104 NAUSET BEACH VIEW PATH	HARWICH	MA	02645
4043	48-4-0-R	MAYO KENNETH N & DONNA P	100 FINLAY RD	100 FINLAY RD	ORLEANS	MA	02653
4044	48-5-0-R	CARLSON PAUL	93 FINLAY RD	93 FINLAY RD	ORLEANS	MA	02653
4045	48-6-0-R	WELLS GARY & TIRINGER TERRY	83 FINLAY RD	83 FINLAY RD	ORLEANS	MA	02653
4087	48-48-0-R	AUTY BEATRICE P	16 LAKE FARM LN	PO BOX 533	E ORLEANS	MA	02643
4089	48-50-0-R	MACGILLIVRAY KYLE I IRENE M MACGILLIVARY TRUST	9 LAKE FARM LN	895 SPORT HILL RD	EASTON	CT	06612
4090	48-51-0-R	NOVER ROBERT A & AIMEE A	15 LAKE FARM LN	5410 CONNECTICUT AVE NW STE111	WASHINGTON	DC	20015

27-72-0-R

WALDRON TIMOTHY J & NANCY J
34 GREAT OAK RD
ORLEANS, MA 02653

35-37-0-R

MCLEAN STUART A
C/O MCLEAN STUART A TRUSTEE
15 CLIFFORD AVE
PELHAM, NY 10803

35-47-0-R

FULLER JON R & BEVERLY A
PO BOX 667
E ORLEANS, MA 02643

35-56-0-R

OLLIVIER VINCENT A & GALLIGAN
KEVIN
22 GREAT OAK RD
ORLEANS, MA 02653

35-57-0-R

OLLIVIER VINCENT A
22 GREAT OAK RD
ORLEANS, MA 02653

35-58-0-R

QUACKENBUSH STEVEN & ALISON A
64 OVERLOOK DR WEST
FRAMINGHAM, MA 01701

35-59-0-R

CHAREST KEITH & CHAREST CRAIG
22 IROQUOIS LN
WILBRAHAM, MA 01095

35-60-0-R

CAREY ROBERT R & BARBARA S
23 HOE SHOP RD
BERNARDSTON, MA 01337

35-61-0-R

COUGHLAN KATHLEEN & CONLAN BRE
113 MAIN ST
ORLEANS, MA 02653

35-62-0-R

HAGENBUCKLE CHERYL
C/O CHERYL CEREPANYA
4536 E MILLER CANYON RD
HEREFORD, AZ 85615

35-63-0-R

SCHOUR ELLEN& MCCUTCHEON BRUCE
30 GREAT OAK RD
ORLEANS, MA 02653

35-64-0-E

ORLEANS CONSERVATION TRUST
203 S ORLEANS RD
ORLEANS, MA 02653

35-73-0-R

CANTOR SHARI G & MICHAEL A TRS
SHARI G CANTOR 2014 QUAL TRUST
39 COLONY RD
W HARTFORD, CT 06117

35-74-0-R

CANTOR SHARI G & MICHAEL A TRS
SHARI G CANTOR 2014 QUAL TRUST
39 COLONY RD
W HARTFORD, CT 06117

35-89-0-R

RIVAL LAURA & RIVAL DALE TRS
RIVAL REALTY TRUST
261 HIGH ST
MANCHESTER, CT 06040

35-91-0-R

ALEKNA CATHERINE
PO BOX 961
ORLEANS, MA 02653

35-93-0-R

DEMPZE NANCY & NOTIS-MCCONARTY
EDWARD TRS
C/O RIX
118 COMSTOCK RD
WOODSIDE, CA 94062

35-94-0-R

DAYTON JAMES E & MICHELE
193 MAIN ST
ORLEANS, MA 02653

35-95-0-R

ARONE CATHLEEN
189 MAIN ST
ORLEANS, MA 02653

35-96-0-R

FISHER DAVID & LEILA L TRS
DAVID E FISHER LIVING TR
PO BOX 291
E ORLEANS, MA 02643

35-97-0-R

BLAZAR JAMES M & NANCY E
555 SOUTH AVE EAST APT 434
CRANFORD, NJ 07016

35-101-0-R

MACLEAN BRUCE C
PO BOX 964
E ORLEANS, MA 02643

35-102-0-R

SULLIVAN ROBERT W & MARCY
606 ALHAMBRA LN N
PONTE VEDRA BEACH, FL 32082

35-103-0-R

WINTER CHRISTIAN ET ALI
64 BOUTON RD
S SALEM, NY 10590

35-115-0-R

NEHER GEORGE & PATRICIA TRS
GEORGE & PATRICIA NEHER LIV TR
PO BOX 275
E ORLEANS, MA 02643

36-2-0-R

SMITH III GEORGE C & COE JEAN
31 GREAT OAK RD
ORLEANS, MA 02653

36-3-0-R

HIGGINS GLENN R
37 GREAT OAK RD
ORLEANS, MA 02653

36-14-0-R

HAYNIE JOHN JR & DONNA M
23 FRANCES RD
HARWICH, MA 02645

36-15-0-R

FULCHER GENE A & GENEVIEVE L
PO BOX 1476
ORLEANS, MA 02653

36-16-0-R

DALY WILLIAM & MONA G TRS
6 COLE PLACE NOMINEE TRUST
6 COLE PLACE
ORLEANS, MA 02653

36-18-1-R

220 MAIN STREET LLC
PO BOX 1551
E ORLEANS, MA 02643

36-18-2-R

GOULD JAY S
218 MAIN ST
ORLEANS, MA 02653

36-18-3-R

GOULD JAY S
218 MAIN ST
ORLEANS, MA 02653

36-19-0-R

ONEBUFFALO LLC
PO BOX 189
ORLEANS, MA 02653

36-20-0-R

MACKENZIE DONALD W
PO BOX 406
E ORLEANS, MA 02643

36-22-0-R

SCHEEL LAURA V
PO BOX 417
E ORLEANS, MA 02643

36-23-1-R

ASANTUGRUL SIBEL
PO BOX 1988
ORLEANS, MA 02653

36-23-2-R

CYGNET LANE GROUP LLC
300 HEBRON AVE SUITE 215
GLASTONBURY, CT 06033

36-23-3-R

BUDRYK JENNIFER M
PO BOX 1255
E ORLEANS, MA 02643

36-23-4-R

BURZLAFF KRAIG & JULIE
1353 WILD PINE CT
TRINITY, FL 34655

36-23-5-R

SCHENFELD STEVEN E & SHARI D
34 GARLEN RD
KATONAH, NY 10536

36-37-0-R

MORLEY ROBERT A
C/O R CURTIS MORLEY
5 CHANDLER DR
LONDONDERRY, NH 03053

36-84-0-R

FERRARA MARGARET M TRUSTEE
MARGARET M FERRARA FAM REAL TR
5 BRICK HILL RD
ORLEANS, MA 02653

36-85-0-R

SILVERMAN MYRNA A & LEE H TRS
MYRNA A SILVERMAN RES TRUST
2235 HARMAIN RD
PITTSBURGH, PA 15235

36-100-0-R

DAVIES PAUL & ROMANS THERESA
PO BOX 717
E ORLEANS, MA 02643

36-101-0-R

WHARFF ELIZABETH A TRUSTEE
ELIZABETH A WHARFF TRUST
77 CHANDLER ST UNIT 2
BOSTON, MA 02116

36-102-0-R

ABBOTT DAVID W & LYNNE A
50 GINLEY RD
WALPOLE, MA 02081

36-103-0-R

HOEY KEVIN B & ROBIN A
53 PILGRIM RD
MARBLEHEAD, MA 01945

36-108-0-R

MARELLA PAULA M TR
THE NATURAL DRIVE REALTY TRUST
660 UNION ST #2C
BRAINTREE, MA 02184

36-112-0-R

WIENCEK PAUL & ANN MAUREEN TRS
WIENCEK REALTY TRUST
15 ROSSI LN
ASHLAND, MA 01721

36-113-0-R

MCMANUS BARRY & HAINES AMANDA
276 COUNTY RD
BOURNE, MA 02532

36-114-0-R

WIEGERS DEAN & EDNA
9 LARBOARD LN
ORLEANS, MA 02653

36-115-0-R

FOOTIT PAUL F & BARBARA R
C/O FOOTIT BARBARA R & PAUL F
7 MEETINGHOUSE LN
WILBRAHAM, MA 01095

36-116-0-R

TAYLOR JANET C TRUSTEE
PO BOX 97
E ORLEANS, MA 02643

36-117-0-R

23 POCHET LLC
110 BROAD ST UNIT 903
BOSTON, MA 02110

36-121-0-R

SANT JENIFER & REIN CHRISTINE
30 BARLEY NECK RD REALTY TR
8 THOMPSON COURT
NATICK, MA 01760

36-123-0-R

MOLE JOHN D & BARBARA L TRS
MOLE REALTY TRUST
311 LOWELL AVE
NEWTON, MA 02460

36-125-0-R

PLIMPTON GLENN G & JUDITH A
25 BARLEY NECK RD
ORLEANS, MA 02653

36-130-0-R

ISNER MICHAEL & PRISCILLA TRS
MICHAEL & PRISCILLA ISNER LVTR
PO BOX 363
E ORLEANS, MA 02643

36-131-0-R

SICLARI WILLIAM & MARY ANN C
C/O SICLARI WILLIAM & MARY ANN
16120 EDGEMONT DR
FT MYERS, FL 33908

36-132-0-R

BROWN WILLIAM B & ANN T TRS
WILLIAM & ANN BROWN NOM TRUST
PO BOX 1384
E ORLEANS, MA 02643

36-133-0-R

UGLIAROLO MICHAEL E & SUSAN
C/O UGIAROLO MICHAEL E & SUSAN
6 MOSS RUN
WHITE PLAINS, NY 10605

36-134-0-R

OHNEMUS DAVID & VIRGINIA
11 GRIST RD
ORLEANS, MA 02653

36-135-0-E

TOWN OF ORLEANS
19 SCHOOL RD
ORLEANS, MA 02653

36-136-1-R

LONDA JOHN J & JOANNE
PO BOX 1045
E ORLEANS, MA 02643

36-136-A-R

CHRISTIE SUSAN B TRUSTEE
FLATLAND REALTY TRUST
PO BOX 945
E ORLEANS, MA 02643

36-136-B-R

LONGTON EDWARD B & ANNE F TRS
C/O BRADBURY JO ANNE TRUSTEE
PO BOX 254
E ORLEANS, MA 02643

36-136-C-R

BARKER CANDICE & ROBERT J TRS
CANDICE BARKER 2015 LVG TRST
PO BOX 354
E ORLEANS, MA 02643

36-136-D-R

CUOMO RALPH A
C/O CUOMO RALPH A TRUSTEE
PO BOX 687
E ORLEANS, MA 02643

36-136-E-R

OLESKI ANDREW R & COLEEN K TRS
ANDREW & COLEEN OLESKI LIV TRS
PO BOX 546
E ORLEANS, MA 02643

36-136-F-R

VYSKOCIL MARY KAY
80 EAST END AVE #18A
NEW YORK, NY 10028

36-136-G-R

MCMAHON THOMAS W TR
T MAC REALTY TRUST
70 CACHE CAY DR
VERO BEACH, FL 32963

36-136-H-R

STEIN JONATHAN & DEBRA TRS
DEBRA H REVOCABLE TRUST
31 CHESTNUT ST
WELLESLEY, MA 02481

36-137-1-R

CONROY GARY & GREEN WILLIAM TR
CRAZY FINGERS REALTY TRUST
118 HUNTINGTON AVE UNIT 2102
BOSTON, MA 02116

36-137-2-R

GREEN WILLIAM & CONROY GARY TR
CRAZY FINGERS REALTY TRUST
118 HUNTINGTON AVE APT 2102
BOSTON, MA 02116

36-137-3-R

NELSON ROSEMARY KING
PO BOX 407
E ORLEANS, MA 02643

36-137-4-R

FURST ROBERT E & JUDITH M
PO BOX 992
E ORLEANS, MA 02643

36-137-5-R

HURLEY DAVID J & ELAINE J
PO BOX 776
E ORLEANS, MA 02643

36-137-6-R

PETTENGILL JOHN R TRUSTEE
JOHN R PETTENGILL REVOC TR
1 CARANDO DR
SPRINGFIELD, MA 01104

36-137-7-R

BUFFER ZONE PROPERTIES LLC
100 MAIN ST APT 2G
TUCKAHOE, NY 10707

36-138-0-R

WARE MARY &CHAPPELL BEVERLY TR
PO BOX 55
E ORLEANS, MA 02643

36-144-0-R

HUSKINS SUZANNE TRUSTEE
MEETINGHOUSE POND PROPERTY TR
PO BOX 995
E ORLEANS, MA 02643

36-145-0-R

FIALA JAMES & HENNESSY ROBIN
131 DAVIS AVE #2
BROOKLINE, MA 02445

36-146-0-R

DER HAGOPIAN MARK A TRUSTEE
M & M LUCKY OYSTER REALTY TR
651 BOYLSTON ST
BOSTON, MA 02116

36-147-0-R

MCKENZIE JAMES J & LINDA
19 BELKNAP RD
MEDFIELD, MA 02052

36-148-0-R

WAUGH ELIZABETH ESTATE OF
31 MUSSEL POINT WY
MAGNOLIA, MA 01930

36-151-0-R

AOKI JOHN M & TERRIE E
61 FALMOUTH RD
SCARSDALE, NY 10583

36-153-0-R

BOYD WHITFORD G & MARGARET
PO BOX 1487
ORLEANS, MA 02653

36-156-0-R

KUBSCH WILLIAM N TRUSTEE
KUBSCH FAMILY REVOCABLE TRUST
PO BOX 371
E ORLEANS, MA 02643

36-157-0-R

NIX PETER D & JOAN P TRUSTEES
NIX FAMILY TRUST
14 LEWIS RD
ORLEANS, MA 02653

41-40-0-R

WILCOX ROBERT B
PO BOX 501
ORLEANS, MA 02653

41-41-0-E

TOWN OF ORLEANS
19 SCHOOL RD
ORLEANS, MA 02653

41-46-0-R

KANG YUN-SUN & LEE YOUNG-JOO
7006 ALICENT PLACE
MCLEAN, VA 22101

41-47-0-R

MOORE NANCY J
PO BOX 1426
ORLEANS, MA 02653

41-49-0-R

REYNOLDS JANICE G TRUSTEE
JANICE G REYNOLDS REVC TRUST
29 UNCLE VICKS WY
ORLEANS, MA 02653

41-50-0-R

MARVEL STANLEY W & LORETTA B
27 UNCLE VICKS WY
ORLEANS, MA 02653

41-51-0-R

WERNER WILLIAM J & RAYMOND F
513 S MOUNTAIN RD
NEW CITY, NY 10956

41-52-0-R

OLIVEIRA CRAIG & ERICA TASHA
9 UNCLE VICKS WAY
ORLEANS, MA 02653

41-53-0-R

CINCOTTA ANTHONY J & LYNN C
24 MONUMENT RD
ORLEANS, MA 02653

41-57-0-R

MALONEY JAMES ET ALI TRS
MALONEY REALTY TRUST
390 CHERRY ST
NEWTON, MA 02465

41-58-3-R

YOUNG WILLIAM & PAINE ALLISON
PO BOX 1458
WELLFLEET, MA 02667

41-122-0-R

ALLARD STEVEN J & MARY ANN TRS
ALLARD LIVING TRUST
1050 GEORGE ST APT 9D
NEW BURNSWICK, NJ 08901

41-123-0-R

BOOTH KEVIN R & BARBARA J
15 BEAVER DAM RD
UPPER SADDLE RIVER, NJ 07458

41-124-0-R

OKEEFE BRENDAN J & MELANIE J
25 POND RD
ORLEANS, MA 02653

41-133-0-R

DOANE ELEANOR A & ROBERT R
49 POND RD
ORLEANS, MA 02653

42-1-0-R

HOWELL TIMOTHY S & ANDREA B
TIM & ANDREA HOWELL 2020 LIVTR
PO BOX 1208
E ORLEANS, MA 02643

42-3-0-E

ORLEANS CONSERVATION TRUST
203 S ORLEANS RD
ORLEANS, MA 02653

42-6-0-R

ANDERSON MARK& BUDRYK JENNIFER
PO BOX 1432
E ORLEANS, MA 02643

42-13-0-R

FAHERTY MARILYN& FREDERICK TRS
MARILYN J FAHERTY LIV TRUST
2 HUCKLEBERRY LN
ACTON, MA 01720

42-14-0-R

ATHANASSIOU NICHOLAS A & JEANN
MCNETT
PO BOX 882
E ORLEANS, MA 02643

42-15-0-R

TYNG STEPHEN H TRUSTEE
STEPHEN & BARBARA TYNG LIV TR
PO BOX 621
E ORLEANS, MA 02643

42-19-0-R

PETRINO RICHARD E & PATRICIA R
12 SLEEPY HOLLOW RD
KINNELON, NJ 07405

42-20-0-R

PETERS NOAH & WELCH RYDELL
3 PACKET LANDING
ORLEANS, MA 02653

42-22-0-R

DEFANTI KATHLEEN H TRUSTEE
6 PACKET LANDING REAL EST TR
6 PACKET LANDING
ORLEANS, MA 02653

42-23-0-R

KATHERMAN JUDITH T
PO BOX 79
E ORLEANS, MA 02643

42-25-0-R

DEWING J THOMPSON JR & SALLY A
16 PACKET LANDING
ORLEANS, MA 02653

42-26-0-R

ATHANASSIOU NICHOLAS A TR
23 DEERWOOD NOMINEE TRUST
PO BOX 882
E ORLEANS, MA 02643

42-27-0-R

RUEL JAMES & DEBRA
5 ABBOTTSFORD
AVON, CT 06001

42-28-0-R

WOLFF JOHN R & DEBORAH
31 BASSWOOD CIRCLE
CHANHASSEN, MN 55317

42-32-0-R

JOHNSON DAVID L TRUSTEE
DLJ 29 RIVER RD REALTY TRUST
79 SUGARLOAF DR
WILTON, CT 06897

42-44-0-R

SETTERLUND ROY&MARIANI DEBORAH
5 LINDEND LN
ORLEANS, MA 02653

42-45-0-R

BALDESSARINI FRANCES
C/O BALDESSARINI FRANCES O & R
49 NEHOIDEN RD
WABAN, MA 02468

42-63-0-R

STEIN JOHN A ET ALI
41 MONUMENT RD
ORLEANS, MA 02653

42-76-0-R

SCANLON JUDITH ANN TRUSTEE
SCANLON REALTY TRUST
40 MONUMENT RD
ORLEANS, MA 02653

42-77-2-R

SCHAEFER GRACE
46 MONUMENT RD
ORLEANS, MA 02653

42-77-4-R

WINSLOW SIGURD A ET AL TRS
WINSLOW SCANLON REALTY TRUST
PO BOX 647
ORLEANS, MA 02653

42-80-2-R

RIMBACH JONATHAN L
60 PURITAN DR
BREWSTER, MA 02631

43-4-0-R

MCDONALD SARAH
6121 ETERNAL OCEAN PL
CLARKSVILLE, MD 21029

43-5-0-R

MAJEWICZ RONALD & LINNEA
4553 YACHT HARBOR DR
NAPLES, FL 34112

43-7-0-R

CAPE COD 5 CENTS SAV BANK TRS
JUDITH K BRAINERD TRUST
PO BOX 20
ORLEANS, MA 02653

43-10-0-R

KELLY JOHN J & PATRICIA W TRS
JOHN & PATRICIA KELLY FAM TR
PO BOX 685
E ORLEANS, MA 02643

43-11-0-R

BARDWELL ROBERT & ROBIN TRS
MARY H BARDWELL IRR FAM TRUST
PO BOX 138
E ORLEANS, MA 02643

43-16-0-R

SEDLACEK MARTIN & BASCUNAN
CARMEN P
57 BARLEY NECK RD
ORLEANS, MA 02653

43-17-0-R

HICKEY CYNTHIA & WILLIAM TRS
HICKEY TRUST
54 OAK RIDGE CIRCLE
WEYMOUTH, MA 02188

43-19-0-R

BISSELL WILLIAM C ET AL TRS
GEORGE S BISSELL REALTY TRUST
PO BOX 562
E ORLEANS, MA 02643

43-22-0-R

GIESS BENJAMIN P & CATHERINE S
47 TEMPLE RD
WELLESLEY, MA 02482

43-96-0-E

ORLEANS CONSERVATION TRUST
203 S ORLEANS RD
ORLEANS, MA 02653

43-98-0-R

BARTHOLOMEW SARAH TRS
SARAH BARTHOLOMEW TRUST
6 HARVEYS LN
ORLEANS, MA 02653

43-99-0-R

PEDONE RONALD &PAYER ELIZABETH
RONALD J PEDONE REV LIV TRUST
3309 GUMWOOD DR
HYATTSVILLE, MD 20783

43-101-0-R

DEAN SUZANNE B
171 THORNDIKE ST
BROOKLINE, MA 02446

43-104-0-R

FILOMENO MICHAEL J & FILOMENO
THOMAS J
44 WILDWOOD GLEN
LONGMEADOW, MA 01106

43-105-0-R

MURPHY DENNIS J & ELIZABETH
PO BOX 1546
E ORLEANS, MA 02643

43-107-0-R

WINEMAN M MARIAN ET ALI
3611 45TH AVE
W SEATTLE, WA 98199

43-108-0-R

WINNICK DAVID & DEBORAH TRS
DAVID & DEBORAH WINNICK RES TR
8 WINDY HILL LN
ORLEANS, MA 02653

43-111-0-R

CRONIN NANCY E TRUSTEE
NANCY E CRONIN REVOC TRUST
76 POWDER HILL RD
BEDFORD, NH 03110

43-114-0-R

MCGONAGLE JAMES &PAUL MARYBETH
3 ICE HOUSE LN
NATICK, MA 01760

43-115-0-R

WOLFF EDWARD J & JENNIFER A
23 BUCKINGHAM RD
MILTON, MA 02186

43-134-0-R

MUDD CAROLINE B TRUSTEE
THE 46 POCHET RD TRUST
269 CENTER ST
N EASTON, MA 02356

43-135-0-R

FULCHER FREDERICK &TAGLIAFERRI
C/O FULCHER FREDERICK &TAGLIAF
40 POCHET RD
ORLEANS, MA 02653

48-2-0-R

TREESE JAMES R
90 FINLAY RD
ORLEANS, MA 02653

48-3-0-R

MURPHY BRYAN T
104 NAUSET BEACH VIEW PATH
HARWICH, MA 02645

48-4-0-R

MAYO KENNETH N & DONNA P
100 FINLAY RD
ORLEANS, MA 02653

48-5-0-R

CARLSON PAUL
93 FINLAY RD
ORLEANS, MA 02653

48-6-0-R

WELLS GARY & TIRINGER TERRY
83 FINLAY RD
ORLEANS, MA 02653

48-48-0-R

AUTY BEATRICE P
PO BOX 533
E ORLEANS, MA 02643

48-50-0-R

MACGILLIVRAY KYLE I
IRENE M MACGILLIVARY TRUST
895 SPORT HILL RD
EASTON, CT 06612

48-51-0-R

NOVER ROBERT A & AIMEE A
5410 CONNECTICUT AVE NW STE111
WASHINGTON, DC 20015

Attachment E

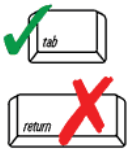
Stormwater Checklist

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

A stormwater report has not been included since no new impervious surface is proposed

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

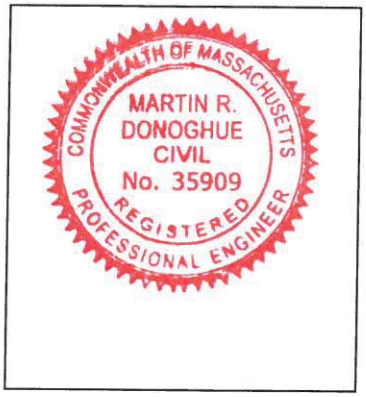
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



9/27/22
Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

☐ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe): no new impervious pavement

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation N/A - no new impervious surface

☒ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☐ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge N/A - no new impervious surface

☐ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality N/A - no new BMPs proposed

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☐ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☐ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☐ The BMP is sized (and calculations provided) based on:

- ☐ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs. N/A - no LUHPPLs are present

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas N/A - no treatment train BMPs are proposed

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☒ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☒ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☐ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☐ Name of the stormwater management system owners; N/A - no permanent BMPs are proposed
- ☐ Party responsible for operation and maintenance;
- ☐ Schedule for implementation of routine and non-routine maintenance tasks;
- ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges Project involves installation of new sewer pipe and no discharges will be connected to the pipe

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

State Highway Access Permit

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5-2022-0639

PERMIT - ORLEANS
Utility: Capital Improvements - Sewer - Amendment

Subject to all terms, conditions, and restrictions printed or written below, permission is hereby granted to **ORLEANS ADMINISTRATION**, Tom Daley, 19 School Road, Orleans, MA 02653 to enter upon State Highway in the Town of **ORLEANS** on Route 28, locally known as South Orleans Road, for the purpose of installing approximately 65 linear feet of 8" (inch) sewer main, within the State Highway Layout (SHLO).

A 17.5' (foot) southerly and 17.0' (foot) northerly x 8' (foot) trench parallel to Finlay Road, a 30' (foot) and 31.2' (foot) x 8' (foot) trench continuing diagonally and southerly across South Orleans Road, a 12' (foot) x 12' (foot) trench over a manhole and an 8.1' (foot) and 7.3' (foot) x 8.0' (foot) trench will be made adjacent to one another across the intersection of South Orleans Road, Finlay Road and Pond Road in the State Highway Layout (SHLO) to install the proposed sewer main between approximate Stations 24+00 and 25+00.

An 8" (inch) sewer force main will be installed via an open cut trench across Route 28 at the intersection of Pond Road/Finlay Road. The installation will enter the SHLO from Pond Road and diagonally cross the northbound lane of Route 28 to a proposed manhole to be installed in the center of the southbound lane of Route 28. From the new manhole the installation will continue in a westerly direction to exit the SHLO on Finlay Road.

Prior to any work being done the Grantee must contact the District 5 Permits section to arrange a site visit to discuss the extent of the final pavement restoration work.

All work, including the traffic management plan, is to be done as described herein and as shown on the approved plans entitled "Plan and Profile Sewer Finlay Road" as drafted by AECCOM Technical Services, Inc., 9 Jonathan Bourne Drive Pocasset, MA 02559, tel.: (978) 905-2100, and dated October 2022.

THIS PERMIT IS BEING ISSUED FOR WORK WITHIN THE SHLO ONLY. AUTHORIZATION TO PERFORM ASSOCIATED WORK OUTSIDE OF SHLO MUST BE GRANTED BY IMPACTED PROPERTY OWNERS.

PLEASE BE ADVISED THAT IF ANY SETTLEMENT IS ENCOUNTERED ON THE ROADWAY DUE TO THIS WORK, THE GRANTEE WILL BE RESPONSIBLE TO PERFORM REPAIR OF THE SETTLED AREA PLUS MILLING AND OVERLAYING THE ENTIRE PAVEMENT CURB TO CURB (LENGTH TO BE DETERMINED AT THE DISCRETION OF THE DEPARTMENT).

The Grantee(s) shall assume all liabilities and expenses associated with any changes in design, labor, materials, etc. for the project in its entirety, to bring said project into compliance with the approved plans, and the terms and conditions set forth by MassDOT, Highway Division.

District 5, 1000 County Street Taunton, MA 02780
Tel: (857) 368-5000, FAX: (508) 880-6102
www.mass.gov/orgs/highway-division

States of Emergencies and Executive Orders

In addition to the conditions and restrictions herein contained, the Grantee is responsible for complying with any relevant Executive Orders or States of Emergencies that may be issued by the Governor's Office while this permit is active. The Governor may declare a State of Emergency in the event or imminent threat of natural or man-made disasters. A State of Emergency can cover a specific municipality, multiple communities, or the entire Commonwealth.
Detailed Information on States of Emergencies and Executive Orders can be found on the Mass.GOV website.
https://www.mass.gov/service-details/state-of-emergency-infomation and
https://www.mass.gov/massachusettsexecutive-orders

Prior to any work being done within the State Highway Layout, the Grantee(s) must upload/submit a Work Request in State Highway Access Permit System (SHAPS) to obtain approval for the proposed work schedule. Said form to be completed/uploaded can be found under the Forms and Sample Submission Documents tab and is entitled "Work Request Form D1 - D5". One (1) of these forms must be uploaded by the close of business every Thursday for the entire duration of the project in order to request approval for the following week's work schedule.

The Grantee(s) must adhere to 520 CMR 14.00: Excavation and Trench Safety as promulgated by the Department of Public Safety in conjunction with the Division of Occupational Safety pursuant to authority granted by M.G.L. c. 82a §1. If not already approved, a Trench Permit Rider must be completed and uploaded to SHAPS before any trench work is performed under this Permit.

The Grantee(s) shall be responsible for all litter and debris generated from their property during the work as described herein and/or from all prospective residents, visitors or patrons of all existing or proposed facilities mentioned herein. This responsibility shall remain in effect for the entirety of all current or future owners of said property. The Grantee(s) shall perform routine inspections and upkeep within the State Highway Layout. If conditions warrant an individual to enter in or within the proximity of a travelled way, the Grantee(s) shall assume all liability and responsibility for the removal of all litter and debris or the hiring of an appropriate party to perform such duties. Significant work within the travelled way may require a police detail. In consideration to all abutters, the Grantee(s) must take notice to the drifting of debris and the removal thereof. If it is found that this requirement is not being fulfilled in a satisfactory manner, MassDOT, Highway Division may decide to clean the area at the Grantee's expense.

PAVEMENT REPAIR

THE PAVEMENT REPAIR WILL REQUIRE MILLING AND OVERLAYING WITH 2" (INCHES) OF SURFACE COURSE A MINIMUM OF 1' (FOOT) ON EITHER SIDE OF THE TRENCH. THE PERMANENT REPAIR OF THE TRENCH, INCLUDING THE MILLING AND OVERLAYING, MUST BE DONE AFTER COMPLETION OF THE 90-DAY SETTLEMENT PERIOD AS DESCRIBED IN THIS PERMIT.

FINAL PAVEMENT REPAIR JOINTS MUST BE SQUARE AND PERPENDICULAR TO THE DIRECTION OF TRAVEL.

The permanent trench repair shall be done as indicated below. Please note that the final trench repair must include a minimum of 7" (inches) of Hot Mix Asphalt or match the existing thickness of the Hot Mix Asphalt for the roadway, whichever is larger.

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1. 8" (inches) of gravel plus 4" (inches) Dense Graded Crushed Stone (DGCS) over it.
2. 3" (inch) Intermediate or Base Course
3. 2" (inch) Intermediate Course
4. 2" (inch) Surface Course
5. Asphalt emulsion tack coat (RS-1H) must be placed between each course.
6. All vertical edges must be coated with hot poured joint sealer.
7. All damaged pavement markings shall be restriped in kind.

All openings in paved surfaces must be backfilled and paved with a temporary patch consisting of 3” (inches) of hot mix asphalt at the end of every workday. Exposed gravel will not be permitted within the State Highway Layout.

All pavement compositions must meet MassDOT's latest Standards and Specifications for Highways and Bridges.

PLEASE BE ADVISED THAT MASSDOT, DISTRICT 5 RESERVES THE RIGHT TO REQUEST ADDITIONAL REPAIR IF THE REPAIR AREA IS FOUND TO BE LARGER THAN ANTICIPATED.

CONTROLLED DENSITY FILL (CDF) WAIVER

At the written request of the Grantee(s) and approval from MassDOT, Highway Division, CDF is NOT required on this project for trenches greater than 48" (inches) in depth. The Grantee(s) shall perform the work for conventional backfill methods as follows:

1. All methods used to determine and verify the proper compaction of backfill shall be in accordance with AASHTO Standard Specifications of Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth) (Designation T238-86 Method B - Direct Transmission shall be used to determine in-place density) and Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth) (Designation T239-91). Backfill material shall be in accordance with MassDOT, Highway Division Standard Specifications, Section 150.64, Subsection C.

All methods and work shall be performed by a technician on location certified in "soils" by the New England Transportation Technician Certification Program (NETTCP). All data and results shall be submitted to the appropriate District Highway Director for its review and acceptance.

Soil compaction needs to be performed every 6” (inches). Nuclear Gauge Density Testing shall be performed every 1' (foot) of depth and at least twice a week. Proctor/Sieve Analysis testing shall be performed once a week per source of material.

2. A Performance Bond in the (approximate) amount of **$50,000.00** is required by the Grantee(s) to warranty the work described in this waiver. The Performance Bond must be submitted before any work commences on State Property. The life of the Performance Bond shall continue for three (3) additional years from the date MassDOT, Highway Division signs off on the permit.

The Performance Bond shall be in a form satisfactory to MassDOT, Highway Division, furnished by a surety company incorporated pursuant to M.G.L. chapter 175, section 105 or authorized to do business in the Commonwealth under M.G.L. Chapter 175, section 106 and satisfactory to the awarding authority. The name of the agency or agent writing these bonds shall be identified within the bond.

3. The Completion of Work Form shall be electronically uploaded, via the State Highway Access Permit System (SHAPS), as soon as possible after the completion of the physical work to begin the sign-off process. MassDOT, Highway Division, will hold the Permit on file for a period of not less than three (3) years.

4. The Grantee(s) shall assume full responsibility for the structural integrity of any trench described in this Permit. This responsibility shall remain in place for a period of three (3) years after the completion of work which time starts with MassDOT, Highway Division, receiving the Completion of Work Form.

The Grantee(s) shall immediately respond to trench maintenance requests by the District Highway Director. The Grantee(s) must respond within two (2) working days for non-emergency situations. Non-response within the specified time will result in the required maintenance work being done by MassDOT, Highway Division, with all expenses charged to the Grantee(s).

5. Supplying, positioning, adjusting, and re-positioning of all required signs and traffic warning devices shall be the responsibility of the Grantee(s). All signs and devices shall be in accordance with the current Manual on Uniform Traffic Control Devices. The number and location of all signs and devices shall be as deemed necessary by the District Highway Director for the safe and efficient performance of the work and safety of the travelling public.
Care must be exercised so as not to disturb any existing State Highway Drainage or Traffic Duct/wiring Systems or any underground structures that exist. If said system is disturbed, it shall be restored immediately to its original condition. All expenses for restoring conditions shall be the responsibility of the Grantee(s).

6. Uniformed Police Officers or Certified Flaggers shall be provided and compensated by the Grantee(s) and shall be in attendance at all times until completion of the physical work.

WORK WITHIN THE HARDENED SURFACE WITH CDF WAIVER APPROVED

The pavement shall be saw-cut in neat, true lines along the length of the trench. The trench shall then be excavated, the utility installed, and backfilled. The backfill material shall consist of gravel or other suitable material conforming to MassDOT Specifications throughout, to a compacted depth of three inches below the existing surface.

The material shall be selected from excavation free from large lumps, clods, or rock placed between the pipe and the walls of the trench in layers not exceeding 6" (inches) in depth and thoroughly compacted. Each layer, if dry, shall be moistened and then compacted by rolling or by tamping with mechanical rammers. Special care shall be taken to thoroughly compact the fill under the haunches of the pipe or conduit. This method of filling and compacting shall be continued until the material is level with the top of the pipe or conduit. The remainder of the filling shall consist of suitable material placed in successive layers not more than 6" (inches) in depth. The top layer shall be thoroughly compacted to within 3" (inches) of the existing surface.

The trench will then be patched temporarily with a minimum of 3" (inches) of Surface Course placed in one layer to the finished grade of the roadway surface. Be advised that a temporary patch with a minimum of 4" (inches) of Surface Course is required on high traffic volume roadways.

In the cases where the trench needs to include the repair of the entire travel lane/paved shoulder/curb-to-curb, the Grantee may patch the temporary trench with a minimum of 7" (inches) of Hot Mix Asphalt pavement or match existing thickness of this for the roadway, whichever is larger. Pavement composition must meet MassDOT's latest standards. Then after the 90-day settlement period (SOP HMD-75-03-1-000), the Grantee will have to mill 2" (inches) of the existing pavement and overlay the travel lane/paved shoulder/curb-to-curb with two 2" (inches) of Surface Course.

If required, steel plates may be utilized for the safety of overnight motorists. However, steel plates create a slippery surface and should only be used when necessary. The plates may need to be recessed to the finished grade of the roadway as directed by the Engineer. No plates may be left over the weekend. Therefore, the Grantee(s) shall schedule the work accordingly.

Temporary patches shall remain in place for ninety (90) days before being replaced with permanent patch or until in the Engineer's judgment that final compaction and settlement of the trench area has taken place.

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The Grantee(s) must then excavate the temporary patching and material to a depth of 7" (inches) below the existing surface and replace with the permanent patch which shall consist of 3" (inches) of Intermediate or Base Course, 2" (inches) of Intermediate Course, and 2" (inches) of Surface Course.

All abutting edges of the existing pavement shall be coated with hot poured joint sealer immediately prior to the placement of the permanent patch.

DRAINAGE IMPACTS

Note that existing drainage lines are not located/marked out by Dig-Safe, therefore, care should be taken during excavation operations to ensure that drainage components located within the limit(s) of work are not impacted during work to be performed under this Permit. The Grantee(s) may send a request for drainage plans in anticipation of the work to the Highway Maintenance Section at (857) 368-5240. Requests should be sent a minimum of five (5) business days ahead of the proposed work. Be advised that if additional information is needed, the Grantee(s) will be required to perform survey work of the drainage structures to identify the location of the drainage components.

If the work under this Permit includes the installation or relocation of drainage structures or work alters the existing State drainage system, the Grantee(s) shall be responsible to clean the drainage system, including any other structure/drainage line/outfall within the project limits to ensure the drainage system works adequately.

The Grantee(s) shall be responsible for any damage that occurs to said drainage components as a result of the work. Should any damage(s) occur, the Grantee(s) must immediately contact the Highway Maintenance Section.

TIME RESTRICTIONS AND NOTIFICATIONS

DUE TO HEAVY SUMMER TRAFFIC, NO WORK SHALL BE PERFORMED ON THIS PROJECT BETWEEN MEMORIAL DAY WEEKEND AND LABOR DAY WEEKEND WITHOUT PRIOR APPROVAL FROM THE DISTRICT HIGHWAY DIRECTOR.

Special attention shall be given when performing work that will impact MassDOT, Highway Division, snow and ice operations.

No work shall be performed in the hardened surface of the roadway between November 15th and April 1st of any year without prior written approval from the District Highway Director.

No pavement shall be laid between November 15th and April 1st of any year without prior written approval from the District Highway Director.

No work shall be performed on this project on Saturdays, Sundays, and Holidays, or on the Friday after a Thursday Holiday. Work is also restricted on the day before and the day after a long Holiday weekend without prior written approval by the District Highway Director.

No equipment, trucks, etc., shall occupy any part of the travelled way except between the hours of **9:00 a.m. and 3:00 p.m., Monday - Friday**. In no case will operations exceed the specified hours. This includes the placement of traffic control devices, equipment, or anything that restricts the flow of traffic through the construction zone. Any change in work hours will require prior written approval by the District Highway Director. The 12-minute rule will remain in effect for the duration of the permit.

All other work, off the pavement on this project is restricted to a normal 8-hour day, Monday - Friday, with the prime Contractor and all subcontractors working on the same shift. Any change in work hours will require prior written approval by the District Highway Director.

GENERAL TRAFFIC MANAGEMENT AND SAFETY REQUIREMENTS

If required by MassDOT, Highway Division District 5, variable message boards (VMBs) shall be utilized as part of the approved traffic management plan under this Permit which must be properly secured with regards to hacking and unauthorized tampering prevention. The Grantee(s) shall adhere to all appropriate security specifications and take all necessary precautions to mitigate the risk of the boards being hacked. All VMBs shall be stored in a secured area and shall have a lockable, weatherproof enclosure for the operator interface, removable local keyboards which shall be removed whenever possible, and a password protected controller with local administrative passwords changed on a regular basis.

When any portion of the roadway will be blocked with equipment to facilitate the proposed work, the Grantee(s) will be required to adhere to the attached Traffic Management Plan (TMP) or submit a proposed TMP to MassDOT, Highway Division, to be reviewed and approved by the District Traffic Maintenance Engineer prior to working within or impacting the roadway. The plan must include information relating to proper signing, traffic control device placement and police details.
It is imperative to maintain two-way traffic at all times and these operations are managed so that motorists travel "delay" is minimized. At any time during the operation when a traffic delay of over twelve (12) minutes occurs and the situation is worsening, the Resident Engineer, Contractor, or Police Detail will begin to suspend operations.

Continuously increasing "delays" of over twelve (12) minutes are not to be permitted.

If traffic must be "stopped", the duration shall not be more than five (5) minutes.

Uniformed State/Local Police Officer(s) and their official vehicle(s) may be necessary to provide protection for those installing and removing all temporary traffic warning signs and devices and to perform all traffic management as required.

The Grantee(s) will monitor the flow of traffic during peak traffic volumes and if necessary, shall suspend all operations. Work will resume at the discretion of the Police detail officer and/or to the satisfaction of the supervising MassDOT, Highway Division, Engineer.

In the event of inclement weather or dense fog, which lessens the visibility of advance warning signs, vehicles and workers, the Grantee(s) will suspend all operations so as not to interfere with the safety of the motoring public and the operations of work. In the event of snow or icing conditions, all vehicles and equipment must be removed from the roadway and/or shoulder area so as not to interfere with Snow and Ice Operations.

The Grantee(s) shall provide safe and ready means of access and egress to all public and private roads and drives 24 hours per day. Every effort must be made as not to interfere with or inconvenience all abutters throughout the duration of this project.

Signs and traffic control devices are required for advance notice of the work and within the work area

The Grantee(s) or Applicant will supply all required signs and traffic warning devices and shall be in accordance with the Massachusetts Manual on Uniform Traffic Control Devices. The number and location of all signs and devices shall be as deemed necessary by the Engineer for the safe and efficient performance of the work and the safety of the travelling public.

All warning devices shall be subject to removal, replacement, and/or repositioning by the applicant as often as deemed necessary by the Engineer.

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Cones or non-reflectorized warning devices shall not be left in operating position on the highway when the daytime operations have ceased. If it becomes necessary for MassDOT, Highway Division, to remove the construction warning devices or their appurtenances from the project due to negligence by the applicant, all costs for this work will be charged to the Grantee(s).

All vehicles, except passenger's cars, which are assigned to the permitted project, and which operate on the site at speeds of 25 MPH or less, shall have an official SLOW-MOVING VEHICLE emblem displayed. All vehicles and equipment on this project must be equipped with back-up alarms.

All personnel who are working on the travelled way or breakdown lanes shall wear approved safety vests and hard hats.

GENERAL CONDITIONS AND APPROVED PROCEDURES

The Grantee(s) must contact the "Dig Safe" Center at 811 to obtain a "Dig Safe" number prior to starting the proposed excavation for the purpose of identifying the location of underground utilities.

IF THE PROPOSED WORK FALLS WITHIN THE AREA OF A SIGNALIZED INTERSECTION, the Grantee(s) must contact the District Traffic Maintenance Engineer at (857) 368-5261 at least two (2) weeks prior to the commencement of said work to locate the existing traffic signal conduit/detectors and to coordinate this work so as not to disturb the traffic signals. The Grantee(s) shall provide the District Traffic Maintenance Engineer with the Permit number, the approximate Stations where the work will take place, and the limits of the work. The Grantee(s) will be responsible for marking the limits of the work in the field so that MassDOT, Highway Division, can mark the locations of all existing traffic signal conduit/detectors within those limits. The Grantee(s) will be responsible to repair/replace all damaged items and will be billed for any cost incurred to restore normal operation to MassDOT, Highway Division, signal equipment to the satisfaction of the Engineer.

Unless otherwise stated, no hardened surface of the State Highway may be disturbed.

When an opening in the roadway is required and permitted herein, the opening must be as small as possible to perform the proposed work.

If the integrity of any existing sidewalks, catch basins, manholes or any other underground structures or equipment is compromised, the Grantee(s) will reconstruct and/or replace all items according to MassDOT, Highway Division, Standards at the cost of the Grantee(s) and to the satisfaction of the Engineer.

The Grantee(s) must not disturb or remove any MassDOT, Highway Division, bound(s) (MHB) associated with this project. If so disturbed or missing, the bound(s) must be reset/replaced by a Registered Land Surveyor. All procedures and materials must be in compliance with Massachusetts Design and Construction Standards. A copy of the paid bill must be submitted to this office upon completion of said work.

All traffic safety lines if disturbed shall be replaced in kind.

DRAINAGE AND UTILITY CASTINGS

“The use of risers to adjust drainage and utility structures will not be allowed. All adjustment work done to existing or new drainage structures shall conform to Section 220 of MassDOT, Highway Division, Standard Specifications and according to Plates 201.3.0 and 2029.0 o MassDOT, Highway Division, Construction Standards.”

ENVIRONMENTAL LIABILITY AND COMPLIANCE

The Grantee(s) assumes all risk associated with any environmental condition within the subject property and shall be solely responsible for all costs associated with evaluating, assessing, and remediating, in accordance with all applicable laws, any environmental contamination (1) discovered during Grantee's work or activities under this Permit to the extent such evaluation, assessment or remediation is required for Grantee's work, or (2) resulting from the Grantee's work or activities under this Permit. The Grantee(s) shall notify MassDOT, Highway Division, of any such assessment and remediation activities.

The Grantee(s) is hereby held solely responsible for obtaining and maintaining any and all environmental compliance permits required by local, state, and federal laws and regulations when regular or emergency work is proposed within, or in close proximity to, any wetland area. These environmental compliance requirements include, but are not limited to, a Negative Determination of Applicability or Order of Conditions from the local Conservation Commission, a Water Quality Certificate from the Department of Environmental Protection, and a Programmatic General Permit from the U.S. Army Corps of Engineers. The Grantee(s) shall forward to MassDOT, Highway Division, a copy of each such environmental compliance permit.

CLOSING CONDITIONS

ALL OF SAID WORK SHALL COMPLY WITH THE TERMS AND CONDITIONS HEREIN, AND MUST BE DONE AS DIRECTED BY AND TO THE SATISFACTION OF THE ENGINEER

All work done under this contract shall be in conformance with the Massachusetts Highway Department "Standard Specifications for Highways and Bridges" 2022 Edition and any subsequent "Supplemental Specifications". All construction shall conform to the June 2017 edition of the Massachusetts Department of Transportation, Highway Division "Construction Standard Details (English Edition)"; the latest Manual on Uniform Traffic Control Devices with Massachusetts Amendments; the latest edition to the following: the 1996 Construction and Traffic Standard Details (as related to Traffic Standard details only); the 1990 Standard Drawings for Traffic Signs and Supports; the 1968 Standard Drawings for Traffic Signals and Highway Lighting; the latest edition of American Standard for Nursery Stock; the Plans and these Special Provisions. These publications can be access from the SHAPS dashboard of from the following link: https://www.mass.gov/lists/miscellaneous-publications#miscellaneous-publications

The Grantee(s) shall indemnify and save harmless the Commonwealth and MassDOT, Highway Division, against all suits, claims or liability of every name and nature arising at the time out of or in consequence of the acts of the Grantee(s) in the performance of the work covered by this Permit and/or failure to comply with the terms and conditions of this Permit whether by themselves or their employees or subcontractors.

It is noted that the Grantee(s) will be responsible for future corrective actions resulting from defective work under the subject permit. Any damage to roadway and/or shoulder as a result of the permitted work is the Grantee's responsibility and shall be repaired at his/her expense.

THE GRANTEE(S) SHALL SUBMIT A COMPLETION OF WORK FORM, BY REQUESTING A SIGN–OFF USUING THE ACTION LINK IN THE SHAPS DASHBOARD, WHEN THE WORK REQUIRED UNDER THIS PERMIT HAS BEEN COMPLETED IN ORDER FOR A FINAL INSPECTION TO BE PERFORMED BY MASSDOT, HIGHWAY DIVISION. THE LIABILITY ASSUMED UNDER THIS PERMIT WILL CONTINUE UNTIL THE WORK HAS BEEN SIGNED OFF AS COMPLETE.

A COPY OF THIS PERMIT MUST BE ON THE JOB SITE AT ALL TIMES FOR INSPECTION. FAILURE TO HAVE THIS PERMIT AVAILABLE AT THE SITE WILL RESULT IN SUSPENSION OF THE RIGHTS GRANTED BY THE PERMIT.

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"FOLLOWING CONDITIONS APPLY TO PERMITS"
Conditions Relating Particularly to Permits for the Laying of Pipes, Conduits, etc.

After any pipes, conduits, drains or other underground structures are laid, or any excavation is made in the roadway, the trenches or openings shall be properly backfilled with suitable material, the backfilling shall be thoroughly tamped, and the surface of the road over said structures shall be left even with the adjoining ground. If the work is done in cold weather no frozen material shall be used for backfilling.

Wherever the hardened surface of the roadway, gutters, or any part of the surface of the highway is disturbed it shall be replaced in as good condition as before it was disturbed, and if new materials are required, they shall correspond with those already in place on the road.

Where service pipes are to cross the highway, the connections shall be made without disturbing the hardened surface of the roadway, by driving the pipes under the roadway, or the service pipes shall be carried under and across the road in a larger pipe, unless otherwise ordered by the Director.

The Grantee shall maintain the surface of the roadway over said structures as long as MassDOT may deem necessary, until all signs of the trenches shall have been eliminated.

CONDITIONS RELATING PARTICULARLY TO PERMITS FOR THE ERECTION OF POLES, WORKS AND OVERHEAD STRUCTURES, AND THE CUTTING AND TRIMMING OF TREES

In the erection of pole lines, unless otherwise herein provided, no trees located within the limits of the State Highway shall be cut or trimmed. No guy wires shall be attached to trees without a special Permit from MassDOT, and in no event shall they be so attached as to girdle the trees or in any way interfere with their growth. The wires shall be so protected at all time and places that they shall not interfere with or injure the trees either inside or outside the location of the highway.

Where the cutting or trimming of trees is authorized by this Permit, only such cutting, and trimming shall be done as may be designated by the Director.

In the construction or reconstruction of pole lines no guy wires shall be erected nearer to the surface of the ground than 6' (feet); provided, however, that the owners of such lines may maintain such guy wires at a lower elevation than 6' (feet) from the ground until such time as MassDOT shall notify them to remove said wires or to the elevation first stated.

In order to protect the trees through which any wires may pass, said wires shall be insulated and such other tree guards used as may be directed by the Director.

Where high tension wires are erected under this Permit, they shall be so located that, under conditions of maximum severity as regards a coating of ice or snow, there shall be a space of at least 8' (feet) between such high-tension wires and other wires.

The Grantee shall, within sixty (60) days from the date of completion of the work, file in the office of MassDOT a plan showing the location of each pole erected in accordance with the Permit, said plan to be of such size and in such form as MassDOT may direct.

GENERAL AND ADDITONAL CONDITIONS

Whenever the word "MassDOT" is used herein it shall mean the Massachusetts Department of Transportation of the Commonwealth of Massachusetts.

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Whenever the word "Director" is used herein it shall mean the District Highway Director or other authorized representative of MassDOT.

Whenever the word "Grantee" is used herein it shall mean the person or persons, corporation or municipality to whom this Permit is granted, or their legal representatives.

During the progress of the work all structures underground and above ground shall be properly protected from damage or injury; such barriers shall be erected and maintained as may be necessary for the protection of the traveling public; the same shall be properly lighted at night; and the Grantee shall be responsible for the damages to persons or property due to or resulting from any work done under this Permit.

Except as herein authorized, no excavation shall be made, or obstacle placed within the limits of the State highways in such a manner as to interfere unnecessarily with the travel over said road.

If any grading of sidewalk work done under this Permit interferes with the drainage of the State highway in any way, such catch basins and outlets shall be constructed as may be necessary, in the opinion of the Director, to take proper care of such drainage.

Wherever the hardened surface of the roadway is disturbed and the Director may consider it necessary or advisable to do so, said surface will be restored by the employees of MassDOT, at such time as MassDOT may direct, and the expense thereof shall be borne by the Grantee, who shall purchase and deliver on the road the materials necessary for said work if and when directed by the Director. All payments to the supplier and to laborers, inspectors, etc., employed by MassDOT for or on account of the work herein contemplated shall be made by said Grantee forthwith on receipt of written orders, pay rolls, or vouchers approved by MassDOT.

IF THE GRANTEE DOES ANY WORK CONTRARY TO THE ORDERS OF THE DIRECTOR, AND, AFTER DUE NOTICE, FAILS TO CORRECT SUCH WORK OR TO REMOVE STRUCTURES OR MATERIALS ORDERED TO BE REMOVED, OR FAILS TO COMPLETE WITHIN THE SPECIFIED TIME THE WORK AUTHORIZED BY THIS PERMIT, MASSDOT MAY, WITH OR WITHOUT NOTICE, CORRECT OR COMPLETE SUCH WORK IN WHOLE OR IN PART, OR REMOVE SUCH STRUCTURES OR MATERIALS, AND THE GRANTEE SHALL REIMBURSE MASSDOT FOR ANY EXPENSE INCURRED IN CORRECTING AND/OR COMPLETING THE WORK OR REMOVING THE STRUCTURES OR MATERIALS.

ALL OF THE WORK HEREIN CONTEMPLATED SHALL BE DONE UNDER THE SUPERVISION AND TO THE SATISFACTION OF THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION, AND THE ENTIRE EXPENSE THEREOF SHALL BE BORNE BY THE GRANTEE.

On the completion of the work herein contemplated all rubbish and debris shall be removed and the roadway and roadsides shall be left neat and presentable and satisfactory to the Director.

MassDOT hereby reserves the right to order the change of location or the removal of any structure or structures authorized by this Permit at any time, said change or removal to be made by and at the expense of the Grantee or its / their successors or assigns.

This Permit may be modified or revoked at any time by MassDOT without rendering said MassDOT or the Commonwealth of Massachusetts liable in any way.

The Grantee shall pay the salary, subsistence, and travel expenses of any inspector appointed by MassDOT to supervise the work herein contemplated.

All of the above conditions shall be applicable to the work herein authorized, unless the same are inconsistent with the conditions on the face of the Permit, in which case the conditions written or printed on the face of the Permit shall apply.

The acceptance of this Permit or the doing of any work thereunder shall constitute an agreement by the Grantee to comply with all of the conditions and restrictions printed or written herein.

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Maura Healey, Governor
Kimberly Driscoll, Lieutenant Governor
Gina Fiandaca, Secretary of Transportation & CEO
Jonathan L. Gulliver, Highway Administrator

5-2022-0639

Approved Signature

Mary-Joe Perry by B.T.
District Highway Director

Date of Issued Amendment: March 2, 2023

Permit Expiration: Wednesday, December 27, 2023

District 5, 1000 County Street Taunton, MA 02780
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Easements

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BARNSTABLE LAND COURT REGISTRY

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COMMONWEALTH OF MASSACHUSETTS

BARNSTABLE, SS.

TOWN OF ORLEANS
OFFICE OF THE SELECT BOARD

ORDER OF TAKING

At a regularly scheduled meeting of the Select Board of the Town of Orleans, a municipal corporation located in the County of Barnstable, Commonwealth of Massachusetts (the "Town") held on the 24th day of August, 2022, it was voted and ordered as follows:

The Select Board of the Town of Orleans, duly elected, qualified, and acting pursuant to the provisions of G.L. c. 79, G.L. c. 83, §1 and §3, and any and every other power and authority as hereto in any way enabling, does hereby take on behalf of the Town, permanent easements in, on, under and across the parcels of land in Orleans, known as Linden Lane, Packet Landing, Uncle Vick's Way, Larboard Lane, Karen Way, Natural Drive, Windy Hill Lane, Bayberry Way, High Tide Lane, Cedar Way, Pond View Road, Grist Road, Lake Farm Lane, Cole Place, Manito Road, Cheney Road, Loomis Lane, Nauset Farms Way, Reverend Treat Road, Whistle Berry Lane, Gesner Road, a certain 20 foot Way on Main Street, Lucy's Lane, and Baxter Lane (collectively, the "Easement Premises"), and described more particularly in Exhibit A, attached hereto and incorporated herein, for the purpose of constructing, inspecting, maintaining, operating, improving, repairing, renewing, replacing and abandoning in place (a) a sewer system and any and all structures and facilities related thereto, including, without limitation, manholes, lines, mains, pipes, conduits, pump stations and such other structures, facilities and/or appurtenances as may be necessary or convenient to establish a public sewerage system, including, without limitation, for the purpose of extending and/or connecting, regardless of origin, to other land, (b) stormwater drain or drains, drainage swales, detention or retention basins, and any manhole, pipes, catch basins, conduits, culverts, channels, and such other structures, facilities and/or appurtenances as may be necessary or convenient for the proper drainage of stormwater, including, without limitation, for the purpose of extending and/or connecting drainage facilities, regardless of origin, to other land, and (c) water mains, pipes, shut-offs, service boxes and such other equipment including any works, facilities and appurtenances associated therewith, including, without limitation, for the purpose of extending and/or connecting water facilities, regardless of origin, to other land; and, further, to take any and all actions as may be necessary or incidental to accomplish the foregoing purposes.

The Town shall have the right to enter upon and pass over the Easement Premises from time to time, by foot, vehicle, or heavy equipment, for any and all purposes stated herein and uses necessary or incidental thereto, including, without limitation, using and temporarily storing, as needed, construction equipment, materials or other incidental items within the Easement Premises for the purposes set forth herein. All sewer, drainage and water facilities installed by the Town shall be and remain the property of the Town.

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No permanent or temporary buildings, structures, and/or objects shall be constructed, installed, maintained and/or placed upon the Easement Premises that may interfere with the rights hereby taken.

Trees, shrubs and stone walls located within the Easement Premises are also taken hereby and shrubs and stone walls may be relocated within the easement area. Other structures so located are not taken and shall be removed or may be relocated within the Easement Premises whenever their removal or relocation shall be required for the purposes for which the easements are taken.

The Town is not hereby taking any interest in existing easements, if any affecting the Easement Premises that do not interfere with the use of the premises for the purposes for which the easements are taken, and is not taking any structures located within the Easement Premises pursuant to any such existing easements but such structures may be relocated.

The land affected by the herein taking are owned or supposedly owned by the owners listed in Exhibit B attached hereto and incorporated within. If in any instance the name of any owner is not correctly stated in Exhibit B, it is understood that in such instance the land referred to is owned by an owner or owners unknown to us.

We have determined that no persons will sustain damages in their property by reason of the herein taking, all in accordance with the provisions of G.L. c.79, §6, as amended, and accordingly award no damages for this taking.

Betterments are to be assessed in accordance with applicable statutes and bylaws.

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Adopted and dated at Orleans, Massachusetts, this 24th day of August, 2022.

TOWN OF ORLEANS SELECT BOARD

Andrea Shaw Reed, Chair

Michael Herman, Vice Chair

Mefford R. Runyon, Clerk

Mark W. Mathison

Kevin Galligan

COMMONWEALTH OF MASSACHUSETTS

BARNSTABLE, SS.

On this the 24 day of August, 2022, before me, the undersigned notary public, personally appeared Andrea Shaw Reed, Mefford R. Runyon, and Mark W. Mathison, proved to me through satisfactory evidence of identification which was personal knowledge, to be the person(s) whose name(s) is/are signed on the preceding or attached document, and acknowledged to me that he/she/they signed it freely and voluntarily for its stated purpose.

Notary Public
My commission expires:

MICHAEL D. FORD
Notary Public
Commonwealth of Massachusetts
My Commission Expires
April 26, 2024

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EXHIBIT A
EASEMENT PREMISES

The Easement Premises are described more particularly as follows:

(a) The parcel of land known as "Linden Lane" and shown on Land Court Plan No. 17687-G filed with the Barnstable Registry District of the Land Court.

(b) The parcel of land known as "Packet Landing" and shown on Land Court Plan No. 17687-C filed with the Barnstable Registry District of the Land Court.

(c) The parcel of land known as "Uncle Vick's Way" and shown on a plan entitled "'Vick's Hill Estates' Land in Orleans" dated May 1966, recorded in the Registry Plan Book 204 Page 1.

(d) The parcel of land known as "Larboard Lane" and shown as "40 Ft. Private Way" on a plan entitled "Subdivision of Land in Orleans (East), Mass." dated March 1967, recorded with the Registry in Plan Book 211 Page 99.

(e) The parcel of land known as "Karen Way" and shown as "Way" on a plan entitled "Subdivision Plan of Land in East Orleans" dated December 1964 recorded with the Registry in Plan Book 190 Page 133.

(f) The parcel of land known as "Natural Drive" and shown on a plan entitled "Subdivision Plan of Land in East Orleans" dated May 1964, recorded with the Registry in Plan Book 186 Page 81.

(g) The parcel of land known as "Windy Hill Lane" and shown on a plan entitled "Subdivision of Properties in Orleans (east), Mass. Belonging to Stuart E. Hockenbury et ux" dated January 1958, recorded with the Registry in Plan Book 140 Page 67.

(h) The parcel of land known as "Bayberry Way" and shown on a plan entitled "Subdivision of Properties in Orleans (east), Mass. Belonging to Stuart E. Hockenbury et ux" dated January 1958, recorded with the Registry in Plan Book 140 Page 67.

(i) The parcel of land now known as "High Tide Lane" and shown as "Tide Lane" on a plan entitled "Subdivision of Land in Orleans (east), Mass. As surveyed for Charles M and Dorothy W. Campbell" dated February 1958, recorded with the Registry in Plan Book 141 Page 33 and shown as "Tide Lane" on a plan entitled "Subdivision of Land in Orleans East Mass. known as 'Pawidaja Village'" dated February 1952, recorded with the Registry in Plan Book 102 Page 129.

(j) The parcel of land known as "Cedar Way" and shown on a plan entitled "Subdivision of Land in Orleans East Mass. known as 'Pawidaja Village'" dated February 1952, recorded with the Registry in Plan Book 102 Page 129.

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(k) The parcel of land known as "Pond View Road" and shown on a plan entitled "Plan of Land in Orleans Mass as subdivided by Paul W. Cheney" dated June 1952, recorded with the Registry in Plan Book 104 Page 155, and shown on the Orleans Assessor's Map 43.

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(l) The parcel of land known as "Grist Road" and shown on a plan entitled "Subdivision of Land in Orleans (east), Mass. As surveyed for Charles M and Dorothy W. Campbell" dated February 1958, recorded with the Registry in Plan Book 141 Page 33.

(m) The parcel of land known as "Lake Farm Lane" and shown on a plan entitled "Subdivision Plan of Land in Orleans, Massachusetts prepared for Preservation Advocacy Trust" dated January 30, 1987, recorded with the Registry in Plan Book 434 Page 38.

(n) The parcel of land known as "Cole Place" and shown as "40 ft. Way" on a plan entitled "Plan of Land in Orleans (east), Mass." dated November 1956, recorded with the Registry in Plan Book 133 Page 35.

(o) The parcel of land known as "Manito Road" and shown as "Private Way Variable Width" on a plan entitled "Subdivision of Land in Orleans (East) Mass. as prepared for John L. Tullis et ux. (Frances D.)" dated September 1970, recorded with the Registry in Plan Book 243 Page 19.

(p) The parcel of land known as "Cheney Road" and shown on a plan entitled "Subdivision of Land in Orleans Mass made for Howard M. Rogers" dated July 1959, recorded with the Registry in Plan Book 150 Page 107.

(q) The parcel of land known as "Loomis Lane" and shown as "Variable Width WAY P.B. 89-P.35", "WAY P.B. 89-P.35" and "Private Way" on a plan entitled "Plan Showing a Subdivision of Land in Orleans (East) Mass. prepared for Preservation Advocacy Trust" dated 25 Oct. 1983, recorded with the Registry in Plan Book 378 Page 10, and including the area shown on said plan as "Easement for Road Purposes".

(r) The parcel of land now known as "Nauset Farms Way" and shown as "Demott's Way" on a plan entitled "'Nauset Farms' Subdivision Plan of Land in Orleans Mass. made for Alfred S. Demott and Lois E. Demott" dated December 1969, recorded with the Registry in Plan Book 240 Page 119.

(s) The parcel of land known as "Reverend Treat Road" and shown as "Forty Foot Way" on a plan entitled "Subdivision Plan of Land in Orleans Mass. made for Lewis F. Gill and Edith R. Gill" dated Sept. 1966, recorded with the Registry in Plan Book 208 Page 5.

(t) The parcel of land known as "Whistle Berry Lane" and shown on a plan entitled "Subdivision Plan of Land in Orleans (East) Mass. as prepared for Ricardo A. Viprino et ux

N O T
C O P Y

(Grace M.)" dated May 1965, recorded with the Registry in Plan Book 194 Page 25, and further shown as "Whistle Berry Lane" on the Orleans Assessor's Map 35.

N O T
C O P Y

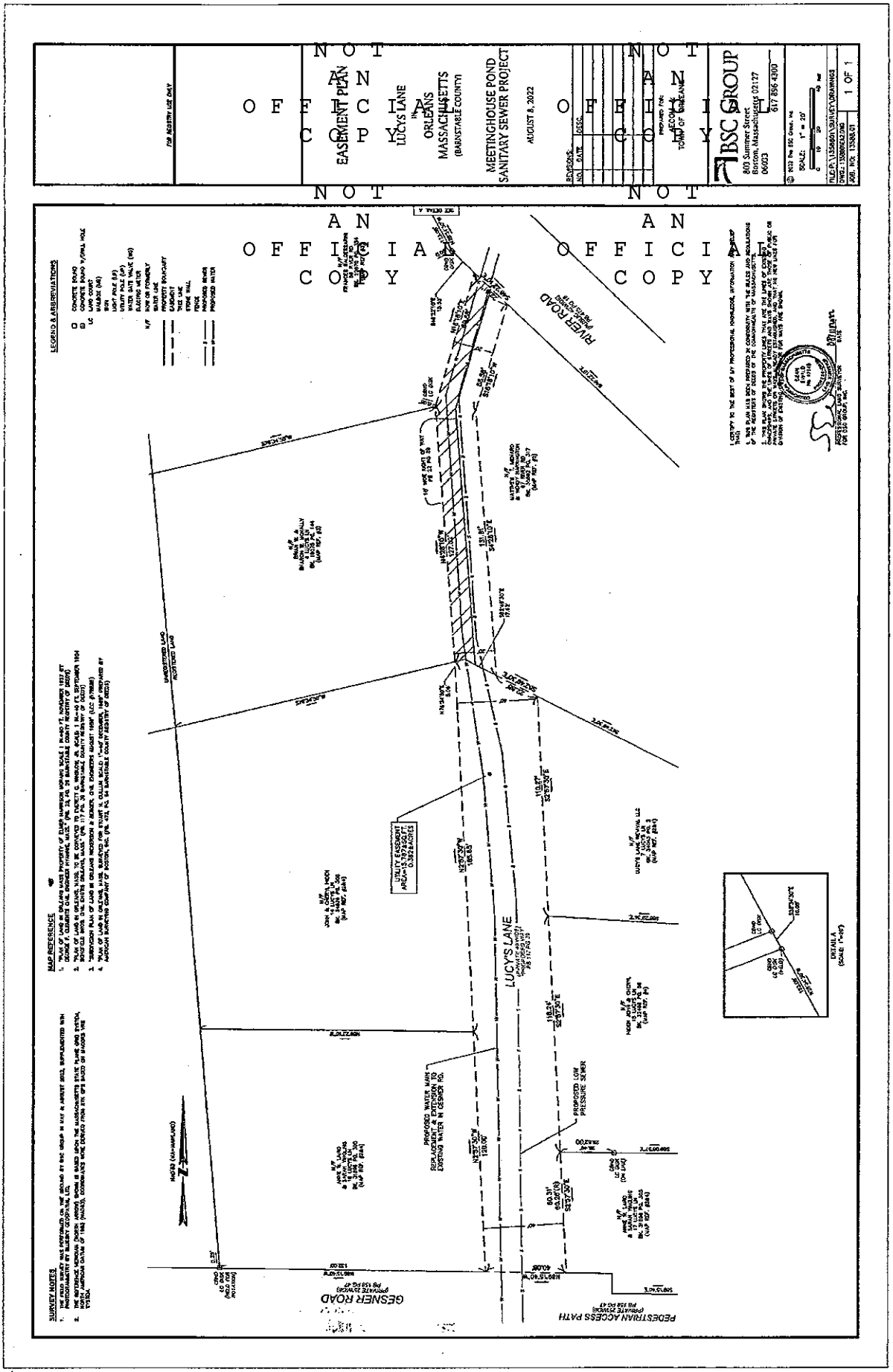
(u) The parcel of land known as "Gesner Road" and shown (portions thereof) on plans recorded with the Registry in Plan Book 95 Page 129, Plan Book 158 Page 47, and Plan Book 479 Page 74, and further shown as "Gesner Road" on Orleans Assessor's Map 42.

O F F I C I A L
C O P Y

(v) The parcel of land located on Main Street (Town Road) and shown as "20 ft. Way" on a plan entitled "Subdivision of Land in Orleans, Mass. as surveyed for James F. Shaw et ux" dated October 1956, recorded with the Registry in Plan Book 131 Page 129.

(w) The parcel of land shown as "Utility Easement Area = 15,767 ± Sq.Ft. 0.362 ± Acres" on a plan entitled "Easement Plan Lucy's Lane in Orleans Massachusetts (Barnstable County) Meetinghouse Pond Sanitary Sewer Project August 8, 2022", a copy of which is attached hereto.

(x) The parcel of land shown as "Utility Easement Area = 22,995 ± Sq.Ft. 0.528 ± Acres" on a plan entitled "Easement Plan Baxter Lane in Orleans Massachusetts (Barnstable County) Meetinghouse Pond Sanitary Sewer Project August 8, 2022", a copy of which is attached hereto.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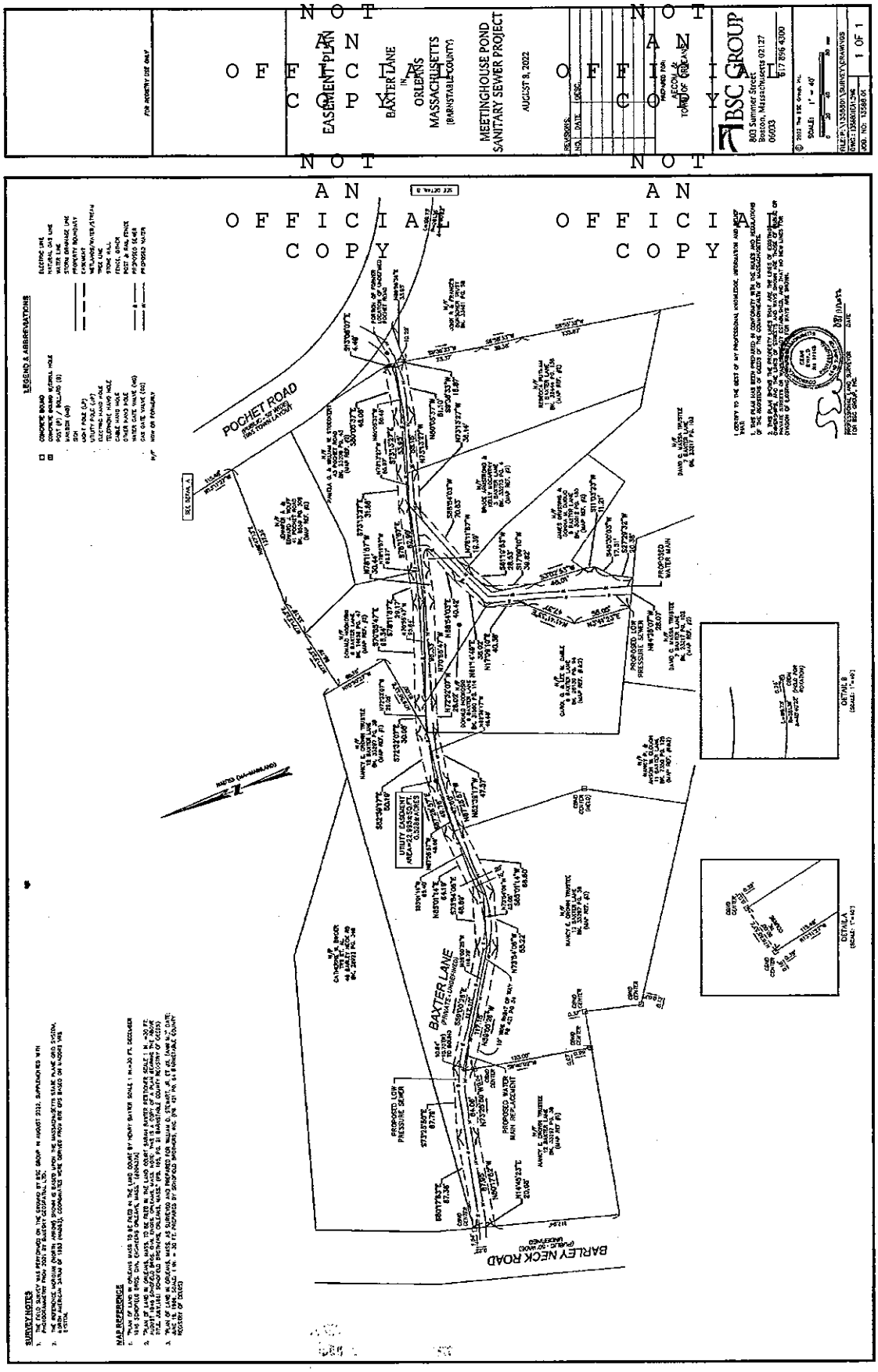
EASEMENT PLAN
IN
LUCY'S LANE
ORLEANS
MASSACHUSETTS
(BARNSTABLE COUNTY)
MEETINGHOUSE POND
SANITARY SEWER PROJECT
AUGUST 8, 2022
PREPARED FOR:
TOWN OF ORLEANS
BSC GROUP
803 Summer Street
Boston, Massachusetts 02127
617 896 4300
FOR REGISTRY USE ONLY
SURVEY NOTES
MAP REFERENCE
LEGEND & ABBREVIATIONS
LUCY'S LANE
PRIVATE WAY
RIVER ROAD
PUBLIC WAY
GESNER ROAD
PRIVATE WAY
PEDESTRIAN ACCESS PATH
PROPOSED LOW PRESSURE SEWER
PROPOSED WATER MAIN
UTILITY EASEMENT
AREA= 0.382 ACRES
DETAIL A
(SCALE: 1"=40')
1 OF 1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EASEMENT PLAN
IN
BAXTER LANE
ORLEANS
MASSACHUSETTS
(BARNSTABLE COUNTY)
MEETINGHOUSE POND
SANITARY SEWER PROJECT
AUGUST 8, 2022
PREPARED FOR:
ACCOM &
TOWN OF ORLEANS
BSC GROUP
803 Summer Street
Boston, Massachusetts 02127
617.896.4300
SCALE: 1" = 40'
1 OF 1
FOR ASSESSOR USE ONLY
LEGEND & ABBREVIATIONS
SURVEY NOTES
MAP REFERENCE
POCHET ROAD
BAXTER LANE
BARLEY NECK ROAD
PROPOSED WATER MAIN
PROPOSED LOW PRESSURE SEWER
PROPOSED MAIN REPLACEMENT
UTILITY EASEMENT
DETAIL A
DETAIL B

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EXHIBIT B
LIST OF OWNERS

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LINDEN LANE		
PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	**RECORD OWNER**	**DEED / CERTIFICATE PLAN REFERENCE**
47 River Road Map 42-39	Paul J. Marinaccio (Life Estate) Paul J. Marinaccio, Trustee Marinaccio Family Realty Trust u/d/t dated January 13, 2017 (remainder in fee) 47 River Road Orleans, MA 02653	Certificate 212085 ✓ Lot 19 Plan 17687-G
5 Linden Lane Map 42-44	Roy H. Setterlund and Deborah L. Mariani 5 Linden Lane Orleans, MA 02653	Certificate 205867 ✓ Lot 20 Plan 17687-G
7 Linden Lane Map 42-43	Arthur C. Marsh and Kathleen B. Marsh, as Trustees of the Marsh-Linden Lane Realty Trust u/d/t dated January 13, 2000 PO Box 801 East Orleans, MA 02643	Certificate 156522 ✓ Lot 21 Plan 17687-G
8 Linden Lane Map 42-41	Dennis F. Repoli, Pamela J. Repoli, Justin N. Repoli, and Carl F. Repoli 1178 Silas Deane Highway, Unit 414, Wethersfield, CT 06109	Certificate 230517 ✓ Lot 23 Plan 17687-G
9 Linden Lane Map 42-42	Tahani A. Rivers, as trustee of the Rivers Family Trust u/d/t dated October 23, 2018 9 Linden Lane Orleans, MA 02653	Certificate 217859 ✓ Lot 22 Plan 17687-G
6 Linden Lane Map 42-40	Robert H. Warburton, Jr. and Kathleen A. Warburton PO Box 2822 Orleans, MA 02653	Certificate 148958 ✓ Lot 18 Plan 17687-G

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PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	PACKET LANDING RECORD OWNER	DEED / CERTIFICATE PLAN REFERENCE
2 Packet Landing Map 42-21	Kristen Joshi and Victoria Joshi 137 Cabot Street Chestnut Hill, MA 02467	Certificate 226301 ✓ Lot 30 Plan 17687-I Lot 32 Plan 17687-J
6 Packet Landing Map 42-22	Kathleen Haynes Defanti, Trustee of the 6 Packet Landing Real Estate Trust under a Declaration of Trust dated August 6, 2020 6 Packet Landing Orleans, MA 02653	Certificate 224052 ✓ Lot 3 Plan 17687-C
10 Packet Landing Map 42-23	Judith T. Katherman PO Box 79 East Orleans, MA 02643	Certificate 160157 ✓ Lot 4 Plan 17687-C
14 Packet Landing Map 42-24	Carol A. Paskiewicz, as trustee of Carol A. Paskiewicz Trust Agreement u/d/t dated July 22, 1999 (Doc. No. 792,050) 13 Ellwood Road Kensington, CT 06037-2729	Certificate 156567 ✓ Lot 5 Plan 17687-C
16 Packet Landing Map 42-25	J. Thompson Dewing Jr. and Sally A Dewing 16 Packet Landing Orleans, MA 02653	Certificate 136043 ✓ Lot 6 Plan 17687-C
3 Packet Landing Map 42-20	Noah J. Peters and Rydell Welch 3 Packet Landing Orleans, MA 02653	Certificate 215530 ✓ Lot 15 Plan 17687-E
7 Packet Landing Map 42-18	Bruce J. Ryan, Trustee of the Bruce J. Ryan Trust u/d/t dated 8/1/13 and Kathleen M. Ryan, Trustee of the Kathleen M. Ryan Trust u/d/t dated 8/1/13 7 Packet Landing Orleans, MA 02653	Certificate 214597 ✓ Lot 16 Plan 17687-E
9 Packet Landing Map 42-19	Richard E. Petrino and Patricia R. Petrino, 12 Sleepy Hollow Road Kinnelon, NJ 07405	Certificate 220865 ✓ Lot 10 Plan 17687-C
13 Packet Landing Map 42-16	Helen A. Richardson, David E. Wilber and Richard L. Wilber, Trustees of the Helen A Richardson 2007 Declaration of Trust u/d/t dated July 12, 2007 13 Packet Landing Orleans, MA 02653	Certificate 199958 ✓ Lot 9 Plan 17687-C

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15 Packet Landing Map 42-17	David J. Frogel and Laura E. Frogel, Trustees of the David J. Frogel Trust u/d/t dated August 20, 2018 David J. Frogel and Laura E. Frogel, Trustees of the Laura E. Frogel Trust u/d/t dated August 20, 2018 19 Brickyard Lane Westborough, MA 01581	Certificate 217109 ✓ Lot 13 Plan 17687-D
17 Packet Landing Map 42-15	Stephen H. Tyng, Trustee of the Stephen H. Tyng Living Trust Agreement dated March 13, 2014 Stephen H. Tyng, Trustee of the Barbara C. Tyng Living Trust Agreement dated March 13, 2014 PO Box 621 East Orleans, MA 02643	Certificate 203304 ✓ Lot 14 Plan 17687-D

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LUCY'S LANE and GESNER ROAD

PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	RECORD OWNER	DEED / CERTIFICATE/ PLAN REFERENCE
16 Lucy's Lane Map 42-52	Sarah Woodward Yingling and Anne Woodward Laird 731 Fairacres Ave Westfield, NJ 07090	Book 31896 Page 300 Lot A Plan Book 117 Page 39 ✓
14 Lucy's Lane Map 42-47	John Hiden and Cheryl Hiden PO Box 1987 Orleans, MA 02653	Book 34829 Page 305 Lot B Plan Book 117 Page 39 ✓ Lot 6A Plan Book 673 Page 38
7 Lucy's Lane Map 42-49	Lucy's Lane Revival, LLC c/o Ament Klauer LLP 39 Town Hall Square Falmouth, MA 02540	Book 34043 Page 2 ✓
15 Lucy's Lane Map 42-50	John Hiden and Cheryl Hiden 138 Old Redding Road Weston, CT 06883	Book 32498 Page 58 ✓ Lot 1 Plan Book 473 Page 94
4 Lucy's Lane Map 42-46	Brian W. McNally and Sharon W. McNally 492 Beacon Street, Apt 54 Boston, MA 02115	Certificate 174522 ✓ Lot 2 Plan 17688-B Book 19075 Page 144 Lot 3 Plan Book 152 Page 111
17 Lucy's Lane Map 42-51	Sarah Lea Woodward Yingling and Anne Osborn Woodward Laird 731 Fairacres Ave Westfield, NJ 07090	Book 31896 Page 303 ✓
67 River Road Map 42-48	Matthew T. Menard and Wendy Harrington 4 Millstone Lane Lincoln, MA 01773	Book 30892 Page 317 ✓
59 River Road Map 42-45	Frances H. O'Brien Baldessarini and Ross J. Baldessarini, Trustees of The Frances H. O'Brien Baldessarini Trust – 2007, dated August 2, 2007 49 Nehoiden Road Waban, MA 02468	Certificate 230609 ✓ Lot 1 Plan 17688-B Lot 17 Plan 17687-F
47 Monument Road Map 42-61	Mary E. Morgan, Trustee Mary E. Morgan Living Trust PO Box 1718 Orleans, MA 02653	Book 29534 Page 297 Plan Book 136 Page 17 ✓
8 Gesner Road Map 42-60	Arthur E. Fancy, Jr. and Meredith Fancy PO Box 98 Orleans, MA 02643	Book 21344 Page 312 Book 26435 Page 103 Plan 160/109 ✓

6 Gesner Road Map 42-64	Arthur E. Fancy and Meredith T. Fancy PO Box 98 Orleans, MA 02643	Book 13163 Page 20 Lot 3 Plan 490 Page 5
10 Gesner Road Map 42-59	Sigurd A. Winslow and Judith A. Scanlon, Trustees Winslow Scanlon Realty Trust PO Box 647 Orleans, MA 02653	Book 24062 Page 266
14 Gesner Road Map 42-57	Dale R. Fuller and Sophia M. Fuller, Trustees Kinderhoek Trust PO Box 18 East Orleans, MA 02643	Book 29133 Page 103 Lots 1&2 Plan Book 479 Page 74
18 Gesner Road Map 42-55	Matthew S. Varnum Box 2022 Orleans, MA 02653	Book 26935 Page 63 Lot 4 Plan Book 479 Page 74
20 Gesner Road Map 42-54	Kimberely L. Mead-Walters and F. Davis Walters, Trustees Joint Revocable Trust of Kimberely L. Mead- Walters and F. Davis Walters Box 1082 Orleans, MA 02653	Book 27914 Page 67 Lot 5 Plan Book 479 Page 74
20 Gesner Road Map 42-53	Sigurd A. Winslow and Judith A. Scanlon, Co-Trustees, Winslow Scanlon Realty Trust Box 647 Orleans, MA 02653	Book 30992 Page 118 Lot 6B on Plan Book 673 Page 38
49 Monument Road Map 42-78	Sondra Scheir PO Box 697 Orleans, MA 02653	Book 11540 Page 255 Lot A Plan Book 116 Page 119
7 Gesner Road Map 42-79	Joan F. Christopher, Trustee 7 Gesner Road Nominee Trust 7 Gesner Road Orleans, MA 02653	Book 34374 Page 203 Lot B Plan Book 116 Page 119
11 Gesner Road Map 42-84	Frederick D. Walters, Jr., Trustee Dorothy P. Walters, Trustee Leslie Ann Walters Nelson, Trustee Frederick D. Walters and Dorothy P. Walters Joint Revocable Trust PO Box 1482 East Orleans, MA 02643	Book 27888 Page 104 Lot A Plan Book 86 Page 63
25 Gesner Road Map 42-86	Paul R. van Steensel PO Box 801 South Orleans, MA 02662	Book 34513 Page 54 Lot 2A Plan Book 513 Page 76
29 Gesner Road	Sheryl M. Boland	Book 26621 Page 191

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Map 42-89-1	Al Tower Drive Dover, MA 02030	Lot 3A Plan Book 617 Page 90 ✓
33 Gesner Road Map 42-89	Paul G. Cunningham, Trustee of The Paul G. Cunningham 2005 Family Trust Janis G. Cunningham, Trustee of The Janis G. Cunningham 2005 Family Trust 6 Stevens Circle Westwood, MA 02090	Book 32530 Page 127 Lot 3B Plan Book 617 Page 90 ✓
40 Gesner Road Map 42-91	Philip D. Kuhlmann and Cheryl A. Schley, Trustees Kuhlman Family Revocable Trust of 2013 9 Brookford Street Cambridge, MA 02140	Book 33435 Page 130 Lot 4 Plan Book 158 Page 47 ✓
36 Gesner Road Map 42-90	Mid Century Modern LLC 216 Academy Drive Longmeadow, MA 01106	Book 30666 Page 109 ✓ Lot 5 Plan Book 158 Page 47
16 Gesner Road Map 42-56	Gail L. Schlesinger, Trustee Schlesinger Family Trust 3 Deerfield Road Medfield, MA 02052	Book 33846 Page 213 ✓ Lot 3 Plan Book 479 Page 74

UNCLE VICK'S WAY		
PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	**RECORD OWNER**	**DEED / CERTIFICATE PLAN REFERENCE**
4 Uncle Vick's Way Map 41-40	Robert B. Wilcox PO Box 501 Orleans, MA 02653	Book 2931 Page 232 Lot 3 Plan Book 153/67 ✓
5 Misty Lane Map 41-41	Town of Orleans	Book 15911 Page 282 Book 19476 Page156 ✓
10 Uncle Vick's Way Map 41-42	Lawrence E. Wilcox, Trustee Wilcox Family Trust, u/d/t dated June 16, 1986 recorded in Book 5136 Page 163 PO Box 1291 Orleans, MA 02653	Book 5136 Page 167 Lot 1 Plan Book 204/1 ✓
14 Uncle Vick's Way Map 41-43	Michael J. Byrne 454 Prospect Avenue Brooklyn, NY 11215	Book 25581 Page 309 Lot 3 Plan Bk 204/1 ✓
18 Uncle Vick's Way Map 41-44	Robert Doiron and Pamela Doiron 9 Fulling Mill Drive Charlton, MA 01507	Book 31027 Page 162 Lot 4 Plan Bk 204 Page 1 ✓

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22 Uncle Vick's Way Map 41-45	Christopher C. Demaria and Frank J. Demaria, Trustees of The De Maria Legacy Trust u/d/t dated May 20, 2022 37 Oak Street White Plains, NY 10607	Book 35240 Page 267 Lot 5 Plan Bk 204 Page 1 ✓
24 Uncle Vick's Way Map 41-46	Yun-Sun Kang and Young-Joo Lee 7006 Alicent Place McLean, VA 22101	Book 26425 Page 230 Lot 6 Plan Bk 204 Page 1 ✓
30 Uncle Vick's Way Map 41-47	Nancy J. Moore PO Box 1426 Orleans, MA 02653	Book 4366 Page 327 ✓ Lot 7 on Plan Book 204/1
31 Uncle Vick's Way Map 41-48	Elaine K. Clements and Kevin A. Clements, Trustees of the Elaine K Clements Revocable Trust, dated June 23, 2009 and Kevin A. Clements and Elaine K. Clements, Trustees of the Kevin A Clements Revocable Trust, dated June 23, 2009 PO Box 1533 East Orleans, MA 02643	Book 24058 Page 270 ✓ Book 24058 Page 266 Lot 8 Plan Bk 204/1
29 Uncle Vick's Way Map 41-49	Janice G. Reynolds, Trustee of The Janice G. Reynolds Revocable Trust, u/d/t dated April 24, 2015 29 Uncle Vick's Way Orleans, MA 02653	Book 28860 Page 136 Lot 9 Plan Bk 204 Page 1 ✓
27 Uncle Vick's Way Map 41-50	Stanley W. Marvel and Loretta B. Marvel 27 Uncle Vick's Way Orleans, MA 02653	Book 32964 Page 330 ✓ Lot 12 Plan Bk 204 Page 1
15 Uncle Vick's Way Map 41-51	William J. Werner and Raymond F. Werner 513 South Mountain Road New City, NY 10956	Book 4596 Page 121 ✓ Lot 11 Plan Bk 204 Page 1
9 Uncle Vick's Way Map 41-52	Craig Oliveira and Erica Tasha-Oliveira 9 Uncle Vick's Way Orleans, MA 02653	Book 34265 Page 88 Lot 10 Plan Bk 204 Page 1 ✓
24 Monument Road Map 41-53	Anthony J. Cincotta and Lynn C. Cincotta 24 Monument Road Orleans, MA 02653	Book 29708 Page 289 Lot 2 Plan Bk 153 Page 67 ✓

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LARBOARD LANE		
PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	**RECORD OWNER**	**DEED / CERTIFICATE PLAN REFERENCE**
4 Larboard Lane Map 36-111	Robert P. Boffoli and Cynthia H. Boffoli PO Box 1468 East Orleans, MA 02643	Book 29557 Page 12 Lot 1 Plan Book 211/99 ✓
8 Larboard Lane Map 36-112	Paul R. Wiencek and Ann Maureen S. Wiencek, Trustees of the Wiencek Realty Trust of 2012 u/d/t dated April 25, 2012 15 Rossi Lane Ashland, MA 01721	Book 26299 Page 268 Lot 2 Plan Book 211/99 ✓
10 Larboard Lane Map 36-113	Barry N. McManus and Amanda Haines 276 County Road Bourne, MA 02532	Book 33935 Page 98 Lot 3 Plan Book 211/99 ✓
9 Larboard Lane Map 36-114	Dean Wiegers and Edna Wiegers 9 Larboard Lane East Orleans, MA 02653	Deed 15863 Page 1 Lot 4 Plan Book 211/99 ✓
7 Larboard Lane Map 36-115	Paul F. Footit and Barbara R. Footit, Trustees of the Barbara R. Footit Revocable Trust, dated April 4, 2002, as amended February 9, 2022 7 Meetinghouse Lane Wilbraham, MA 01095	Book 34897 Page 65 Lot 7 Plan Book 211/ 99 ✓
3 Larboard Lane Map 36-116	Janet C. Taylor, Trustee of The Janet C Taylor Revocable Living Trust Agreement Dated April 1, 2002, recorded in Book 15156 Page 235 Janet C. Taylor, Trustee of The R. Bruce Taylor Revocable Living Trust Agreement Dated April 1, 2002, and recorded in Book 15156 Page 221 PO Box 97 East Orleans, MA 02643	Book 15156 Page 250 Lot 8 Plan Bk 211 Page 99 ✓

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PROPERTY ADDRESS (ORLEANS, MA)/ ASSESSOR MAP	KAREN WAY RECORD OWNER	DEED / CERTIFICATE PLAN REFERENCE
30 Karen Way Map 35-38	Thomas Newman 518 Main Street, Apt 67 New Haven CT 06612	Book 31433 Page 248 ✓ Lot B Plan Book 293 Page 15
27 Karen Way Map 35-40	Joanne A. Garofalo, as Trustee of The Joanne A. Garofalo 2017 Living Trust, u/d/t dated 8/11/17 27 Karen Way Orleans, MA 02653	Book 30693 Page 230 ✓ Lot 2 Plan Book 190/133
21 Karen Way Map 35-42	Gregory W. Peach and Margaret L. Conover, Trustees of the Gregory W. Peach Revocable Trust Agreement dated August 7, 2018 and Gregory W. Peach and Margaret L. Conover, Trustees of the Margaret L. Conover Revocable Trust Agreement dated August 7, 2018 21 Karen Way, Orleans, MA 02653	Book 31590 Page 97 ✓ Lot 4 Plan Book 190/133
17 Karen Way Map 35-43	Scott V. Barron and Patricia G. Barron PO Box 1860 Orleans, MA 02653	Book 27635 Page 213 ✓ Lot 5 Plan Book 190/133
22 Karen Way Map 35-44	Peter B. Zimmerman & Judith K. Zimmerman PO Box 1628 Orleans, MA 02653	Book 27506 Page 2 ✓ Lot 7 Plan Book 190/133
31 Karen Way Map 35-39	Sean P. Doherty and Claudia J. Doherty 17 Willard Street Newton, MA 02458	Book 23067 Page 192 ✓ Lot 1 Plan Book 190/133
25 Karen Way Map 35-41	Robert E. Donath and Marianne C. Paskowski PO Box 432 East Orleans, MA 02643	Book 12660 Page 172 ✓ Lot 3 Plan Book 190/133

18 Karen Way Map 35 – 45	Thomas D. Hanrahan and Martha W. Hanrahan PO Box 773 East Orleans, MA 02643	Book 28809 Page 87 Lot 6 Plan Book 190/133
180 Main Street Map 35-37	Stuart McLean, Trustee Stuart McLean Living Trust dated April 13, 2022 15 Clifford Ave Pelham, NY 10803	Book 35085 Page 154 Lot A Plan Book 293 Page 18
184 Main Street Map 35-47	Jon R. Fuller and Beverly A. Fuller PO Box 667 E Orleans MA 02643	Deed Book 9950 Page 218

NATURAL DRIVE

PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	RECORD OWNER	DEED / CERTIFICATE PLAN REFERENCE
4 Natural Drive Map 36-101	Elizabeth Averill Wharff, Trustee The Elizabeth Averill Wharff Trust – 2016 u/d/t dated May 13, 2016 77 Chandler Street, Unit 2 Boston, MA 02116	Book 29658 Page 187 Lot 1 Plan Bk 186 Page 1
6 Natural Drive Map 36-102	David W. Abbott and Lynne A. Abbott 50 Ginley Road, Walpole, MA 02081	Book 31018 Page 36 Lot 2 Plan Bk 186 Page 1
10 Natural Drive Map 36-103	Kevin B. Hoey and Robin A. Hoey 53 Pilgrim Road Marblehead, MA 01945	Book 23197 Page 178 Lot 6 Plan Book 186 /1
16 Natural Drive Map 36-104	David J. Bishop and Vanessa J. Levin 82 Ivy Street, Apt 4 Brookline, MA 02446	Book 25269 Page 22 Lot 7 Plan Book 186/1
18 Natural Drive Map 36-105	Amanda Haines and Barry N. McManus 10 Larboard Lane Orleans, MA 02653	Book 34943 Page 161 Lot 9 Plan Book 186/1
17 Natural Drive Map 36-106	Amanda Haines and Barry N. McManus 10 Larboard Lane Orleans, MA 02653	Book 34943 Page 161 Lot 10 Plan Book 186/1
11 Natural Drive Map 36-107	Andrew C. Stanley and Mary A. Stanley 1040 Beaver Creek Road	Book 23228 Page 176 Lot 11 Plan Book 186/1

	Shelburne, Vermont 05482	
7 Natural Drive Map 36-108	Paula M. Marella, Trustee The Natural Drive Realty Trust 660 Union Street, #2C Braintree, MA 02184	Book 20563 Page 167 Lot 12 Plan Book 186/ 1 ✓
3 Natural Drive Map 36-109	Ann Czerwonka, Trustee The Breezy Natural Drive Nominee Trust PO Box 845 Orleans, MA 02653	Book 31816 Page 222 Lot 13 Plan Book 186/1 ✓
	WINDY HILL LANE and BAYBERRY WAY	
PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	**RECORD OWNER**	**DEED / CERTIFICATE/ PLAN REFERENCE**
54 Barley Neck Road Map 43 – 110	George V. Lascher and Janet A. Lascher, Trustees, Lascher Orleans Real Estate Trust PO Box 341 East Orleans, MA 02643	Book 17413 Page 135 Lot 1 Plan Book 140/67 ✓ (including any rights in Bayberry Way on Plan Book 140/67)
4 Windy Hill Lane Map 43-109	Esther P. Lobo 15 Baxter Lane Orleans, MA 02653	Book 23862 Page 241 Lot 2 Plan Book 140/67 ✓
8 Windy Hill Lane Map 43 – 108	David J. Winnick and Deborah S. Winnick, Trustees of the David J. Winnick 2016 Restated Trust, dated 6/24/16 and David J. Winnick and Deborah S. Winnick, Trustees of the Deborah S. Winnick 2016 Restated Trust, dated 6/24/16 8 Windy Hill Lane Orleans, MA 02653	Book 29761 Page 197 Lot 3 Plan Book 140/67 ✓
10 Windy Hill Lane Map 43 – 107	Janet J. Wineman Jean D. Wineman M. Marian Wineman 3611 45th Ave. West Seattle, WA 98199	Book 31389 Page 60 Lot 4 Plan Book 140 /67 ✓
10 Harvey's Lane Map 43 – 106	Janet J. Wineman, Jean D.Wineman and M. Marian Wineman, Trustees of Breezy Realty Trust u/d/t dated 12/22/2005 3611 45th Ave. West, Seattle, WA 98199	Book 20613 Page 98 Lot 5 Plan Book 140/67 ✓

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12 Harvey's Lane Map 43 – 97	Orleans Conservation Trust 203 S. Orleans Road, Orleans, MA 02653	Book 18787 Page 201 Lot 6 Plan Book 140/67 ✓
14 Harvey's Lane Map 43 – 96	Orleans Conservation Trust 203 S. Orleans Road, Orleans, MA 02653	Book 18787 Page 201 Lot 7 Plan Book 140/67 ✓
6 Harvey's Lane Map 43 – 98	Sarah Bartholomew, as Trustee of the Sarah Bartholomew Trust, September 22, 2009 and any amendments thereto 6 Harvey's Lane Orleans, MA 02653	Book 32575 Page 68 Lot 8 Plan Book 140/67 ✓
11Windy Hill Lane Map 43 – 105	Dennis J. Murphy and Elizabeth Murphy PO Box 1546 East Orleans, MA 02643	Book 18466 Page 346 Lot 9 Plan Book 140/67 ✓
5 Windy Hill Lane Map 43 – 104	Thomas J. Filomeno Michael J. Filomeno 44 Wildwood Glen Longmeadow, MA 01106	Book 27011 Page 242 ✓ Lot 10 Plan Book 140/67
3 Windy Hill Lane Map 43 – 103	James H. Beall, Jr. and Barbara L Beall, Trustees of the Barbara L Beall 2001 Trust 34 Scofield Lane New Canaan, CT 06840	Book 30011 Page 210 Lot 11 Plan Book 140/67 ✓
6 Bayberry Way Map 43-17	Cynthia J. Hickey and William V. Hickey, Trustees of Hickey Trust 54 Oak Ridge Circle Weymouth, MA 02188	Book 32634 Page 332 Lots 16A and 16B Plan ✓ Book 373 Page 25
57 Barley Neck Road Map 43-16	Martin Sedlacek and Carmen P. Bascunan 57 Barley Neck Road Orleans, MA 02653	Book 29120 Page 194 Lots 14A and 14B on Plan 373/25 ✓

	HIGH TIDE LANE, CEDAR WAY, POND VIEW ROAD and GRIST ROAD	
PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	**RECORD OWNER**	**DEED / CERTIFICATE/ PLAN REFERENCE**
223 Main Street Map 36-151	Minoru John Aoki and Terrie Edwards Aoki 61 Falmouth Road Scarsdale, NY 10583	Book 9825 Page 183 ✓ Lot A Plan Book 95 Page 55

235 Main Street Map 36-150	Nauset Marine Realty Trust, LLC c/o Todd Walker PO Box 357 Orleans, MA 02653	Book 31759 Page 241 Portion of Lot B on Plan Book 95 Page 55 ✓
39 High Tide Lane Map 36-149-1	Nauset Marine Realty Trust, LLC c/o Todd Walker PO Box 357 Orleans, MA 02653	Book 31759 Page 241 Lot 17 Plan Book 141/33 ✓
37 High Tide Lane Map 36-149	Nauset Marine Realty Trust, LLC c/o Todd Walker PO Box 357 Orleans, MA 02653	Book 31759 Page 241 Lot 16 Plan 141/33 ✓
35 High Tide Lane Map 36-148	Estate of Elizabeth O. Waugh Warren F. Waugh, Jr., Personal Representative Warren F. Waugh, Jr. and Karen M. Hanson, Trustees Elizabeth O. Waugh 2007 Revocable Trust 31 Mussel Point Way Gloucester, MA 01930	Book 17873 Page 114 Book 32116 Page191 Essex Probate No. ES18P2459EA ✓ Lot 15 Plan 141/33
31 High Tide Lane Map 36-147	James J. McKenzie Linda McKenzie 19 Belknap Road Medfield, MA 02052	Book 8401 Page 217 Book 8401 Page 219 Book 9221 Page 231 Book 11296 Page 33 Lot 14 Plan 141/33 ✓
32 High Tide Lane Map 36-144	Suzanne Huskins, Trustee Meetinghouse Pond Property Trust u/d/t dated August 24, 2005 PO Box 995 East Orleans, MA 02643	Book 20193 Page 348 Book 33752 Page 203 Lot 6 Plan 141/3333 ✓
34 High Tide Lane Map 36-143	Nauset Marine Realty Trust, LLC c/o Todd Walker PO Box 357 Orleans, MA 02653	Book 31759 Page 241 Lot 4 Plan 141/33 ✓
36 High Tide Lane Map 36-142	Nauset Marine Realty Trust, LLC c/o Todd Walker PO Box 357 Orleans, MA 02653	Book 31759 Page 241 Lot 2 Plan 141/33 ✓
3 Barley Neck Road Map 36-141	Nauset Marine Realty Trust, LLC c/o Todd Walker PO Box 357 Orleans, MA 02653	Book 31759 Page 241 Lot 1 Plan 141/33 ✓
20 High Tide Lane Map 36-131	William Siclari and Mary Ann C. Siclari, Co-Trustees The Siclari Revocable Trust	Book 34818 Page 30 Lot 5 Plan Book 102 Page 129 ✓

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15 High Tide Lane Map 43-5	Ronald J. Majewicz and Linnea C. Majewicz 4557 Yacht Harbor Drive Naples, FL 34112	Book 21051 Page 167 Lot 1(portion of) and Lot 2 Plan Book 102 Page 129 ✓
9 High Tide Lane Map 43-7	Cape Cod Five Cents Savings Bank, Trustee of the Judith K. Brainerd Trust PO Box 10 Orleans, MA 02653	Book 34426 Page 327 Lot 9 Plan Book 102 Page 129 ✓
25 High Tide Lane Map 36-146	Mark A. Der Hagopian, Trustee of the M and M Lucky Oyster Realty Trust 651 Boylston Street Boston, MA 02116	Book 34076 Page 277 Lot 13 Plan Book 141 Page 33 ✓
16 High Tide Lane Map 43-4	Sarah McDonald 6121 Eternal Ocean Pl Clarksville, MD 21029	Book 31725 Page 282 ✓ Lot 6 Plan Book 102 Page 129 ✓
17 High Tide Lane Map 43-3	Justin A. Manafort and Tabitha W. Manafort 33 Lena Avenue Plainville, CT 06062	Book 34531 Page 316 Lot 3A Plan Book 570 Page 61
3 High Tide Lane Map 43-9	Michael L. Betlinski and Lisa Allen, as Trustees of the Betlinski Allen Living Trust PO Box 297 East Orleans MA 02643	Book 29728 Page 18 ✓ Lot 8 Plan Book 102/129
24 High Tide Lane Map 36-132	William B. Brown and Ann T. Brown, Trustees, William and Ann Brown Nominee Trust u/d/t dated May 28, 2008 PO Box 1384 East Orleans, MA 02643	Book 23041 Page 126 Lot 12 Plan 141 Page 33 ✓

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12 Cedar Way Map 36-129	Charles Mole John D. Mole and Barbara Lacey Mole, Trustees of the Mole Realty Trust, u/d/t dated 12/20/2163 Main Street Bovina Center, NY 13740	Book 8368 Page 63 Book 34785 Page 103 Lot 11 Plan Book 102 Page 129 ✓
5 Cedar Way Map 36-123	John D. Mole and Barbara Lacey Mole, Trustees of the Mole Realty Trust, u/d/t dated 12/20/21 311 Lowell Avenue Newton, MA 02460	Book 34785 Page 106 Lot 15 Plan 102/129 ✓
6 Cedar Way Map 36-126	Eric D. Schlesinger and Ann Susan Peterson PO Box 725 East Orleans MA 02643	Book 8990 Page 313 Lot 14 Plan 102/129 ✓
10 Cedar Way Map 36-128	Megan G. Fates, Trustee Megan G. Fates Trust dated 7/12/2016 PO Box 925 East Orleans MA 02643	Book 29820 Page 76 Lot 12 Plan 102/129 ✓ ✓
25 Barley Neck Road Map 36 -125	Glenn G. and Judith A. Plimpton 25 Barley Neck Road Orleans, MA 02653	Book 24851 Page 211 Lots 20 & 21 Plan 102/129
14 High Tide Lane Map 36-130	Priscilla C. Isner and Michael S. Isner, Trustees of The Michael S. Isner and Priscilla C. Isner 2015 Living Trust dated December 22, 2015, u/t/a dated 12/22/2015 PO Box 363 East Orleans MA 02643	Book 34036 Page 218 Lot 10 Plan 102/129 ✓
8 Cedar Way Map 36-127	Saul Shocket and Alice B Shocket PO Box 5 East Orleans, MA 02643	Book 18864 Page 259 Lot 13 Plan 102/129 ✓
29 Barley Neck Road Map 36 -124	Marc L. Angelillo PO Box 95 Orleans, MA 02653	Book 11602 Page 60 Lot 19 Plan 102/129 ✓
10 High Tide Lane Map 36 -122-1	Eric D. Sweet and Carinne Y. Sweet 201 Church Road Devon, PA 19333	Deed Book 26821 Page 249 Lot 16 Plan 102/129 ✓

9 Pond View Road Map 43-13	Daune G. Albiston, Trustee The Daune G. Albiston Trust of 1999 49 Barley Neck Road Orleans, MA 02653	Book 12462 Page 25 Book 12462 Page 27 Lot 5 Plan 104/155 Lot 6 Plan 104/155 ✓
49 Barley Neck Road	Daune G. Albiston, Trustee	Book 12462 Page 27

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Map 43-14	The Daune G. Albiston Trust of 1999 49 Barley Neck Road Orleans, MA 02653	Lot 4 on Plan 104/155 ✓
8 Pond View Road Map 43-10	John J. Kelly, Jr. and Patricia W. Kelly, Trustees of The John J. Kelly Family Trust dated September 12, 1983 and Patricia W. Kelly and John J. Kelly, Jr. Trustees of The Patricia W. Kelly Family Trust dated September 12, 1983 PO Box 685 East Orleans, MA 02643	Book 31960 Page 223 Lots 1 and 2 on Plan Book 517 Page 59 ✓
14 Pond View Road Map 43-11	Robert D. Bardwell, III and Robin B. Bardwell, Trustees of the Mary H. Bardwell Irrevocable Family Trust of 2007 PO Box 138 East Orleans, MA 02643	Book 22564 Page 60 Lot 1 Plan Book 104 Page 155 ✓

11 Grist Road Map 36-134	David Ohnemus and Virginia Ohnemus 11 Grist Road Orleans, MA 02653	Book 28452 Page 271 ✓ Lot 10 Plan Book 141/33
19 Barley Neck Road Map 36-135	Town of Orleans 19 School Road Orleans, MA 02653	Book 2810 Page 236 ✓ Lot 9 Plan Book 141/33
15 Barley Neck Road Map 36-138	Mary A. Ware and Beverly E. Chappell, Trustees, The Mary A Ware Revocable Living Trust Agreement Dated August 9, 1999, as amended and Mary A. Ware, Trustee, The Paul M Ware, Jr. Living Trust Agreement Dated June 3 2009 PO Box 55 East Orleans MA 02643	Book 23822 Page 66 Lot 8 Plan 141/33 ✓
12 Grist Road Map 36-145	James G. Fiala Jr. and Robin M. Hennessy 131 Davis Avenue #2 Brookline, MA 02445	Book 30828 Page 174 Lot 7 Plan Book 141/33 ✓
15 Grist Road Map 36-133	Scott McKay and Suzanne Ugliarolo-McKay 3 Dalphin Drive Rye, NY 10530	Book 35099 Page 159 ✓ Lot 11 Plan Book 141/33

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LAKE FARM LANE

PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	RECORD OWNER	DEED / CERTIFICATE/ PLAN REFERENCE
3 Lake Farm Lane Map 41-123	Kevin R. Booth and Barbara J. Booth 15 Beaver Dam Road Upper Saddle River, NJ 07458	Book 27335 Page 269 Lot 1 Plan Book 434 Page 38 ✓
7 Lake Farm Lane Map 48-49	Robert W. Normann and Lorraine Normann 7 Lake Farm Lane Orleans MA 02653	Book 31309 Page 90 Lot 2 Plan Book 434 Page 38 ✓
9 Lake Farm Lane Map 48-50	Kyle I. Macgillivray, Trustee of The Irene M Macgillivray Trust of 1998 895 Sport Hill Road Easton, CT 06612	Book 27685 Page 342 Lot 3 Plan Book 434 Page 38 ✓
15 Lake Farm Lane Map 48-51	Robert A. Nover and Aimee A. Nover 5410 Connecticut Ave NW Suite 111 Washington, DC 20015	Book 25684 Page 110 Lot 4 Plan Book 434 Page 38 ✓
19 Lake Farm Lane Map 41-131	Susan N. Fleming and Susan Eitel 19 Lake Farm Lane, Orleans, MA 02653	Book 9139 Page 167 ✓ Lot 5 Plan Book 434 Page 38
18 Lake Farm Lane Map 41-134	Susan J. Trump, Trustee Trump Family Nominee Trust u/d/t dated September 11, 2002 18 Lake Farm Lane, Orleans, MA 02653	Book 15815 Page 76 ✓ Lot 12 Plan 652 Page 21
16 Lake Farm Lane Map 48-48	Beatrice P. Auty PO Box 533 East Orleans, MA 02643	Book 8389 Page 168 ✓ Lot 7 Plan Book 434 Page 38
10 Lake Farm Lane Map 48-47	Alan Levick and Nancy Rogoff, Trustees of the Alan Levick Revocable Trust Alan Levick and Nancy Rogoff, Trustees of the Nancy Rogoff Revocable Trust 10 Lake Farm Lane Orleans, MA 02653	Book 27956 Page 209 Lot 8 Plan Book 434 Page 38 ✓
6 Lake Farm Lane Map 48-46	James J. Athanas and Carrie Webb Athanas 231 Jefferson Avenue Northbridge, MA 01534	Book 28202 Page 26 ✓ Lot 9 Plan Book 434 Page 38

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4 Lake Farm Lane Map 41-122	Steven J. Allard and Mary Ann M. Allard, Trustees, Allard Living Trust 208 Amherst Street Highland Park, NJ 08904	Book 34756 Page 140 Lot 1 Plan Book 434 Page 38 ✓

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COLE PLACE

PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	RECORD OWNER	DEED / CERTIFICATE/ PLAN REFERENCE
2 Beach Road Map 36-22	Laura V. Scheel PO Box 417 East Orleans, MA 02643	Book 20291 Page 221 ✓ Lot 1 Plan Book 592 Page 91
4 Cole Place Map 36-21	Joseph F. Boughan and Alison J. Boughan 15 Phillips Drive Westford, MA 01886	Book 24755 Page 226 ✓ Book 23876 Page 226 Lot 2 Plan Book 592 Page 91
6 Cole Place Map 36-16	William Daly and Mona G. Daly, Trustees 6 Cole Place Nominee Trust 3 Nelson Way Mansfield, MA 02048	Book 30983 Page 64 ✓ Plan Book 137 Page 61
18 Cole Place Map 36-14	John Haynie, Jr. and Donna M. Haynie 23 Frances Road Harwich, MA 02645	Book 22902 Page 21 ✓ Plan Book 133 Page 35
20 Cole Place Map 36-4	Christopher Gaskill and Mary J. Baldwin 20 Cole Place Orleans, MA 02653	Book 23986 Page 235 ✓ Lot 2 on Plan Book 266 Page 42
19 Cole Place Map 36-13	Gene A. Fulcher and Genevieve Fulcher PO Box 1476 Orleans, MA 02653	Book 4758 Page 196 ✓
15 Cole Place Map 36-15	Gene A. Fulcher and Genevieve Fulcher PO Box 1476 Orleans, MA 02653	Book 26731 Page 129 ✓
8 Beach Road Map 36-23	Trustees of the Village East Condominium Trust u/d/t dated 11/21/05	Book 20495 Page 67 ✓

	MANITO WAY	
PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	**RECORD OWNER**	**DEED / CERTIFICATE / PLAN REFERENCE**
17 Manito Way Map 35-84	Paul Lafleche and Lucy Nims Lafleche, Trustees Lucy Nims Lafleche 2013 Revocable Trust 6 Savoy Road, Needham, MA 02492	Book 28520 Page 228 Lot 4 Plan 243 Page 19 ✓
15 Manito Way Map 35-85	Nancy Noonan, Trustee Nancy Noonan Declaration of Trust 2150 S. Ocean Blvd., Apt 7B Delray Beach, FL 33483	Book 26597 Page 36 ✓ Lot 3 Plan Book 243/19 Lot B Plan Book 597 Page 80
11 Manito Way Map 35-86	David K. Suonpera and Cynthia O. Suonpera PO Box 1355 East Orleans, MA 02643	Book 22653 Page 249 Lot A Plan Book 597 Page 80 ✓
21 Manito Way Map 42-4	Peter Paulsen and Ulrike Paulsen Erlengrund 12 Rellingen, 25462 Germany	Book 26926 Page 189 Lot 5 Plan Book 243 Page 19 ✓
22 Manito Way Map 42-5	Gary J. Guzzeau and Gwynne W. Guzzeau PO Box 1434 East Orleans, MA 02643	Book 19181 Page 22 ✓ Lot 6 Plan Book 243 Page 19
199 Main Street Map 35 -87	Holy Kamoli, LLC PO Box 1525 East Orleans, MA 02643	Book 28116 Page 309 ✓ Lot 1 Plan Book 243 Page 19

	CHENEY ROAD	
PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	**RECORD OWNER**	**DEED / CERTIFICATE/ PLAN REFERENCE**
207 Main Street Map 35-79	Trustees of East Main Street Condominium Trust Trisha Daly-Karlson, Trustee The Karlson Group LLC PO Box 1601 East Orleans, MA 02643	Book 6108 Page 327 Book 6109 Page 1 ✓
4 Cheney Road Map 35-80	Sankaran Thayumanavan and Sharmila Muratoti 45 Kingman Road Amherst, MA 01002	Book 27749 Page 8 ✓ Lot 2 Plan Book 150/107

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8 Cheney Road Map 35-81	Dennis H. Charbonneau and Bree M. Charbonneau 34 Lovell Street, Mendon, MA 01756	Book 34445 Page 95 Lot 3 Plan 150/107
10 Cheney Road Map 35-82	James F. Murphy Justine C. Murphy David C. Murphy Amy J. Murphy 40 Stockbridge Road Bridgewater, MA 02324	Book 34802 Page 32 Lot 4 Plan 150/107
14 Cheney Road Map 35-83	Steven H. Koehler and Anne E. Koehler PO Box 611 East Orleans, MA 02643	Book 17728 Page 105 Lots 5 and 6 Plan 150/107
17 Cheney Road Map 35-75	Steven H. Koehler and Anne E. Koehler PO Box 611 East Orleans, MA 02643	Book 27913 Page 42 Lots 12 and 13 Plan 150/107
20 Cheney Road Map 42-3	Orleans Conservation Trust 203 South Orleans Road Orleans, MA 02653	Book 18787 Page 201 Book 7497 Page 2 Lots 7 and 8 Plan 150/107
27 Cheney Road Map 42-2	Michael W. Roberge and Tracy Roberge 29 High Rock Road Wayland, MA 01778	Book 20225 Page 36 Lot 9 Plan Book 150/107
25 Cheney Road Map 42-1	Timothy S. Howell and Andrea B. Howell, as Trustees of The Timothy and Andrea Howell 2020 Living Trust PO Box 1208 East Orleans, MA 02643	Book 33033 Page 134 Lot 10 Plan Book 150/107
21 Cheney Road Map 43-1	Lisa Brannock Nancy Newlove 448 6th Avenue, Apt. 2F NY, NY 10011	Book 22396 Page 265 Lot 11 Plan Book 150/107
9 Cheney Road Map 35-76	Michael W. Roberge and Tracy Roberge 29 High Rock Road Wayland, MA 01778	Book 28156 Page 178 Lot 14 Plan Book 150/107
7 Cheney Road Map 35-77	Helen B. Kelsey 320 SE 4th Street Del Ray Beach, FL 33483	Book 32789 Page 307 Lot 15 Plan Book 150/107
209 Main Street Map 35-78	Diane L. Galazzo and Brian W. McGurk PO Box 505 East Orleans, MA 02643	Book 34885 Page 194

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LOOMIS LANE

PROPERTY ADDRESS (ORLEANS, MA)/ ASSESSOR MAP	RECORD OWNER	DEED / CERTIFICATE/ PLAN REFERENCE
29 Loomis Lane 29B Loomis Lane Map 42-6 Map 42-7	Mark H. Anderson and Jennifer Budryk PO Box 1432 East Orleans, MA 02643	Book 17856 Page 284 Lots B1 and B5 Plan Book 380 Page 71 ✓
31 Loomis Lane Map 42-14	Nicholas A. Athanassiou and Jeanne M. McNett PO Box 882 East Orleans, MA 02643	Book 4468 Page 35 ✓ Lot B-2 on Plan Book 380 Page 72
46 Loomis Lane Map 42-10	Estate of Doris S. Nash c/o Raymond Nash 11 Chatham Circle North Andover, MA 01845	Book 7867 Page 32 Book 12118 Page 258 Essex County Probate ✓ 98P1677EP1 Lot C-2 Plan Book 378 Page 10
44 Loomis Lane Map 42-11	Kristine M. Kavanagh PO Box 86 East Orleans, MA 02643	Book 4068 Page 63 ✓ Lot C-3 Plan Book 378 Page 10
47 Loomis Lane Map 42-9	Susan MacPherson Lynch George Edward Lynch Carol Ross MacPherson David Charles Locke 44 Peabody Drive Stow, MA 01775	Book 33634 Page 105 Book 33634 Page 108 Lot C-1 Plan Book 378 ✓ Page 10
40 Loomis Lane Map 42-13	Marilyn J. Faherty and Frederick C. Faherty, Trustees of the Marilyn J. Faherty Living Trust 2 Huckleberry Lane Acton, MA 01720	Book 30577 Page 325 Lot B-3 Plan Book 380 ✓ Page 71
42 Loomis Lane Map 42-12	Michael R. Shabazian and Elaine M. Shabazian PO Box 1166 East Orleans, MA 02643	Book 28832 Page 111 ✓ Lot B-4 Plan Book 380 Page 71

189 Main Street Map 35-95	Cathleen Arone, Trustee Arone Condominium Trust 189 Main Street Orleans, MA 02653	Master Deed of Arone Condominium Book 35149 Page 195 Plan Book 696 Page 1-2 Lot A Plan Book 378 Page 10

PROPERTYADDRESS (ORLEANS, MA)/ ASSESSOR MAP	NAUSET FARMS WAY RECORD OWNER	DEED / CERTIFICATE/ PLAN REFERENCE
26 Beach Road Map 36-28	Stephen J. Koepp and Leila H. Koepp 84 Edgemont Road Upper Montclair, NJ 07043	Book 6919 Page 31 Lot 1 Plan Book 237 Page 141
4 Nauset Farms Way Map 36-29	Susan P. Cranford, Trustee of the Susan P. Cranford 2010 Revocable Trust 33 Gleason Road Princeton, MA 01541	Book 34724 Page 172 Lot 2 Plan Book 237 Page 141
8 Nauset Farms Way Map 36-30	William L. MacLachlan and Deborah B. MacLachlan PO Box 1516 East Orleans, MA 02643	Book 4248 Page 214 Lot 1 Plan Book 240 Page 119
12 Nauset Farms Way Map 36-31	Kevin Crepeau and Heather Crepeau PO Box 239 East Orleans, MA 02643	Book 27766 Page 58 Lot 2 Plan Book 240 Page 119
20 Nauset Farms Way Map 36-32	Thomas W. Finan and Mary R. Finan PO Box 1046 East Orleans, MA 02643	Book 10515 Page 297 Lot 3 Plan Book 240 Page 119
22 Nauset Farms Way Map 36-33	Margaret Steiner, Susan Burks and Stewart Ellis Trustees of The Ellis Family Irrevocable Trust dated June 17, 2010 8840 Glen Ferry Drive Alpharetta, Georgia 30022	Book 25239 Page 195 Lot 4 Plan Book 240/119
23 Nauset Farms Way Map 36-34	Henry V. Spadaccia and Patricia Perry PO Box 1106 East Orleans, MA 02643	Book 12888 Page 339 Lot 5 Plan Book 240 Page 119

21 Nauset Farms Way Map 36-35	Lee H. Hendrickson 18 Coolidge Avenue Hingham, MA 02043	Book 24730 Page 146 Lot 6 Plan Book 240 Page 119
19 Nauset Farms Way Map 36-36	R. Curtis Morley and Joseph S. Morley, Trustees Morley Nauset Farms Way Nominee Trust 5 Chandler Drive Londonderry, NH 03053	Book 30020 Page 328 Lot 7 Plan Book 240 Page 119
15 Nauset Farms Way Map 36-37	Robert A. Morley c/o R. Curtis Morley 5 Chandler Drive Londonderry, NH 03053	Book 9490 Page 267 Lot 8 Plan Book 312 Page 85
9 Nauset Farms Way Map 36-38	John W. Trautwein, Trustee The John W. Trautwein 2017 Living Trust Amelia M. Trautwein, Trustee The Amelia M. Trautwein 2017 Living Trust PO Box 1372 East Orleans, MA 02643	Book 30792 Page 211 Lot 9 Plan Book 312 Page 85
Nauset Farms Way Nauset Farms Lane Beach Road Map 36-39	Nauset Farms Condominium Association Orleans, MA	Nauset Farms Condominium Master Deed and By-Laws Book 2565 Page 1 Plan Book 315 Page 55

	REVEREND TREAT ROAD	
PROPERTYADDRESS (ORLEANS, MA) / ASSESSOR MAP	**RECORD OWNER**	**DEED / CERTIFICATE/ PLAN REFERENCE**
5 Reverend Treat Road Map 35-112	Mark G. and Ruth A. Prall PO Box 34 East Orleans, MA 02643	Book 11696 Page 49 Plan Book 258 Page 69
6 Reverend Treat Road Map 35-110	Marjory M. Gill 6 Reverend Treat Road Orleans, MA 02653	Book 3293 Page 29 Lot 1 Plan Book 208 Page 5
14 Minister's Prim Map 35-111	John J. Lordan and Janice E. Lordan 301 Whitetail Drive Chagrin Falls, OH 44022	Book 1468 Page 864 Plan Book 236 Page 109
165 Main Street Map 35-108	Kristin Van Tassel 165 Main Street Orleans, MA 02653	Book 32088 Page 108 Lot 2 Plan Book 208 Page 5
169 Main Street Map 35-107	Anne B Kiefer PO Box 73 Orleans, MA 02653	Book 11159 Page 248 Pcl B Plan Book 204 Page 21

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PROPERTYADDRESS, (ORLEANS, MA)/ ASSESSOR MAP	BAXTER LANE RECORD OWNER	DEED / CERTIFICATE/ PLAN REFERENCE
12 Baxter Lane Map 43-11	Nancy E. Cronin, Trustee of the Nancy E. Cronin Revocable Trust 76 Powder Hill Road, Bedford, NH 03110	Book 33297 Page 39 ✓
15 Baxter Lane Map 43-120	Esther P. Lobo 15 Baxter Lane Orleans, MA 02653	Book 10911 Page 124 ✓ Plan Book 421 Page 54
11 Baxter Lane Map 43-121	Anson W. Clough and Nancy P. Clough PO Box 1076 East Orleans, MA 02643	Book 7350 Page 126 ✓
9 Baxter Lane Map 43-119	Lee W. Cable and Carol G. Cable 151 Wildcat Hill Road Harwinton, CT 06791	Book 25130 Page 94 ✓ Lot A Plan Book 51 Page 81
6 Baxter Lane Map 43-117	Donald Hodkoski 54 Brynmoor Court Goshen, CT 06756	Book 14958 Page 47 ✓
5A Baxter Lane Map 43-118	Donald Hodkoski 54 Brynmoor Court Goshen, CT 06756	Book 31560 Page 114 ✓ Lot 5 Plan Book 165 Page 21
7 Baxter Lane Map 43-122	David C. Massa, Trustee The David C. Massa Living Trust Agreement 12801 Martha Ann Drive Los Alamitos, CA 90720	Book 23217 Page 102 ✓
7 Baxter Lane Map 43-123	David C. Massa, Trustee The David C. Massa Living Trust Agreement 12801 Martha Ann Drive Los Alamitos, CA 90720	Book 23217 Page 102 ✓
5 Baxter Lane Map 43-124	James Grussing and Donna M. Dubuc 75 Bayberry Lane Manchester, NH 03104	Book 30012 Page 180 ✓
3 Baxter Lane Map 43-125	Bruce Armstrong and Kelly McCarthy 6 Damen Street Wayland, MA 01778	Book 33273 Page 4 ✓
43 Pochet Road Map 43-116	Pamela G. Stoeckert and William W. Stoeckert PO Box 1514 East Orleans, MA 02643	Book 25209 Page 45 ✓
1 Baxter Lane Map 43-126	Rebecca Putnam PO Box 89 East Orleans, MA 02643	Book 32444 Page 136 ✓ Lot 2 Plan Book 165/121

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	WHISTLE BERRY LANE	
PROPERTY ADDRESS (ORLEANS, MA) / ASSESSOR MAP	**RECORD OWNER**	**DEED/CERTIFICATE/PLAN**
191 Main Street Map 35-93	Nancy E. Dempze, Trustee Edward Notis-McConarty, Trustee HNK Realty Trust c/o Hemenway & Barnes 75 State Street, 16th Floor Boston, MA 02109	Book 23359 Page 133 Lot 2 Plan Book 194 Page 25
193 Main Street Map 35-94	James E. Dayton and Michele Dayton 193 Main Street Orleans, MA 02653	Book 28657 Page 217 Lot 1 Plan Book 194 Page 25

	20 Foot Way off MAIN STREET	
PROPERTY ADDRESS (ORLEANS, MA)/ ASSESSOR MAP	**RECORD OWNER**	**DEED/CERTIFICATE/PLAN**
197-A Main Street Map 35-90	Frances M. Davis, Life Estate PO Box 171 East Orleans, MA 02643 Remainder: Julia Christina Davis Hover Andrew Martin Davis Michael Davis	Book 34505 Page 69 Book 29246 Page 55 Lot B3 Plan Book 131 Page 129
197-B Main Street Map 35-91	Catherine Alekna PO Box 961 Orleans, MA 02653	Book 28495 Page 160 Lots B1 and B2 Plan Book 131 Page 129

BARNSTABLE REGISTRY OF DEEDS
John F. Meade, Register

BARNSTABLE COUNTY
REGISTRY OF DEEDS
A TRUE COPY, ATTEST
JOHN F. MEADE, REGISTER

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Archeological Report by Public Archeological Laboratory

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RECEIVED
OCT 27 2021
MASS. HIST. COMM
RC. 70581

APPENDIX A
MASSACHUSETTS HISTORICAL COMMISSION
220 MORRISSEY BOULEVARD
BOSTON, MASS 02125
617-727-8470, FAX: 617-727-5128

PROJECT NOTIFICATION FORM

Project Name: *Meetinghouse Pond Area Wastewater Collection System (MPAWCS)*

Location / Address: *Meetinghouse Pond Area*

City / Town: *Orleans, Massachusetts, MA*

Project Proponent

Name: *Town of Orleans*

Address: *c/o Thomas Parece, PE, AECOM, 9 Jonathan Bourne Drive*

City/Town/Zip/Telephone: *Pocasset, MA 02559*

After review of MHC files and the materials you submitted, it has been determined that this project is unlikely to affect significant historic or archaeological resources.
RC. 70581
11/16/21
Date
Jonathan K. Patton
Archaeological Preservation Planner
Massachusetts Historical Commission

Agency license or funding for the project (list all licenses, permits, approvals, grants or other entitlements being sought from state and federal agencies).

Agency Name:	*Type of License or funding (specify)*
Orleans DPW&NR	*Roadway Opening Permit*
Orleans Conservation Commission	*Wetlands Notice of Intent/Order of Conditions **
Massachusetts Historical Commission	*Certificate of Appropriateness*
MassDOT	*Roadway Opening Permit*
MassDEP	*Water Quality Permit*
MassDEP	*Plan and Specification Approval*
Massachusetts Natural Heritage	*Conservation Permit**
U.S. Army Corps of Engineers	*Programmatic General Permit **
U.S. EPA	*NPDES Permit for construction dewatering permit **
U.S. EPA	*NPDES Construction Genmeral Permit*

Project Description (narrative):

Utility Construction of a Sanitary Sewer Collection System in the Meetinghouse Pond Area of Orleans, MA to provide service to about 486 properties.
Construction will include the following:

- *About 15,750 Linear Feet of 8-inch through 12-inch PVC Gravity Sewer*
- *About 20,750 Linear Feet of 1.5 through 3-inch Low Pressure Sewer*
- *1 Submersible Pumping Station*
- *About 7,500 Linear Feet of 8-inch PVC Force Main*

The sewers will primarily be constructed within the previously disturbed roadway rights of way.

APPENDIX A (continued)

Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition. *No.*

Does the project include rehabilitation of any existing building? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation. *No.*

Does the project include new construction? If so, describe (attach plans and elevations if necessary).

Yes. The project includes sewer system improvements including the construction of three pump stations

To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact? *Yes.* **If so, specify.**

There are two historic districts with 53 historic properties listed within the MPAWCS, one of which is listed in the National Register of Historic Places (ORL.188 – Universalist Society Meetinghouse at 3 River Road). Another ten aboveground resourcers outside the district are located adjacent to proposed sewer lines.

There are 16 previously recorded pre-contact archaeological sites within one half mile of the MPAWCS project area. There is one post-contact archaeological site within one half mile of the MPAWCS project area. Only one of the 17 previously recorded sites (19-BR-209) falls along a proposed MPAWCS line. Other than its location at the northern-most part of Frostfish Cove (Meetinghouse Pond), little is known about this site (MHC site files).

What is the total acreage of the project area?

Woodland	acres	Productive Resources:	
Wetland	acres	Agriculture	acres
Floodplain	acres	Forestry	acres
Open Space	acres	Mining	acres
Developed	acres	Total Project Acreage 7.5	acres

What is the acreage of the proposed new construction? 7.5 acres

What is the present land use of the project area? *Residential and light commercial development*

Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location.
See attached.

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submiting this form A Peter Main Date: 10/25/21

Name: The Public Archaeology Laboratory, Inc.

Address: 26 Main Street

City / Town: Pawtucket, Rhode Island 02860

Telephone: 401-728-8780

REGULATORY AUTHORITY

930CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St.1988, c.254.

Public Archaeology Laboratory

October 25, 2021

Brona Simon
State Historic Preservation Officer
State Archaeologist
Executive Director
Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, Massachusetts 02125

Re: Meetinghouse Pond Area Wastewater Collection System
Orleans, Massachusetts
PAL #3316.02

Dear Ms. Simon:

Enclosed please find a Project Notification Form (PNF) for the above-referenced project, along with maps and a due diligence review report for your review and comment. The Town of Orleans is proposing to construct new sewer lines and a pump station in the Meetinghouse Pond Area. AECOM, on behalf of the Town of Orleans, has retained PAL to assist with cultural resource issues.

If you have any questions or need further information, please do not hesitate to contact Deborah C. Cox, President, or me, at your convenience.

Sincerely,

A. Peter Mair, II
Senior Archaeologist

Enclosures

cc: Reggie Donoghue, AECOM (w/encl. - via email)
Tom Parece, AECOM (w/encl. - via email)

26 Main Street Pawtucket, RI 02860 | 401.728.8780 Main | 401.728.8784 Fax
palinc.com

APPENDIX A (continued)

APPENDIX A
MASSACHUSETTS HISTORICAL COMMISSION
220 MORRISSEY BOULEVARD
BOSTON, MASS 02125
617-727-8470, FAX: 617-727-5128

PROJECT NOTIFICATION FORM

Project Name: *Meetinghouse Pond Area Wastewater Collection System (MPAWCS)*

Location / Address: *Meetinghouse Pond Area*

City / Town: *Orleans, Massachusetts, MA*

Project Proponent

Name: *Town of Orleans*

Address: *c/o Thomas Parece, PE, AECOM, 9 Jonathan Bourne Drive*

City/Town/Zip/Telephone: *Pocasset, MA 02559*

Agency license or funding for the project (list all licenses, permits, approvals, grants or other entitlements being sought from state and federal agencies).

Agency Name:	*Type of License or funding (specify)*
Orleans DPW&NR	*Roadway Opening Permit*
Orleans Conservation Commission	*Wetlands Notice of Intent/Order of Conditions **
Massachusetts Historical Commission	*Certificate of Appropriateness*
MassDOT	*Roadway Opening Permit*
MassDEP	*Water Quality Permit*
MassDEP	*Plan and Specification Approval*
Massachusetts Natural Heritage	*Conservation Permit**
U.S. Army Corps of Engineers	*Programmatic General Permit **
U.S. EPA	*NPDES Permit for construction dewatering permit **
U.S. EPA	*NPDES Construction Genmeral Permit*

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APPENDIX A (continued)

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Does the project include rehabilitation of any existing building? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation. *No.*

Does the project include new construction? If so, describe (attach plans and elevations if necessary).

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To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact? *Yes*. **If so, specify.**

There are two historic districts with 53 historic properties listed within the MPAWCS, one of which is listed in the National Register of Historic Places (ORL.188 – Universalist Society Meetinghouse at 3 River Road). Another ten aboveground resourcers outside the district are located adjacent to proposed sewer lines.

There are 16 previously recorded pre-contact archaeological sites within one half mile of the MPAWCS project area. There is one post-contact archaeological site within one half mile of the MPAWCS project area. Only one of the 17 previously recorded sites (19-BR-209) falls along a proposed MPAWCS line. Other than its location at the northern-most part of Frostfish Cove (Meetinghouse Pond), little is known about this site (MHC site files).

What is the total acreage of the project area?

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Floodplain	acres	Forestry	acres
Open Space	acres	Mining	acres
Developed	acres	Total Project Acreage 7.5	acres

What is the acreage of the proposed new construction? 7.5 acres

What is the present land use of the project area? *Residential and light commercial development*

Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location.
See attached.

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submiting this form A Peter Maiuoli Date: 10/25/21

Name: The Public Archaeology Laboratory, Inc.

Address: 26 Main Street

City / Town: Pawtucket, Rhode Island 02860

Telephone: 401-728-8780

REGULATORY AUTHORITY

930CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St.1988, c.254.

Memorandum
Meetinghouse Pond Area Wastewater Collection System Project
Orleans, Massachusetts

Cultural Resource Evaluation

September 29, 2021

Submitted to:

PAL Project #3316.02

AECOM
9 Jonathan Bourne Drive
Pocasset, MA 02559

In response to a request from AECOM, on behalf of the Town of Orleans, The Public Archaeology Laboratory, Inc. (PAL) has completed a cultural resources evaluation as part of the Meetinghouse Pond Area Wastewater Collection System Project (MPAWCS or the Project) in Orleans, Massachusetts (Figure 1).

The goal of the archaeological sensitivity assessment was to collect updated information about previously identified archaeological resources, document previous disturbance and existing conditions, and produce a detailed archaeological sensitivity assessment of the project areas. The assessment also includes recommendations on the need for and scope of additional archaeological investigations, if necessary. The survey will be designed to address Massachusetts Historical Commission (MHC) review and comment on the project, and to provide information necessary to facilitate project review under Section 106 of the National Historic Preservation Act of 1966 (as amended) (36 CFR 800) and M.G. L. Chapter 9, Sections 26-27c (950 CMR 70-71).

The cultural resources review included the collection of information about known cultural resources within the project's area of potential effect (APE), including historic and archaeological resources in the Massachusetts Cultural Resource Inventory System (MACRIS), and an assessment of existing conditions within the project area. The purpose of the work was to assemble information about previously documented historical resources within and near the project area and provide recommendations about significant archaeological sites that may be affected by the project. PAL compiled information about previously documented cultural resources and assessed the sensitivity of the project area for the potential to contain previously unrecorded archaeological sites.

This memorandum summarizes the results of the cultural resources evaluation and recommendations for archaeological monitoring during project construction work. The sensitivity assessment included background research and a walkover/drive-over field assessment of the project area.

Figure 1. Location of the Meetinghouse Area Wastewater Collection System Project on the Orleans USGS topographic quadrangle, 7.5 minute series.

Project Setting

The Project will include construction of sewer lines and one pump station in the Meetinghouse Pond area of Orleans. (Figure 2). The project area is primarily residential, with some small pockets of light commercial land-use. Major roads include Pond Road, Monument Road, Main Street, River Road, Great Oak Road, Beach Road, and Barley Neck Road. Many of the side streets off these main roads are private lanes. The topography of the project area is relatively flat to gently rolling with evidence of numerous small depressions that most likely are remnant kettle holes. Crystal Lake and Meetinghouse Pond lie to the south and several small ponds and wetland areas are present at the eastern end of the project area in the vicinity of Cole Place, Dermott Way and Mill Road. Soils in the project area are primarily well to excessively well drained Carver, Deerfield, Carver Hinesburg, Eastchop, Nantucket, and Plymouth coarse loamy sands. Interspersed among these soils are pockets of poorly drained Freetown and Swansea muck, Freetown coarse sand and Ipswich-Pawcatuck-Matunuck complex (USDA 1993).

Area of Potential Effect (APE) and Study Area

The Project's Area of Potential Effects (APE) is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist." A historic property is defined as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (National Register) maintained by the Secretary of the Interior" (36 CFR § 800.16(l)). The APE is defined based on the potential for effect, which may differ for aboveground resources (historic structures and landscapes) and subsurface resources (archaeological sites). The APE for archaeological sites is any areas of ground disturbances that may occur during constructing the proposed MPAWCS, including construction and staging areas.

The study area established for the purposes of the identification effort was broadly defined to provide information about the types of resources located within the vicinity of the Project. For archaeological resources, the study area encompassed one-half mile band around the Project. For historic architectural properties the study area was confined to abutting properties along the proposed routes of the Project (Figure 3). PAL compiled information about previously documented historic properties within the APE and Study Area and reviewed available information about project area conditions to provide recommendations regarding known and potential archaeological sites and historic aboveground properties that may be affected by the project.

Results of the Inventory File Review

The MHC site files list dozens of historic architectural properties and archaeological sites within the vicinity of the MPAWCS project area (Figure 3). The resources were identified through a search of the MHC's MACRIS.

Figure 2. Proposed Collection System Layout, Meetinghouse Pond Area Wastewater Collection System, Orleans, MA.

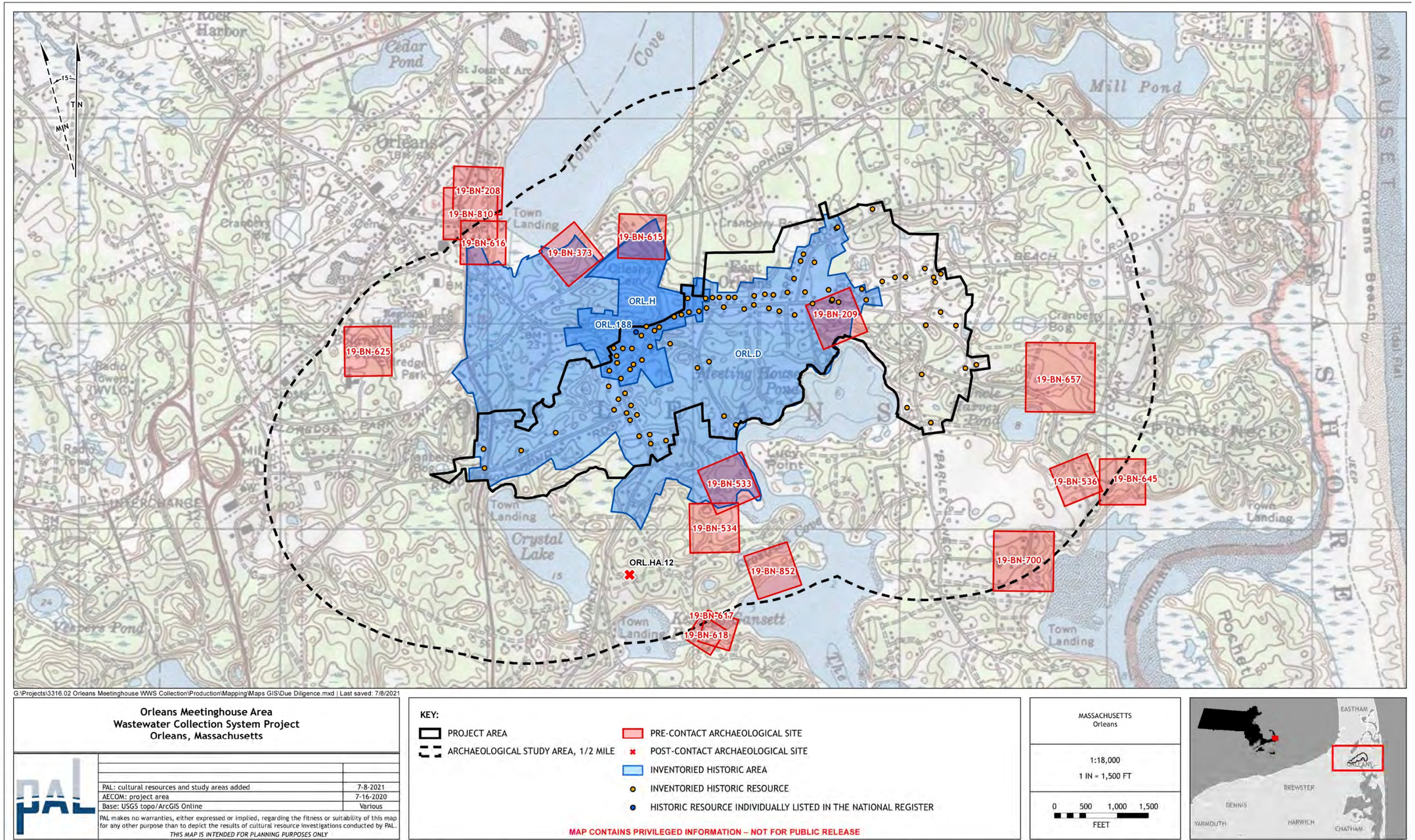

Figure 3. Recorded archaeological sites within a half-mile and inventoried historic aboveground resources within the Meetinghouse Area Wastewater Collection System Project Area on the Orleans, Massachusetts USGS topographic quadrangle, 7.5 minute series.

Architectural and Historic Resources

The MPAWCS encompasses portions of the Main Street, East Area (ORL.D) and the Orleans Village Area (ORL.H) (see Figure 3). The Main Street, East Area (ORL.D) covers over 100 acres and consists of residential, commercial, and civic structures. There are over 90 above ground resources within the district, 53 aboveground resources listed within the district are located on roads where sewer installation is proposed (Table 1; Figure 3). The Orleans Village Area (ORL.H) is an irregular shaped, 65-acre, densely developed, mixed-use area within the Main Street East Area (ORL.D). It consists of 34 buildings. One resource, Universalist Society Meetinghouse (ORL.188) on River Road, is listed in the National Register of Historic Places. Three war memorials (ORL.912, ORL.913, and ORL.914) fall within OMAWCS. Another 10 aboveground resources outside of the district are located adjacent to proposed sewer lines.

Table 1. Evaluated and Unevaluated Architectural Properties Recorded within the MPAWCS Project Area.

MHC #	Area	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.143	D	Mayo, Alexander House	128 South Orleans Rd	1850	Greek Revival
ORL.167	D & H	Orleans Universalist Church Parsonage	19 Monument Rd	1850	Greek Revival
ORL.168	D	Higgins, Daniel - Crosby, Edmund House	30 Monument Rd	1850	Federal; Greek Revival
ORL.169	D	Taylor, Joseph and Waters House	32 Monument Rd	1800	No style;
ORL.170	D	Hurd, Theophilus H. House	27 Monument Rd	1850	Greek Revival
ORL.171	D	Higgins, John H. House	33 Monument Rd	1800	No style
ORL.172	D	Taylor, Louise A. House	54 Pond Rd	1903	Victorian Eclectic
ORL.173	D	Higgins, Willard House	26 Pond Rd	1830	Greek Revival
ORL.174	D	Taylor, James House	14 Pond Rd	1810	Greek Revival
ORL.175	D	Taylor, Waters House	38 Monument Rd	1845	Greek Revival
ORL.176	D	Higgins House	40 Monument Rd	1830	Greek Revival
ORL.177	D	Higgins, John H. House	41 Monument Rd	1750	Colonial
ORL.178	D	Sherman, William House	44 Monument Rd	1870	Greek Revival
ORL.179	D	Higgins, Jonathan House	47 Monument Rd	1750	Colonial
ORL.180	D	Sherman, Samuel House	51 Monument Rd	1750	Colonial
ORL.181	D	Higgins, Arseno Barn	7 Gesner Rd	1875	No style
ORL.188*	D & H	Universalist Society Meetinghouse	3 River Rd	1834	Greek Revival
ORL.189	D & H	Orleans Primary School	19 School Rd	1923	Colonial Revival

MHC #	Area	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.190	D	Rock Harbor Academy	19 River Rd	1800	No style
ORL.191	D	Higgins, Jonathan House	39 River Rd	1840	No style
ORL.192	D	Orleans Congregational Church Parsonage	38 River Rd	1800	No style
ORL.194	D	Higgins, Thomas House	67 River Rd	1820	No style
ORL.196	D & H	South Parish Church	162 Main St	1829	Greek Revival; Queen Anne
ORL.197	D	Rogers, Ebenezer House	169 Main St	1870	No style
ORL.198	D	Mayo, Joseph Blacksmith Shop	170 Main St	1870	No style
ORL.199	D	Freeman, Orrin House	172 Main St	1895	Queen Anne
ORL.200	D	Snow, Jesse - Mayo, Freeman House	174 Main St	1835	No style
ORL.202	D	East Orleans Congregational Church Parsonage	204 Main St	1911	Colonial Revival
ORL.203	D	Mayo, Freeman House	178 Main St	1900	No style
ORL.204	D	Hopkins, Capt. John House	175 Main St	1850	Greek Revival
ORL.205	D	Snow, Winsor House	185 Main St	1853	Greek Revival
ORL.206	D	Mayo, Joseph House	187 Main St	1850	No style
ORL.207	D	Linnell, Solomon House	184 Main St	1870	Greek Revival
ORL.208	D	Crosby, Mary S. House	190 Main St	1890	Queen Anne
ORL.209	D	Doane, Capt. Seth P. House - Ivy Lodge	194 Main St	1870	Greek Revival
ORL.210	D	Crosby, Leander House	193 Main St	1865	Italianate
ORL.211	D	Doane, Capt. Truman House	195 Main St	1855	Greek Revival;
ORL.212	D	Kenrick, Alexander House	199 Main St	1860	Italianate;
ORL.213	D	East Orleans Congregational Church Parsonage	202 Main St	1835	Greek Revival
ORL.214	D	Atkins, Edward B. House	6 Great Oak Rd	1820	Federal
ORL.215	D	Small, Godfrey M. House	18 Great Oak Rd	1900	Victorian Eclectic
ORL.216	D	Crosby, Isaiah House	22 Great Oak Rd	1845	Greek Revival
ORL.217	D		21 Great Oak Rd	1810	No style
ORL.218	D	Nickerson, D House	36 Great Oak Rd	1855	No Style

MHC #	Area	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.219	D	Sparrow, Jesse C. Jr. House	209 Main St	1855	Greek Revival
ORL.220	D	Doane, Freeman House	216 Main St	1860	Greek Revival
ORL.221	D	Myrick, William General Store	217 Main St	1830	No style
ORL.222	D	Percival, Augustus House	219 Main St	1860	Greek Revival
ORL.223	D	Doane, Issac S. - Taylor, Capt. Joseph D. House	1 Beach Rd	1857	Second Empire
ORL.245	D	Crosby, Joshua - Higgins, Silvanus House	2 Beach Rd	1800	No style
ORL.246	D	Baker, Abijah Jr. House	38 Great Oak Rd	1810	No style
ORL.247		Doane, Seth P. House	52 Great Oak Rd	1790	Federal
ORL.258		Taylor House	54 Barley Neck Rd	1830	Greek Revival
ORL.284		Snow, Edmund House	30 Barley Neck Rd	1750	No style
ORL.287		Mayo, William C. House	67 Barley Neck Rd	1780	Federal
ORL.316		Doane, J. S. House	12 Pochet Rd	1800	No style
ORL.325		Young, Zenus House	16 Beach Rd	1850	Greek Revival
ORL.326		Cole, Josiah S. House	22 Beach Rd	1860	Greek Revival
ORL.327		Cummings, George W. - Hull, Thomas House	26 Beach Rd	1840	Victorian Gothic
ORL.330		Hopkins, Norman C. House	3 Larboard Ln	1920	Cape; No style
ORL.351	D	Ward, Benjamin House	101-105 Findley Rd	1820	Mo Style
ORL.412		Plimpton, Margery & Edna L. House	76 Barley Neck Road	1925	No Style
ORL.912	D	East Orleans Country Store Marker	217 Main St	1976	
ORL.913	D	Packet Landing Site Marker	River Rd	1976	
ORL.914	D & H	Orleans Civil War Marker	147 Main St	1950	
ORL.949	D & H	Dunham, Earl, Jr. Little League Field	19 School St	1981	
ORL. 1184	D & H		23 Monument Rd.	1985	
ORL.1185	D & H		157 Main St	1935	
ORL.1186	D & H		163 Main St	1973	

MHC #	Area	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.1187	D & H		165 Main St	1966	
ORL.1188	D & H		168 Main St	1925	
ORL.1193	D & H	Orleans Universalist Church Parsonage English Barn	19 Monument Road	1865	
ORL.1194	D & H		23 Monument Rd	1985	
ORL.1195	D & H		24 Monument Rd	1939	
ORL.1197	D & H	Hurd Chapel	3 River Rd/20 School St	1939	Colonial Revival
ORL.1198	D & H		10 River Rd	2015	
ORL.1199	D & H		5 School St	1989	
ORL.1200	D & H		9 School St	1978	
ORL.1201	D & H		23 School St	1935	

*Listed in the National Register of Historic Place, 02/25/1999

Archaeological Resources

Background research was conducted to assist with the archaeological sensitivity assessment and to develop predictive statements for the types of archaeological resources that may be present within the MPAWCS area. Background research for the project was accessed through the Orleans Historical Society's online archives, a review of MHC's cultural resource database, literature review, and a review of PAL's collection of resources from conducting extensive work on Cape Cod. Several sources of information in PAL's database relative to environmental and pre- and post-contact historic contexts for Orleans and Cape Cod were reviewed for information on known and expected archaeological resources (PAL 2016; Banister and Herbster 2015; Doucette 2017, 2018; Gillis and Herbster 2013; Herbster and Heitert 2011; Waller and Leveillee 2011). Cultural resource inventory files maintained at the MHC were also reviewed for updated information on known historic and archaeological resources in proximity to the project area (MHC 1984, 1987; Decima 1994; Decima et al. 1992; Edens 1995; Edens et al. 1995). Primary and secondary histories and historical maps and atlases were examined to assess changes in land use, to locate any documented structures, and to trace the development of transportation networks (an important variable in the location of post-contact archaeological sites). Town and regional histories, and historical maps and atlases were consulted to locate possible sites dating to the post-contact period within and close to the project area (Walker 1880, 1905, 1910; Walling 1857). Taken together, information from these various sources was used to arrive at a preliminary assessment of the archaeological sensitivity of the project area.

There are 16 Native American pre-contact archaeological sites recorded with MHC within one half mile of the MPAWCS area (see Figure 3; Table 2). There is one post-contact archaeological site (Keziah Lane [ORL.HA.12]) recorded within one half mile of the proposed project area. Only one of the 17 previously recorded sites (19-BR-209) falls along a proposed MPAWCS line. Other than its

location at the northern-most part of Frostfish Cove (Meetinghouse Pond), little is known about this site (MHC site files).

Table 2. Pre-Contact Archaeological Sites Recorded within One-Half Mile of the MPAWCS Project Area.

Site Name	MHC Site #	Temporal Period	Site Type
19-BN-208	Peter Hunts Site	Woodland	
19-BN-209			
19-BN-373	Fisk Farm Site		
19-BN-533	Rattle	Late Archaic	
19-BN-534	Henson		
19-BN-536	Lane Site	Late Archaic Early Woodland	Flake scatter
19-BN-615	Cemetery Site	Late Archaic	
19-BN-616	Estlin Site	Late Archaic Transitional Archaic	
19-BN-617		Late Woodland	Shell Midden
19-BN-618			Camp site/lithic workshop
19-BN-625	Orleans Elementary School		Habitation site
19-BN-645	Wilson Site	Woodland	Shell Midden
19-BN-657	Krusen/Rainey Site	Middle & Late Woodland	Shell Midden
19-BN-700	Briar Springs Road Site	Late Woodland/ Contact	Burial Site. Shell Midden
19-BN-810	Franz Site	Late Woodland/ Contact	Burial/Habitation Site, Shell Midden
19-BN-852	Kent's Point	Late Archaic Middle & Late Woodland	Habitation Site

*Site recorded within the project area.

Geotechnical Data and Soil Boring Logs

Information on belowground disturbance within the project area, including geotechnical data and soil boring logs, was also reviewed to help refine the sensitivity (Figure 4). Logs from a total of 184 borings showed profiles of coarse sands and silt beneath existing pavement.

Field Review

A walkover/drive-over field assessment of the MPAWCS project area was conducted to examine and document the existing physical condition of the project area, to assess the integrity of the ground surface, to collect data about the current environmental setting, and to look for any surface indications of archaeological sites. During the field assessment all roads that will be impacted by the proposed sewer line construction as well as the proposed pump station location were reviewed. Most of the project's impact areas are located within and below paved roads (Photographs 1 & 2). Exceptions to

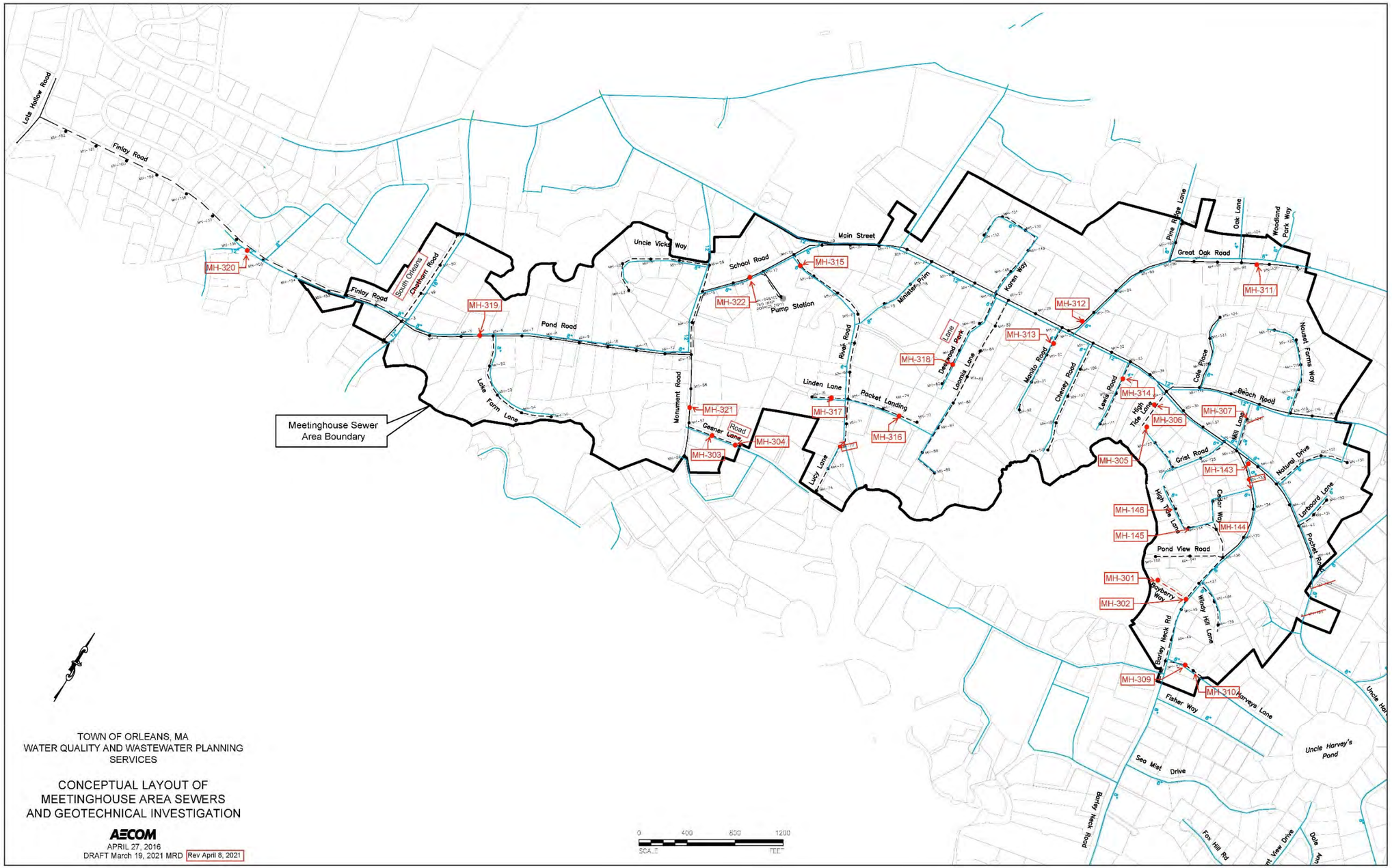

Figure 4. Location of soil borings for geotechnical investigation, Meetinghouse Pond Area Wastewater Collection System, Orleans, MA.

this include, Minister Prim Way, Loomis Lane, Cole Place, portions of Nauset Farm Way, and Uncle Vicks Way (broken pavement) (Photograph 3 & 4). The majority of roads have utilities, including water mains that range from 3 inches to 16 inches in diameter, gas lines, and stormwater drainage.

Photograph 1. Main Street approaching Lewis Lane, view looking west.

Photograph 2. Linden Lane, view looking west.

Photograph 3. Cedar Way, View looking north.

Photograph 4. Loomis Lane, view looking south.

No evidence of archaeological sites was observed on the ground surface during the field assessment. Areas of disturbance, such as sand pits or quarries, or areas of recognizable grading, were not visible during the field assessment to suggest that the soils beneath the roads have been displaced, however, it is likely that utilities in the Orleans Meetinghouse area, and landscaping and utilities in the new residential areas has resulted in some disturbance.

Archaeological Sensitivity

Results of the inventory file review and field assessment were used to develop a sensitivity ranking and predictive statements concerning the potential for the presence of Native American and EuroAmerican cultural resources. Native American archaeological sensitivity was determined by assessing key environmental attributes, the presence of documented cultural resources in and adjacent to the project area, and the degree of disturbance (Table 3). Key environmental attributes are proximity to fresh or salt water, well-drained soils, and level topography. EuroAmerican archaeological sensitivity is determined by assessing information collected during the background research and walkover. Numerous large-scale surveys have determined that historic EuroAmerican sites are not directly correlated with specific environmental variables and that documentary information is not always accurate. As a result, documentary research used in conjunction with an evaluation of the physical condition of a project area and the presence of visible sites is the most useful approach to determining the sensitivity of a project area.

Table 3. Archaeological Sensitivity Ranking.

Presence of Sites		Proximity to Favorable Cultural/Environmental Characteristics			Degree of Disturbance			Sensitivity Ranking
Known	Unknown	< 150 m	≥ 150 ≤ 500 m	> 500 m	None/Minimal	Moderate	Extensive	
•		•			•			High
•		•				•		High
•		•					•	Low
•			•		•			High
•			•			•		High
•			•				•	Low
•				•	•			High
•				•		•		High
•				•			•	Low
	•	•			•			High
	•	•				•		Moderate
	•	•					•	Low
	•		•		•			Moderate
	•		•			•		Moderate
	•		•				•	Low
	•			•	•			Moderate
	•			•		•		Low
	•			•			•	Low

The information collected during the field review was used to refine the preliminary sensitivity assessment of the project area and to stratify the MPAWCS project impact areas into zones of high/moderate or low archaeological sensitivity (Table 4, Figure 5). Overall, portions of the MPAWCS project area are archaeologically sensitive for Native American sites dating to the Pre-Contact, Contact, and early Post-Contact periods (ca. 8000 to 300 B.P.) (see Figure 5). The majority of the monitoring is confined to streets in the eastern limits of the project area because of sandy, well-drained soils adjacent to the shoreline and freshwater wetlands, former kettle holes, and by the presence of a previously recorded archaeological site. Archaeological evidence of pre-contact period Native American activity could include subsistence-related features such as hearths, food storage/disposal pits, living areas including post molds, lithic workshops, and diagnostic chipped and ground stone tool assemblages. Expected pre-contact site types would include base camps, or logistic field camps and foraging locations in proximity to these topographic features where seasonally available (waterfowl, fish) resources could be assured. There is also the potential for burial sites.

The EuroAmerican post-contact archaeological sensitivity for land use is moderate to low. While many of the side streets are of more recent origin, the sewer lines run through some of the earliest roadways in Orleans: Pond Road, Monument Road, School Street, Main Street, River Road, Great Oak Road, Beach Road, Barley Neck Road. However, much of Orleans consisted of pasture and agricultural land up until residential development began in the mid-twentieth century.

Recommendations

Because construction in these linear utility line areas will occur under and within paved and active roadways, where hand-testing is not possible, PAL recommends archaeological monitoring of construction in the high sensitivity areas. The archaeological monitoring will be conducted under an archaeological permit issued by the State Archaeologist's office at the MHC and in compliance with M.G.L. c. 9, ss. 26-27 C (950 CMR 70). In addition, PAL recommends coordinating with the Mashpee Wampanoag and Wampanoag Tribe of Gay Head/Aquinnah (WTGH/A) Tribal Historic Preservation Officers (THPOs) regarding the proposed project schedule, so that a tribal cultural resource monitor can be present during the fieldwork portion of the project. The THPOs will also be consulted for information that may assist with the archaeological investigations. Informant interviews may also be conducted to gather more information about reported sites and/or cultural resources in the project vicinity.

The goal of the archaeological monitoring will be to ensure that if any significant archaeological resources, including human remains and/or burials, are exposed during the construction activities that they are treated appropriately in accordance with the Massachusetts Unmarked Burial Law (M.G.L. c. 7 s. 38A; c. 9, ss. 26A & 27C; c. 38, s. 6; and c. 114, s. 17, as amended by Chapter 659 of the Acts of 1983, Chapter 386 of the Acts of 1989, and Chapter 140 of the Acts 2003). The monitoring will involve the close visual examination of exposed subsoils to identify any potential archaeological deposits and/or human remains that may be located within construction impact areas. Having a representative from the Mashpee Wampanoag Tribe and/or WTGH/A on-site, as well as an experienced archaeologist, during the construction process to determine the significance of a soil anomaly or artifact/s immediately will enable the project proponent to move forward and avoid work stoppage situations.

Table 4. Summary of roadway conditions, recommendations for archaeological monitoring.

Street	Condition	Utilities	Sensitivity	Monitor
Finlay Road	Paved	X	Low	No
Chatham Road	Paved	X	Low	No
Pond Road	Paved	X	Low	No
Lake Farm Lane	Paved	X	Low	No
Monument Road	Paved	X	Low	No
Uncle Vicks Way	**Broken Pavement**	**X**	**Moderate**	**Yes**
School Road	Paved	X	Low	No
River Road	Paved	X	Low	No
Linden Lane	Paved	X	Low	No
Packet Landing	Paved	X	Low	No
Lucy Lane	**Unpaved**	**X**	**High**	**Yes**
Main Street	Paved	X	Low	No
Minister Prim	**Unpaved**	**X**	**Moderate**	**Yes**
Karen Way	Paved	X	Low	No
Deerwood Lane	Paved	X	Low	No
Loomis Lane	**Unpaved**	**X**	**Moderate**	**Yes**
Manito Road	**Paved**	**X**	**High**	**Yes**
Cheney Road	**Paved**	**X**	**High**	**Yes**
Lewis Road	**Paved**	**X**	**High**	**Yes**
High Tide Lane	**Paved**		**High**	**Yes**
Grist Road	**Paved**	**X**	**High**	**Yes**
Barley Neck Road	**Paved**	**X**	**High**	**Yes**
Cedar Way	**Unpaved**	**X**	**High**	**Yes**
Pond View Road	**Unpaved**		**High**	**Yes**
Windy Hill Lane	**Paved**	**X**	**High**	**Yes**
Bayberry Way	**Unpaved**		**High**	**Yes**
Harveys Lane	**Paved**	**X**	**High**	**Yes**
Great Oak Road	Paved	X	Low	No
Pine Ridge Lane	**Paved**	**X**	**High**	**Yes**
Oak Lane	Paved	X	Low	No
Beach Road	Paved	X	Low	No
Cole Place	**Unpaved**	**X**	**High**	**Yes**
Nauset Farms Way	**Paved**	**X**	**Moderate**	**Yes**
Mill Lane	**Paved**	**X**	**Moderate**	**Yes**
Pochet Road	**Paved**	**X**	**Moderate**	**Yes**
Natural Drive	**Paved**	**X**	**Moderate**	**Yes**
Larboard Lane	Paved	X	Low	No
Pump Station	**Unpaved**		**High**	**Yes**

Because potentially significant pre- and/or post-contact archaeological deposits could be present beneath the existing roadways and/or other paved areas that have been assigned low archaeological sensitivity, **PAL also recommends that the proponent develop a Post-Review Discoveries Plan, or, an Unanticipated Discoveries Plan (UDP), to formalize procedures guiding the discovery of any significant cultural resources and/or evidence of human remains during construction.** The Plan will be developed in consultation with the MHC, and in accordance with the Unmarked Burial Law, and would be designed to limit construction work stoppages by providing cultural resource training to construction personnel and streamlining notification and action plans for unanticipated discoveries, such as burials.

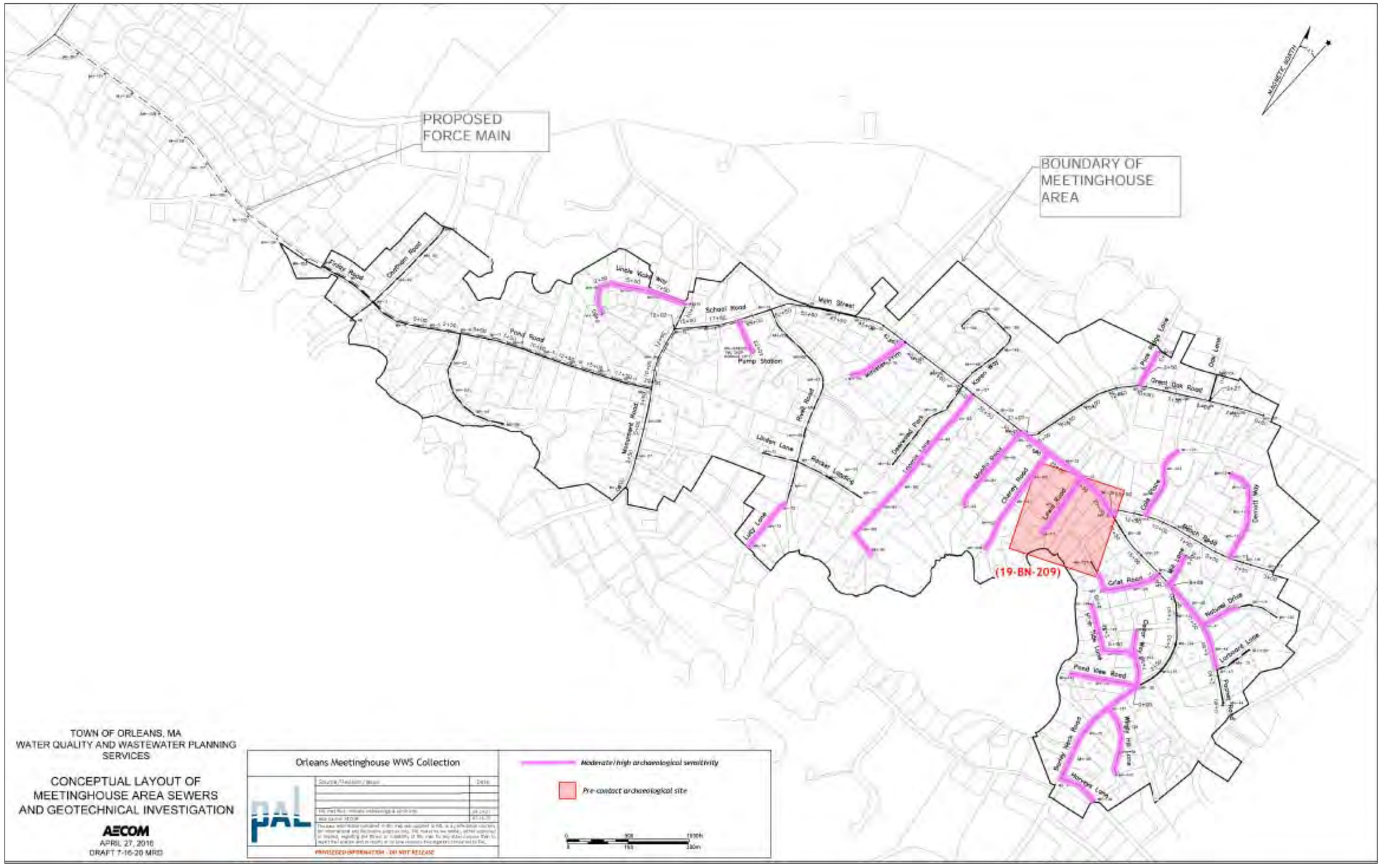

Figure 5. Recorded archaeological site and archaeological sensitivity, Meetinghouse Area Wastewater Collection System, Orleans, MA.

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SPECIAL CONDITIONS - MASSDEP POLICY MEMORANDA

Policy Memorandum No. CG-1	Easements and Rights-of-Way
Policy Memorandum No. CG-2	Permits
Policy Memorandum No. CG-3	Field Controls
Policy Memorandum No. CG-4	Record Drawings
Policy Memorandum No. CG-5	Plan Scale
Policy Memorandum No. CG-6	Borings Logs
Policy Memorandum No. CG-7	Breakdown of Bid Items
Policy Memorandum No. CG-8	Pavement
Policy Memorandum No. CG-9	Pipe Testing
Policy Memorandum No. CG-10	Change Orders
Policy Memorandum No. CG-11	Utility Relocation
Policy Memorandum No. CG-12	Refundable Deposits for Plans and Specifications
Policy Memorandum No. CG-13	Bid Opening Procedures
Policy Memorandum No. CG-14	Payment for Rock Excavation
Policy Memorandum No. CG-15	Traffic Police
Policy Memorandum No. CG-16	Documentation Required to Substantiate Contract Quantities
Policy 88-02	Policy for Review of Sewer Line/Water Supply Protection

Exceptions:

A. Policy Memorandum No. CG-9 Pipe Testing.

1. Under this Contract only seventy-five (75) percent of the price bid per linear foot of pipeline shall be paid for upon its installation, the balance shall be withheld until such time as pipeline has been successfully tested and accepted by the Owner and the site(s) has been fully restored. This percentage is exclusive of normal Contract retainage.

B. Policy Memorandum No. CG-10 Change Orders

1. Paragraph B., item (5.), delete the number 20% and insert the number 15%.
2. Paragraph B., item (6.), delete the number 7-1/2% and insert the number 5%.

C. Policy Memorandum No. CG-14 Payment for Rock Excavation

1. Under this Contract, Rock and/or Boulder Excavation shall be paid as defined in SECTION 01025, MEASUREMENT AND PAYMENT.

COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS

DEPARTMENT OF ENVIRONMENTAL PROTECTION

ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF RESOURCE PROTECTION

DIVISION OF MUNICIPAL SERVICES POLICIES

The Division of Municipal Services (DMS) has established the following policies for all Division financially-assisted projects.

POLICY MEMORANDUM NO. CG-1 EASEMENTS AND RIGHTS OF WAY

Prior to the approval of financial assistance for construction, the owner shall obtain and shall thereafter retain, a fee simple or such estate or interest in the site of construction and rights of access as will assure undisturbed use and possession for the purpose of construction and operation for the estimated life of the project. The Division may refuse to approve financial assistance until it has received from the owner sufficient assurances that such interests have been obtained. Unless the Division otherwise notifies the owner, the certificate (under pains and penalties of perjury) of the owner's legal representative shall constitute such sufficient assurance.

Additional cost which result from interruptions of construction or extensions of contract time caused by the owner's failure to obtain the necessary interests in land shall be ineligible for financial assistance, and all such additional costs shall be borne by the owner.

POLICY MEMORANDUM NO. CG-2 PERMITS

The owner shall be responsible for identifying and obtaining all federal, state, local and railroad permits required by the nature and location of construction, including but not limited to building construction permits and permits for street and highway cuts and openings, and all such permits shall be listed in a separate permits section of the contract documents. To the extent possible, such permits shall be obtained by the owner prior to the solicitation of bids for construction, and copies of all permits so obtained shall be included in the said permits section. The status of the application for each permit, including the permit conditions, and costs, not obtained prior to the solicitation of bids shall also be indicated in the contract documents permits section. The Division may refuse to approve financial assistance for construction unless and until it has received from the owner sufficient assurances that all necessary permits have been or will be obtained prior to the commencement of construction.

The contractor shall be responsible for obtaining all permits required of his equipment, work force, or particular operations (such as blasting) in the performance of the contract and not otherwise specified in the two preceding paragraphs as to be obtained by the owner. These permit fees shall be paid by the contractor.

The owner shall be responsible for the payment of all other permit fees required by the construction.

The following permits shall not be eligible for financial participation by the Department of Environmental Protection (DEP).

- Permits and insurance for construction in railroads' rights of way;
- Building permits;
- Permits for opening public streets and other public or municipal rights of way;
- Permits for the use of explosives;
- Permits for the disposal of waste materials; and
- Permits and fees for connecting to municipal utilities.

Permits required by extraordinary circumstances and not specifically excluded from eligibility above may be eligible for DEP participation. For such permits to be so eligible, the owner or his representative must notify the DEP project engineer in advance of obtaining such permit and receive from the engineer specific agreement that such permit will be eligible for DEP participation. Eligibility for such participation will not be made retroactively.

Additional costs which result from interruptions of construction or extensions of contract time resulting from the owner's or the contractor's failure to obtain the necessary permits may be ineligible for participation.

POLICY MEMORANDUM NO. CG-3 FIELD CONTROLS

The Owner shall be responsible for indicating on the contract drawings all easement limits and all property and other control lines for locating the principal component parts of the work together with those elevations and bench marks used in the design of the work, all hereinafter referred to as "field controls". Where easement and property limits have not previously been established in the field, the owner shall be responsible for establishment of such limits. From the information provided by the Owner, unless otherwise specified, the Contractor shall develop and make all layouts required for construction, such as slope stakes, batter boards, stakes for pipe locations and other working points, lines, elevations and cut sheets.

Whenever he has reason to believe that an error exists or whenever he is otherwise unable to locate the field controls, the contractor shall promptly notify the owner and the owner's engineer of such error with appropriate documentation.

POLICY MEMORANDUM NO. CG-4 RECORD DRAWINGS

The Owner shall be responsible for the preparation of all record drawings required by this contract. This responsibility may be delegated to the Owner's representative. The responsibility for preparation of record drawings shall not be delegated or transferred to the contractor. They may use the contractor's and sub-contractor's certified AS BUILT drawings along with their own marked up set in the preparation of the Record Drawings.

Division approved contract drawings shall be revised upon completion of the contract to reflect any changes made and/or final quantities, as appropriate.

POLICY MEMORANDUM NO. CG-5 PLAN SCALE

Unless otherwise approved in advance by the Division, the horizontal scale for construction plans for non-structural facilities shall be 1" = 40'. A larger horizontal scale shall be used where appropriate to show sufficient detail to construct the project. The vertical scale for construction plans for non-structural facilities shall be 1" = 4'. Based on the best information available at the time of their preparation, the location of underground utilities and support structures for overhead utilities shall be shown on the plans.

Unless otherwise exempted in advance by the Division, construction plans shall be updated whenever the date of the advertisement for bids for the construction of such facilities is more than one year after the date of approval by the Division or EPA; and in the case of approval by both such agencies, the later approval date shall be used in determining the need for update.

The consulting engineer shall receive adequate compensation for updating plans and specifications, and such additional cost shall be eligible for assistance to the extent not otherwise prohibited by USEPA and Division regulations and program guidance.

All revision, or review without need for revision, shall be noted and dated on the plans prior to advertisement of the project for bid.

POLICY MEMORANDUM NO. CG-6 BORINGS LOGS

All soil borings shall be taken as close as practicable to the construction line, and the location of all such borings shall be clearly indicated on the contract drawings. The plan view shall show the location and boring number of each boring. The profile view shall show the location, elevation, and depth of each soil boring, the location of each change in soil stratum, the groundwater level, and the average of blow counts at each five foot interval. As a minimum, boring logs to be submitted with the plans and specifications shall show the name of the company taking the borings, the soil classification, the number of blows per foot of penetration, the groundwater elevation, and the date on which the borings were taken.

As part of the submission of plans and specification for approval, the owner's representative shall include written justification for the lesser frequency and depth of borings where their interval is more than approximately 300' or their depth is less than 50% below depth of pipe invert.

POLICY MEMORANDUM NO. CG-7 BREAKDOWN OF BID ITEMS

The following items shall, where applicable, be listed separately in the bid documents.

1. Mobilization

2. Pavement

a. Municipal
i. temporary
ii. permanent

b. State
i. temporary
ii. permanent

3. Concrete cradle or encasement (to be identified where applicable)

4. Rock-Excavation

5. Wood or steel sheeting left in place

6. Excavation of unsuitable materials below grade

7. Select and/or borrow material

8. Dewatering

9. Special Dewatering (coffer dam)

Mobilization costs are the costs of initiating the contract, exclusive of the cost of materials. Payment for mobilization shall be a lump sum at the price bid for this item in the proposal and shall be payable when the contractor is operational on the site. For purposes of this policy, "operational" shall mean the substantial commencement of work on site.

The lump sum price bid for mobilization shall not exceed five per centum (5%) of the total amount of the bid.

POLICY MEMORANDUM NO. CG-8 PAVEMENT

All roads and trenches therein shall be refilled and repaved in accordance with specifications provided by the owner in the contract documents. Please note that this policy may be excludable on Federally assisted projects where bid alternative items may be required (i.e. trench width vs. full width pavement). You are advised to seek project specific clarification.

Loan eligibility shall be limited to the following:

A. Where the depth of the pipe invert is 0 to 8', the maximum pavement widths which shall be eligible for financial assistance are as follows:

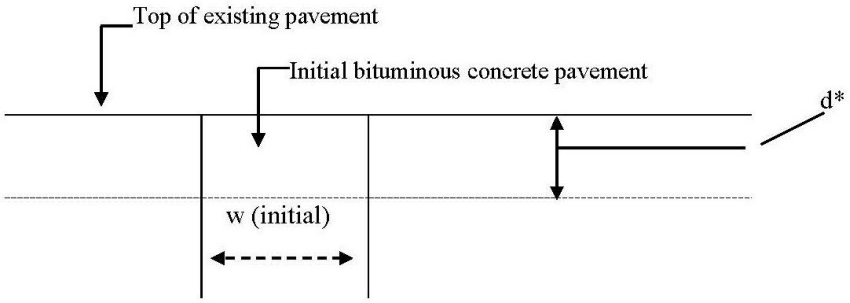
Nominal Pipe Diameter	Maximum Eligible Widths	
	Initial Pavement	Permanent Trench
0-24"	6'-6"	8'-6"

Where the nominal pipe diameter is greater than 24" the maximum eligible width for Initial re-paving shall be the nominal diameter of the pipe plus four (4) feet, and for permanent trench re-paving the maximum eligible width shall be the nominal pipe diameter plus six (6) feet.

B. For each additional four (4) feet (or fraction thereof) of pipe invert depth, add three feet to the eligible width limits stated in paragraph A.

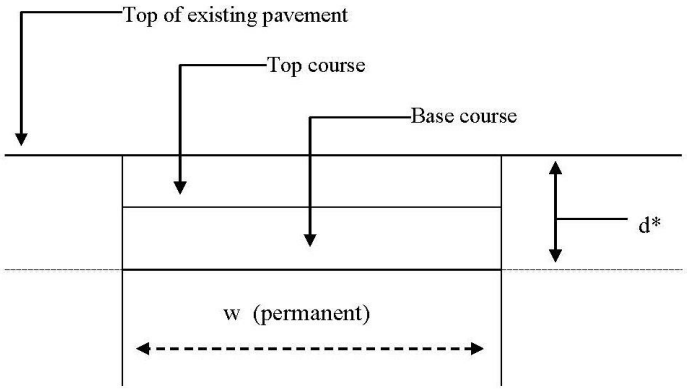
At the design phase of a project the owner has the option to elect either Initial Pavement with Option I (Permanent Trench replacement) or Initial with Option II (curb to curb over initial)

Initial Pavement



d*= depth of existing pavement to a maximum of 3 inches (see general notes #3)
w = maximum eligible Initial pavement width as described in paragraphs "A" & "B" on page DEP-DMS-CG's-P4.

OPTION I Permanent Trench Pavement

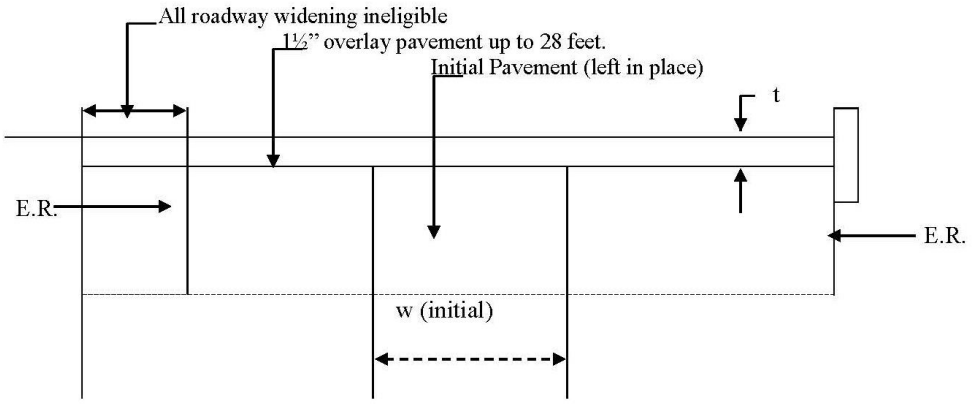


d*= depth of existing pavement trench to a maximum of 3 inches (see general notes #3)
w = maximum eligible permanent pavement width as described in paragraphs "A" & "B". equals initial width plus 2 feet and includes:

- Cutting edges for the permanent trench
- Removal of initial patch plus two feet of existing pavement
- Fine grading/compacting gravel
- Placement of Permanent Trench pavement in two courses.

POLICY

OPTION II Curb to Curb Pavement (overlay pavement for roadways up to 28 feet)



E.R.= edge of existing paved roadway
t = one and one half inch (1½") overlay of bituminous concrete pavement

GENERAL NOTES:

1. Repavement of settled areas and crown restoration within the trench limits shall be the responsibility of the contractor.
2. Leveling outside the trench limits shall be the responsibility of the owner.
3. Sewer trench re-fill and pavement re-paving on public ways under the jurisdiction of the Massachusetts Department of Public Works, the Metropolitan District Commission, or other such agency shall be in accordance with permit(s) issued therefor by that Department or Commission, as the case may be.
4. The Division will consider requests for increase in the participating pay limits defined in paragraphs A and B, when such increases are, in the Division's opinion, reasonable. Such requests should be documented in writing and submitted to the Division in a timely manner.
5. Projects which deviate from the above options are required to seek Division review and approval.

MEMORANDUM NO. CG-9 PIPE TESTING

Monthly payment estimates shall be prepared in accordance with contract documents. All pipe shall be tested in accordance with the contract documents and sound engineering practice. If, after 60 days following submission of a monthly payment estimate for pipe items, the pipe for which payment is requested has not been successfully tested, the owner may withhold up to 10% of the amount requested for such pipe items until the pipe has been so tested. However, in the case of a major (pipe diameter 24 inches or greater) interceptor pipe installation, sums retained by the owner pursuant to this policy memorandum shall not exceed two per centum (2%) of the costs of such pipe items.

POLICY MEMORANDUM NO. CG-10 CHANGE ORDERS

Executed change orders submitted to the Division for review and processing for financial assistance must be prepared on the attached Change Order Forms (CG-10, Attachment 1, pages A-1 & A-2) with a duplicate copy, calculation sheet(s) (CG-10, Attachment 2), and all other supporting documentation necessary for evaluation. Failure to comply with these instructions will result in delays in processing the change order and/or limited financial assistance.

M.G.L. c.44, s.31C requires that the auditor, accountant, or other municipal officer having similar duties must certify that adequate funding in an amount sufficient to cover the total cost of the change order has been made. Change orders will not be processed or approved until this certification is made on the face of the Change Order Form (CG-10 Attachment 1).

Payment of Change Orders:

Payment of all change orders shall be in accordance with the relevant provisions of Massachusetts General laws, Chapter 30, Section 39G for non-building construction and Section 39K for building construction.

Payment of change orders shall be made in accordance with one of the following three methods:

A. Existing unit prices as set forth in the contract; or

B. Agreed upon lump sum or unit prices; or

C. Time and materials

A. Payment for work for which there is a unit price in the contract:

Where the contract contains a unit price for work and the Engineer orders a change for work of the same kind as other work contained in the contract and is performed under similar physical conditions, the contractor may accept full and final payment at the contract unit price(s) for the acceptable quantities.

B. Payment for work or materials for which no price is contained in the contract:

If the Engineer directs, the contractor shall submit promptly in writing to the Engineer and offer to do the required work on a lump sum or unit price basis, as specified by the Engineer. The stated price, either lump sum or unit price, shall be divided so as to show that it is the sum of:

(1) The estimated cost of labor, plus

(2) Direct Labor Cost, plus

(3) Material and Freight Costs, plus

(4) Equipment Costs, plus

(5) An amount not to exceed 20% of the sum of items (1) through (4) for overhead and profit, plus (if applicable),

(6) In the case of work done by a subcontractor and amount not to exceed 7 ½ %, for the general contractor of the sum of items (1) through (4) for his overhead and profit, less, if applicable,

(7) Credits for work deleted from the contract.

C. Payment for work on a time and materials basis:

Unless an agreed lump sum and/or unit price is obtained from above and is so stated in the change price, the contractor shall accept as full payment for which no other agreement is contained in contract, and amount equal to:

(1) The estimated cost of Labor, plus

(2) Direct Labor Cost, plus

(3) Material and Freight Costs, plus

(4) Equipment Costs, plus

(5) An amount not to exceed 20% of the sum of items (1) through (4) for overhead and profit, plus (if applicable),

(6) In the case of work done by a subcontractor and amount not to exceed 7 ½ %, for the general contractor of the sum of items (1) through (4) for his overhead and profit, less, if applicable,

(7) Credits for work deleted from the contract.

Explanation of items (1) through (7) as outlined in "B" and "C":

(1) Labor – Only those workers employed on the project who are doing the extra work, including the foreman in charge, are allowable. General foremen, superintendents, or other supervisory personnel are considered to be included in the overhead markup as provided in items (5) and/or (6). Hourly labor rates in excess of those as listed in the contract wage rates (Federal or State, whichever applies require documentation. As a minimum, an explanation and the appropriate copy of the certified payroll are required.

(2) Direct Labor Costs - These costs are limited to those which are required in the contract document. Coverage in excess of the contract provisions, secured by the contractor/subcontractor(s) at his option, are ineligible for financial assistance. The following list of typical direct labor charges is provided for your assistance and is in no way intended to be complete or all encompassing:

- Workman's Compensation
- Federal/State: Social Security Tax and Unemployment Tax;
- Health, Welfare and Pension Benefits; (this cost is included in the wage rates appearing in the Mass. Wage Rates of the contract specifications)
- Liability Insurance: Bodily Injury; Excess Umbrella; Property damage; Public Liability
- Blasters Insurance
- Builders Risk Insurance
- Experience Modification Insurance
- Surcharges

If applied to any required direct labor costs.

Following award and prior to execution of a construction contract, the contractor and filed sub-bidders (where applicable) shall submit for review by the owner, documentation to establish the Direct Labor Cost percentage(s) (Direct Labor markup percentage(s)).

The documented direct labor markup for this contract may be adjusted on an annual basis as measured from the date the contract is executed. The contract agreement will provide for the establishment of the Direct Labor Cost percentage.

(3) Material and Freight – Only those materials required as a result of the change order and reasonable freight charges for delivery of same are allowable.

(4) Equipment – Only the equipment required as a result of the change order is allowable. Equipment rental rates shall be governed by the current Nielson/Dataquest Rental Rate bluebook for Construction Equipment (the "Bluebook"). In determining the rental rate the following shall apply:

(a) For equipment already on the project – the monthly prorated rental rate by the hourly use shall be applicable;

(b) For equipment not on the project the daily rate, the weekly rate, or monthly rate will prevail, whichever will prove to be most cost effective. Small tools and manual equipment are examples of costs not allowable under this item. These costs are considered to be included in the overhead markup as provided in items (5) and/or (6)

(1 month (normal use) = 176 hours)

(5) & (6) Overhead and Profit – All other costs not previously mentioned are considered to be included in this item, be it for the general contractor or subcontractor(s).

(7) Credits – Work deleted, material and equipment removed from the contractor, stored and/or returned shall be credited to the cost of the change order, less costs.

The Contractor shall furnish itemized statements of the cost of the work ordered and shall give the Engineer access to all accounts, bills and vouchers relating thereto; and unless the Contractor shall furnish such itemized statements, and access to all accounts, bills and vouchers, he shall not be entitled to payment for any items of extra work for which such information is sought by the Engineer. Deviations from any of the above will be reviewed for financial assistance on a case-by-case basis.

The change order will be prepared in such manner as to clearly separate Eligible and Ineligible Costs.

Attachment 1 Page A-1

CHANGE ORDER FORM

SRF Number _____

Public Entity _____

Contract Number _____

Change Order Number _____

Contract Amount (As Bid) $ _____

Net Change in Contract Price (this change order) $ _____

Total Adjusted Contract Price (including this and all other change orders) $ _____

This change order extends the time to complete the work by _____ calendar days.

The extended completion date is _____

This change order checked by _____ _____
(Chief) Resident Engineer Date

This change order is requested by: _____

This change order is recommended by: _____

_____ _____ _____
Consultant Engineer P.E. Number Date

The undersigned agree to the terms of the change order.

_____ _____
Contractor Date

_____ _____
Owner Date

Certification of Appropriation under M.G.L. c.44, §31C: Adequate funding in an amount sufficient to cover the total cost of this change order is available.

By: _____ _____
Certification Officer (Auditor, accountant, treasurer) Date

0Do not write below: this space reserved for STATE AGENCY APPROVAL

1DEP/DMS

Attachment 1 Page A-2

CHANGE ORDER FORM (Continued)

2Public Entity _____

SRF No: _____ Contract No. _____ Change Order No. _____

3Contract Title: _____

4Owner's Name: _____

5Owner's Address: _____

6Contractor's Name: _____

7Contractor's Address: _____

Description of Change

Reason for Change

Attachment 2 - Page B-1

CALCULATION SHEET

(1)	Labor			
	Foreman	10 hrs @ $10.00/hr.	$ 100.00	
	Engineer	10 hrs @ 8.50/hr	85.00	
	Operator	10 hrs @ 9.50/hr	95.00	
	Laborers	24 hrs @ 7.00/hr	168.00	$448.00
(2)	Direct Labor Cost (use the agreed upon Direct Labor Cost)			
	* (30)% of $448			
	* (Used for example purposes only)			134.00
(3)	Materials & Freight			
	150 l.f. of 12" pipe @ $2.00/l.f.		$ 300.00	
	15 v.f. precast SMH		1,700.00	
	Freight (slip # _____ Enclosed)		25.00	2,025.00
(4)	Equipment			
	1 Backhoe 10 hrs @ $80.00/hr		$ 800.00	
	1 Truck-crane 10 hrs @ $100.00/hr		1,000.00	
				1,800.00
	Total (Items 1 through 4)			4,407.00
(5)	20% markup for Overhead, Profit			
	20% of $4,407			881.00
(6)	5% markup for general contractor (if subcontractor is involved)			
	5% of $4,407			220.00
(7)	Credits (deductibles)			-323.00
			Total Cost $	4,965.00

Reminder: Provide support documentation as necessary i.e. vouchers, correspondence, Calculation, photographs, reports……

POLICY MEMORANDUM NO. CG-11 UTILITY RELOCATION

The construction of treatment facilities, sewers, pumping station, force mains and appurtenant work can cause the relocation of utilities. Costly relocation can sometimes be minimized by early communication and cooperation of the representatives of the municipality (owner) and the utilities.

Every possible effort should be made by the owner and each utility to establish the location of existing utilities in the vicinity of the proposed construction. The owner or its consulting engineer should make every reasonable effort to design the proposed construction so that relocation of existing utilities is minimized whenever possible. If the proposed construction is in an area of many existing utilities or in an otherwise critical area, the utilities are encouraged to mark the location of their existing utilities at the site during the design phase of the project.

During the design phase of the project, the municipality should provide timely notice to all utilities known or thought to have facilities in or proximate to the site of such future construction.

POLICY MEMORANDUM NO. CG-12 REFUNDABLE DEPOSITS FOR PLANS AND SPECIFICATIONS

For each set of project plans and specifications provided, the owner may require a deposit in form of cash or other appropriate security, in an amount sufficient to cover the costs of production of such plans and specifications.

Upon return of the plans and specifications to the owner within a reasonable time and in good condition, such deposit shall be refunded.

Actual mailing costs, if any, shall be borne by the party requesting such plans and specifications.

POLICY MEMORANDUM NO. CG-13 BID OPENING PROCEDURES

As a minimum, bid documents shall be reviewed/inspected for conformance to the following bid opening procedure in the order presented below. Failure to comply with any of these steps shall render the bid non-responsive and upon determination of such non-responsiveness, such bid shall be rejected immediately, set aside, and shall receive no further consideration.

Bid Opening Procedure

Step #1. Timeliness – The bid must be filed at the place and within the time specified therefore in the invitation to bid, and no bid shall be accepted after such time. The time at which a bid is filed should be time/date stamped or otherwise prominently noted on the bid;

Step #2. Bid Security – Properly executed bid security, in the amount and terms specified in the invitation to bid (equal to 5% of Base Bid or Highest Possible Amount considering all alternatives) shall be placed in a seal envelope and attached to the outside of the envelope containing the bid at the time of its submission;

A. Bid Bond

The Bid bond must be dated On or Before the Bid Date;
Issued by a Bonding Company Licensed in Massachusetts;
Accompanied by a Current Power of Attorney;
Signed by Surety;

B. Check

The Check must be a Certified, Cashiers or Bank Treasurer's;
Dated On or Before the Bid Date;

Step #3. Bid Signature – The bid and all accompanying documents so required shall be signed by the bidder or its authorized representative before submission;

Step #4. Addenda – All addenda shall be sent certified mail, return receipt requested, by the owner to all individuals and organizations which have received plans and specifications and shall be mailed not later than five days prior to the date established for submission of bids. All bidders shall include with their bids written acknowledgement of receipt of all addenda, which acknowledgement may be on a form provided therefore by the owner.

Alternates – Any Alternates shall be acknowledged.

Step #5. Written Dollar Amounts – The total dollar amount of each bid shall be read, and the three lowest bids shall be selected for further consideration. The remaining bids shall then be set aside. The three apparent low bids shall be read to determine whether the unit price for each line item of each bid has been written therein in words. If it has not, such bid shall be rejected and shall receive no further consideration. Bid amounts shall be consistent (words vs. numbers) and if words and numbers differ, the words govern**.** This procedure shall then be repeated with the next apparent low bid until three are acceptable which have all the unit prices written in words, at which time the lowest bid shall be announced as the apparent low bidder, and the bid opening procedure shall be closed.

The Division recommends that this policy memorandum be included in all contract specifications and that the owner's evaluator(s) use the attached form (CG-13 Attachment #1) for bid opening procedures.

The Contractor's Bid Opening Checklist also attached hereto, is for use by each contractor to assure that his bid conforms with this policy memorandum. It is recommended that the checklist (CG-13 Attachment #2) be included in information for bidders, or at the end of the bid proposal, or in some other prominent part of the bid specifications

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FORM FOR BID OPENING PROCEDURES

(to be completed by the owner's evaluator(s))

CONTRACT NO.: _____ DATE: _____

CONTRACT NAME: _____ BID OPENING TIME: _____

All non-responsive bids shall be rejected forthwith by the awarding authority upon determination of such bids' non-responsiveness at the time bids are opened and read. Failure to comply with any one of the requirements shall render the bid non-responsive, and upon determination of such non-responsiveness such bid shall be rejected and receive no further consideration.

A = Acceptable *N-R = Non-Responsive (explain reasons on supplemental sheet & attach)*

	BIDDER	1. TIMELINESS	2. BID SECURITY	3. SIGNATURE	4. ADDENDA ALTERNATIVES	5. WRITTEN DOLLAR AMOUNTS	COMPLIANCE (CIRCLE ONE)	
1							YES	NO
2							YES	NO
3							YES	NO
4							YES	NO
5							YES	NO
6							YES	NO
7							YES	NO
8							YES	NO
9							YES	NO
10							YES	NO
11							YES	NO
12							YES	NO

DEP/DMS

Evaluator(s) _____

_____

_____

CG-13 Attachment #1

BID OPENING PROCEDURES
CONTRACTORS CHECKLIST

CONTRACT NO.: _____ BIDDER: _____ DATE: _____

All non-responsive bids shall be rejected forthwith by the awarding authority upon determination of such bids' non-responsiveness at the time bids are opened and read. Failure to comply with one or more of the following requirements shall render the bid non-responsive, and upon determination of such non-responsiveness such bid shall be rejected and receive no further consideration.

ITEM	REQUIREMENTS	COMPLIANCE (CIRCLE 1)		REASONS FOR REJECTION
1. Timeliness	Bid filed w/in time specified	Yes	No; Rejected	
2. Bid Security	Appropriate and properly Executed security w/bid.	Yes	No; Rejected	
3. Signature	Bid signed by authorized Representative	Yes	No; Rejected	
4. Addenda	8All addenda acknowledge Any alternative	Yes	No; Rejected	
5. Dollar Amount	Dollar amount in words Specified for each line item in bid	Yes	No; Rejected	

DEP/DMS Attachment #2

POLICY MEMORANDUM NO. CG-14 PAYMENT FOR ROCK EXCAVATION

There shall be in the contract documents a separate pay item for rock excavation. For such purposes, "rock" shall mean igneous, sedimentary, metamorphic, and conglomerate rock, which for excavation must be drilled, blasted, broken, or ripped by power tools. Boulders and concrete structures one cubic yard or greater, however removed, are included within this definition of rock for payment purposes. At the option of the owner or his representative a separate pay item for boulders, concrete structures, or concrete road base may be used.

Depth From Ground Surface To Invert Pipe	Pay Width (Nominal Pipe Diameter)	
	0-24"	Over 24"
* 0 – 12'	5'0"	D+3'0"
* Over 12' – 20'	7'0"	D+5'

Engineer's plans and specifications shall establish pay limits below pipe and structures.

- See CG-14 Attachment #1 (typical cross section)

Payment width for depths over twenty feet (20') shall be determined on a case-by-case basis consistent with the foregoing chart.

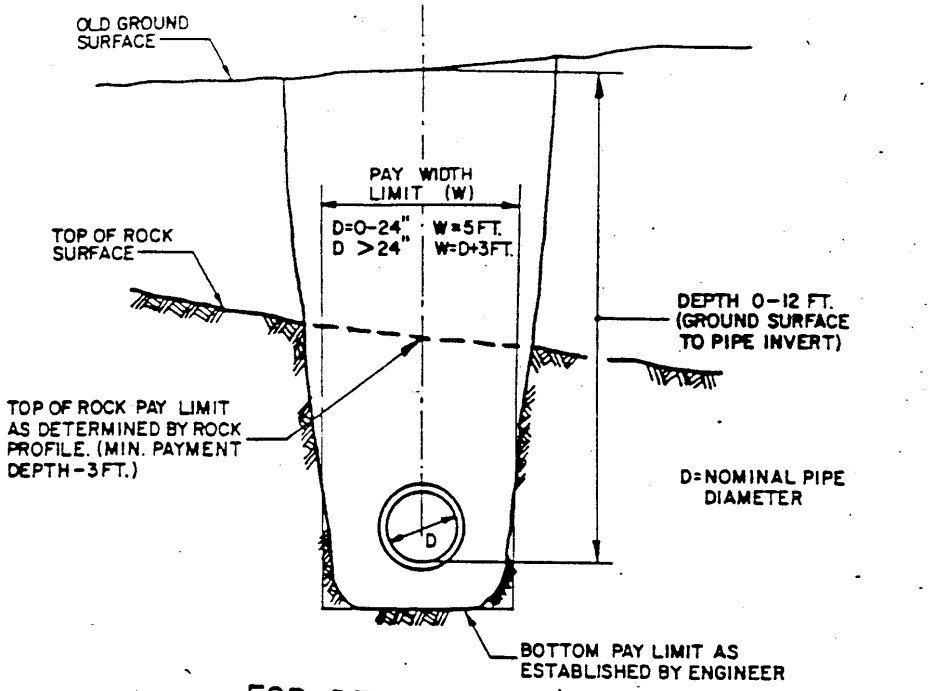
The pay limit for rock removal outside proposed manholes shall commence one foot (1') outside the widest dimension of the structure of shall be the maximum connecting trench width, whichever is greater.

Payment depth for rock which is encountered in a trench shall be no less than three feet (3') when removal can be accomplished only by drilling and blasting or by use of jack (air or hydraulic) hammers.

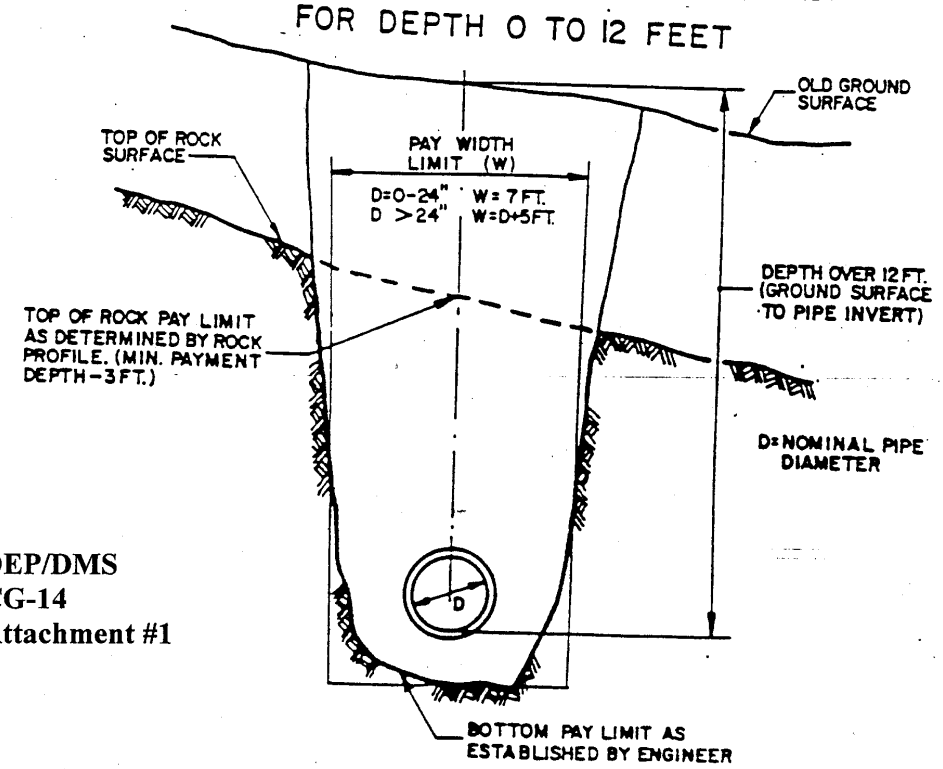
Payment for rock removed, using the same or equal equipment as utilized for normal trench excavation, shall be limited to the actual depth removed within the limits established by the contract documents.

Boulders encountered within the pay limits of excavation, whose volume is one cubic yard or greater, part of which extends outside said limits shall be paid in accordance with the actual volume excavated.

CG-14 ROCK EXCAVATION



FOR DEPTH 0 TO 12 FEET



FOR DEPTH OVER 12 FEET AND UP TO 20 FEET

DEP/DMS
CG-14
Attachment #1

POLICY MEMORANDUM NO. CG-15 TRAFFIC POLICE

The reasonable costs for police details required for traffic control on a construction project which receives financial assistance shall be considered as an eligible administrative cost. A police detail item shall not be included as a bid item in the contract documents.

"Police" as used in this memorandum includes local, county, capital, state, regular and auxiliary police.

Owner's Responsibility

It shall be the owner's responsibility to submit in writing the hourly rate of pay to be established for detailed traffic police and each change in rate during the course of the project. It is the owner's responsibility to arrange, document and pay for such police details. The owner or its representative shall meet with the police chief or other officer in charge of police detail duty to review contract needs. The owner shall maintain a daily record of the following:

a. Officer's name
b. Hours worked
c. Location of assignment
d. Hourly rate

POLICY MEMORANDUM NO. CG-16 DOCUMENTATION REQUIRED TO SUBSTANTIATE CONTRACT QUANTITIES

Unit	Documentation required
Acres (A)	Location, station, offset and calculations. Location = Street right-of-way, etc. Station = Point on Baseline; Offset = Distance left or right of Baseline
Cubic Yard (C.Y.)	Location, stations, widths, depths, calculations and Cross sections as necessary
Each (Ea.)	Location, station, and offset
Gallon (Gal.)	Location, stations, calculations (if appropriate) and delivery slips.
Hour (Hr.)	Hours and location.
Linear Feet (L.F.)	Location, stations, and offsets.
Month (Mo.)	Location, period of time and calculations if applicable.
1000 Foot Board Measure (MFBM)	Location, stations, offset, elevations, grade, and calculations. Attach invoices where applicable.
Pound (Lb.)	Locations, stations, and calculations (if applicable). Attach Delivery weight slips.

Square Feet (S.F.)	Locations, stations and calculations
Square Yard (S.Y.)	Locations, stations and calculations
Ton	Locations, stations and calculations (if applicable). Attach Delivery weight slips.
Vertical Feet (V.F.)	Locations, stations, elevations, and offsets.

Notes:

1. All of the above, that apply must be submitted with a final payment request or change order as applicable.
2. Where in place measurement is not possible or practical, delivery slips may be used to substantiate quantities.
3. Change orders – See CG-10 in which some of the above may be applicable in justifying materials, equipment and labor.
4. When necessary, itemized quantities must be separated into eligible and non-eligible units with separate calculations to justify eligible costs.
5. Overruns and underruns of any specific item shall be explained with an appropriate sentence or paragraph.
6. On all quantities, units of payment shall be maintained at the project site and shall be updated daily so that upon field inspection by the C.O.E., EPA or DMS, the quantities paid to date can be substantiated.
7. In the case of unforeseen conditions, photos should be submitted with the applicable item in addition to the recommended documentation.
8. Documentation of units of payment shall be clearly legible and cross referenced to the applicable sheets of the record drawings.
9. For record drawings policy, please see CG-4.

DMS Policies 1 through 16 Approved By: Division of Municipal Services

DWS POLICY 88-02
DEPARTMENT OF ENVIRONMENTAL PROTECTION
POLICY FOR REVIEW OF SEWER LINE/WATER SUPPLY PROTECTION

The Department of Environmental Protection seeks to protect existing and potential water supplies from the potentially negative effects of leaking sewer lines through the adoption of a Department policy on this subject.

The following restrictions will apply to new sewer construction statewide:

Gravel Packed Wells

~ Within the 400 foot radius protective distance around gravel packed wells, all sewer lines and appurtenances are prohibited, unless they are necessary to eliminate existing and/or potential sources of pollution to the well.

Tubular Wells

~ Within the 250 foot radius protective distance around tubular wells, all sewer lines and appurtenances are prohibited, unless they are necessary to eliminate existing and/or potential sources of pollution to the well.

Gravel Packed and Tubular Wells

~ Within a minimum radius of 2,640 feet or unless otherwise documented by an appropriate study specifically defining the area of influence and approved by the Division of Water Supply, all sewer lines and appurtenances will be designed and constructed for maximum water tightness.

- Force Mains or Pressure Sewers: shall be tested at 150% above maximum operating pressure or 150 p.s.i. whichever is greater. Testing shall conform to the requirements of the American Water works Association (AWWA) standard c 600.

- Gravity Sewers: shall be tested by approved methods which will achieve test results for infiltration or exfiltration of less than 100 gallons/inch diameter/mile/24 hours.

- Manholes: shall be installed with watertight covers with locking or bolted and gasketed assembles. Testing for infiltration/exfiltration shall conform to the same standards as the maximum allowed for pipes in the manhole as required for gravity sewers, indicated above.

- Satisfactory test results for Force Mains, Manholes and Gravity Sewers shall be performed prior to the expiration of the contractor's one year guarantee period.

- All pumping stations within this zone shall have standby power high water alarms telemetered to an appropriated location that is manned at all times. An emergency contingency plan must be developed by the owner and approved by the BRP.

- A minimum of Class B bedding as defined by WPCF-MOP9 must be used for all piping.

- Service connections (laterals and house connections) shall be rigidly inspected by the appropriate municipal official. Certified inspection reports shall be submitted to the BRP.

Bedrock Wells

The above requirements are the same for bedrock wells, with the Department reserving the right to require more stringent controls on a case-by-case basis.

Surface Water Supplies

~ Within 100 feet of all surface water supplies and tributaries all sewer lines and appurtenances are prohibited except as required to cross tributaries or to eliminate existing or potential pollution to the water supply. In the latter case, watertight construction methods shall be use.

~ Tributary stream crossings shall employ watertight construction methods of sewer lines and manholes. Watertight construction must extend 100 feet to either side of the stream.

~ Within 1,000 feet of surface water supplies and tributaries, all pumping stations shall have standby power and high-water alarms telemetered to an appropriate location that is manned at all times. An emergency contingency plan must be developed by the owner of the wastewater treatment facility and submitted to the BRP for approval.

~ Beyond 1,000 feet and within the watershed of surface water supplies the Department may in specific circumstances after review, require additional controls.

Potential Public Water Supplies

The above requirements also apply to potential public water supplies.

Baseline Date Requirements

Two (2) copies of an appropriately scaled map(s) shall be submitted to the Department which details the proposed sewers and/or appurtenances and also includes the following:

(1) the location of all nearby existing or potential surface water supplies, tributaries thereto, and watershed boundaries;

(2) the location of existing and potential public and municipal potable groundwater supply wells.

The Department reserves the right to impose more restrictive measures than those contained in this policy as deemed appropriate.

Definitions

○ Appurtenances – all attachments to sewer lines necessary for the transport and operation and maintenance of sewer lines, including manholes, pumping station, siphons, etc.

○ Area of influence – that area of an aquifer which contributes water to a well under the most severe recharge and pumping condition that can be realistically anticipated (i.e. pumping at the safe yield of the well for 180 days without any natural recharge occurring). It is bounded by the groundwater divides which result from pumping the well and by the contact of the edge of the aquifer with less permeable materials such as till and bedrock. At some locations, streams and lakes may form recharge boundaries.

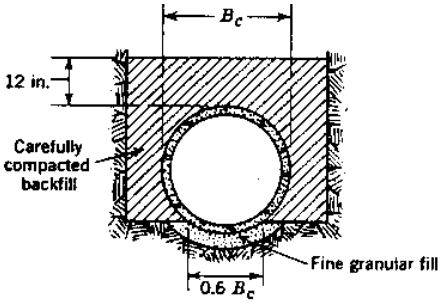
○ Potential public water supply – areas designated by communities for water supply purposes where land has been set aside and Department approved pump tests conducted and surface water supplies as defined below.

○ Surface Water Supply – Waters classified as Class A by the DWPC.

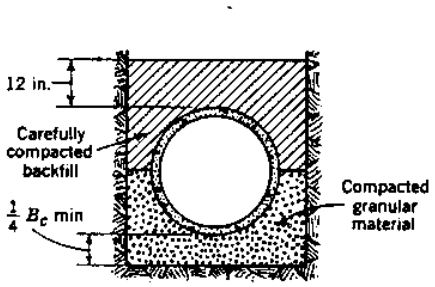
○ Public Water Supply Systems – as defined in 310 CMR 22.02 (DEP Drinking Water Regulations).

○ Class B Bedding – as defined in WPCF Manual of Practice No. 9.

APPROVED: (Signature on File)



Shaped bottom with tamped backfill, load factor 1.9



Compacted granular bedding, load factor 1.9

Class B---First-Class Bedding – Class B bedding may be achieved by either of two construction methods:

a. Shaped Bottom with Tamped Backfill. The bottom of the trench excavation shall be shaped to conform to a cylindrical surface with a radius at least 2 in. (5 cm) greater than the radius to the outside of the pipe and with a width sufficient to allow six-tenths of the width of the pipe barrel to be bedded in fine granular fill placed in the shaped excavation. Carefully compacted backfill shall be placed at the sides of the pipe to a thickness of at least 12 in. (30 cm) above the top of the pipe. Shaped trench bottoms are difficult to achieve under current construction conditions.

b. Compacted Granular Bedding with Tamped Backfill. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding shall have a minimum thickness of one-fourth the outside pipe diameter and shall extend halfway up the pipe barrel at the sides. The remainder of the side fills and a minimum depth of 12 in. (30 cm) over the top of the pipe shall be filled with carefully compacted material.

END OF DOCUMENT

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SECTION 00902

PROJECT SIGN

PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes furnishing all labor, equipment, tools and materials, and performing all operations in connection with furnishing, erecting, maintaining and removal / legal disposal of the Project Sign as specified herein.

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

1.02 - MEASUREMENT AND PAYMENT

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

B. The Contractor shall include the cost for two signs as specified herein.

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Drawing showing layout Project Sign.
2. Scope of supply of all materials and hardware.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed to not degrade the quality of the Project Sign.

1.06 - DESIGN CRITERIA

A. The Contractor shall erect a sign at the project site identifying the project information as specified herein.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

PART 2 - PRODUCTS

2.01 - SUBMITTAL PROCEDURES

A. Panel

1. Material: APA rated A-B grade – Exterior
2. Dimensions: 4-feet x 8-feet x ¾-inch

B. Posts

1. Material: Pressure Treated
2. Dimensions: 4-inch x 4-inch x 12-feet

C. Hardware shall be 5/16-inch Type 304 stainless steel nuts, washers and bolts

D. Finish

1. Front side (background) shall consist of at least three coats of white outdoor enamel paint.
2. Rear side shall be painted with one coat of white outdoor enamel paint.
3. Lettering shall be 4-inch high and either Helvetica or Arial Font and shall be painted with two coats of black outdoor enamel paint.

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings.

C. Notify subcontractors involved or affected by this work and coordinate the work with them.

3.02 – INSTALLATION, MAINTENANCE AND REMOVAL

A. Installation

1. The sign shall be erected within 14 days after shop drawing approval and prior to the start of any construction.
2. The Project Sign shall be installed at a location identified in the field with the Engineer.
3. The Project Sign shall be installed level with the top of the sign 8 feet above natural ground and installed vertically to a minimum depth of 3-feet below natural ground.
4. Install with four nuts and bolts per post with one washer front and back.

B. Maintenance

1. The Contractor shall maintain the Project Sign throughout the direction of construction.
2. The Contractor shall repair, repaint, and/or replace the Project Sign as required to ensure that the sign

C. Removal

1. The sign shall be removed and legally dispose of within 14 days of substantial completion.
2. The location shall be restored in accordance with SECTION 02485, LOAMING AND SEEDING.

3.03 – CONTRACT CLOSEOUT

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

END OF TEXT

See Attached Figure

Meetinghouse Pond Area Collection System and Pumping Station Contract No. 2022-01 and SRF No. 7150

Owner
Town of Orleans, MA

Engineer
AECOM Technical Services, Inc.
Pocasset, MA

Contractor
Name TBD
Address TBD

This Project is Funded and Administered by the US Environmental Protection Agency, the Massachusetts Department of Environmental Protection and the Town of Orleans, MA

Project Cost
$ TBD

DOCUMENT 00945

CERTIFICATE OF SUBSTANTIAL COMPLETION

Project Name:	Meetinghouse Pond Area Collection System and Pumping Station Contract No. 2022-01 and SRF No. 7150
Agreement Date:	
Owner:	Town of Orleans, MA, 19 School Road, Orleans, MA 02653
Completion Date:	
Contractor:	
Contract For:	

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

To:

From:

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on

Date of Substantial Completion:

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of Contractor to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by Contractor within 30 calendar days of the above date of Substantial Completion.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as follows:

Owner:

1. _____
2. _____
3. _____
4. _____
5. _____

Contractor:

1. _____
2. _____
3. _____
4. _____
5. _____

The following documents are attached to and made a part of this Certificate:

1. _____
2. _____
3. _____
4. _____
5. _____

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Executed by Engineer on:

	AECOM Technical Services, Inc.
Date	Consultant Engineer
	Signature
	Timothy Harrison, P.E.
	Name
	Project Manager
	Title

Contractor accepts this Certificate of Substantial Completion on:

Date	Contractor
	Signature of Contractor
	Name
	Title

Owner accepts this Certificate of Substantial Completion on:

	Town of Orleans, MA
Date	Owner
	Signature of Owner
	Name
	Town Administrator
	Title

END OF DOCUMENT

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DOCUMENT 00950

WAIVER OF LIENS

Project Name:	Meetinghouse Pond Area Collection System and Pumping Station Contract No. 2022-01 and SRF No. 7150
Agreement Date:	
Owner:	Town of Orleans, MA, 19 School Road, Orleans, MA 02653
Completion Date:	

The undersigned Contractor hereby swears under penalty of perjury that (1) all previous progress payments received from the Owner on account of Work performed under the Contract referred to above have been applied by the undersigned to discharge, in full, all obligations of the undersigned incurred in connection with Work covered by prior Estimates for Partial Payment under said Contract, being Estimates Number 1 through 6 inclusive; and (2) all labor, materials and equipment incorporated in said Project or otherwise listed in or covered by these Estimates for Partial Payment are free and clear of all liens claims, security interests and encumbrances, except those listed below by obligee, nature and amount of obligation and covered by appropriate Bond or Bonds, as listed beside each obligation and attached to and made a part of this certification.

Obligation	Bond

Date

Contractor

Signature of Officer of the Contractor

Name of Officer of the Contractor

Title

State of: County of:

Subscribed and sworn to before me this day of

personally appeared known to me, who being duly sworn, did depose and save that he is the (Officer) of the Contractor above mentioned; that he executed the above statement on behalf of said Contractor and that all of the statements contained therein are true, correct and complete.

Notary Public

My Commission Expires:

END OF DOCUMENT

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DOCUMENT 00960

CERTIFICATE OF FINAL PAYMENT AND COMPLETION OF WORK

Project Name:	Meetinghouse Pond Area Collection System and Pumping Station Contract No. 2022-01 and SRF No. 7150
Agreement Date:	
Owner:	Town of Orleans, MA, 19 School Road, Orleans, MA 02653
Completion Date:	

FINAL CERTIFICATION OF CONTRACTOR

_____(Contractor), _____ (address) agrees to accept $_____ as full and final payment for all work completed under this Contract dated _____ with the Town of Orleans, MA for Contract No. 2022-01, Meetinghouse Pond Area Collection System and Pumping Station.

I certify that all construction has been carried out in substantial compliance with the Contract Documents, and that all labor, equipment, materials and Subcontractors have been or will be paid in accordance with the requirements of the General Laws of the Commonwealth of Massachusetts.

Date	Contractor
	Signature of Officer of the Contractor
	Name of Officer of the Contractor
	Title

END OF DOCUMENT

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DOCUMENT 00965

TRANSFER OF TITLE

Project Name: Meetinghouse Pond Area Collection System and Pumping Station
Contract No. 2022-01 and SRF No. 7150

Agreement Date: _____

Owner: Town of Orleans, MA, 19 School Road, Orleans, MA 02653

_____, (Contractor), a corporation, or a partnership, or an individual, having a principal place of business in _____ hereby transfers and conveys to the Town of Orleans, MA (Owner), title to the following material(s) delivered and stored at the designated storage area(s) at _____ upon the receipt of $ _____, which amount is to be included in the Application and Certification For Payment No. _____

Therefore, upon the receipt of the sum of $ _____ * paid by the Owner, the Contractor waives all of its statutory lien rights regarding the following material. The storage, transportation, protection and ultimate installation of this material remain the responsibilities of the Contractor.

* Amount subject to reduction by applying applicable retainage percentage according to the terms of the Contract between the Owner and Contractor.

Title to the following material is being transferred by this document:

1. _____
2. _____
3. _____
4. _____
5. _____

In witness whereof, the Contractor has caused this instrument to be executed by its duly authorized representative.

Date	Contractor
	Signature of Officer of the Contractor
	Name of Officer of the Contractor
	Title

State of: County of:

Subscribed and sworn to before me this day of

personally appeared known to me, who being duly sworn, did depose and save that he is the (Officer) of the Contractor above mentioned; that he executed the above statement on behalf of said Contractor and that all of the statements contained therein are true, correct and complete.

Notary Public

My Commission Expires:

END OF DOCUMENT

SECTION 01020

ALLOWANCES

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS – Not Used 2
1.05 - ALLOWANCES FOR PRODUCTS 2
1.06 - SELECTION OF PRODUCTS UNDER ALLOWANCES 2
1.07 - ADJUSTMENT OF COSTS 3
PART 2 - PRODUCTS - Not Used 4
PART 3 - EXECUTION - Not Used 4

PART 1 - GENERAL

1.01 - SCOPE

A. Include all costs related to the scheduled allowances in the applicable bid item of DOCUMENT 00300, BID FORM. Allowance amounts listed herein have been estimated. Actual paid invoice amounts shall be used for reimbursement purposes.

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

1.02 - MEASUREMENT AND PAYMENT

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

B. Include in the Contract Price, scheduled allowances included under the applicable Bid Item of DOCUMENT 00300, BID FORM specified in the respective specification sections and listed below:

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS – Not Used

1.05 - ALLOWANCES FOR PRODUCTS

A. The amount of each allowance unless otherwise specified in SECTION 01025, MEASUREMENT AND PAYMENT:
   1. The cost of the product for service.
   2. Applicable taxes.

B. In addition to the amount of each allowance, include, except as specified herein, in the Contract Sum the Contractor's costs for:
   1. Handling at the site, including unloading, uncrating, and storage.
   2. Protection from the elements and from damage.
   3. Labor for installation and finishing, except where labor is specified to be a part of the Allowance.
   4. Other expenses required to complete the installation.
   5. Contractor's and Subcontractor's overhead and profit.

C. The scheduled allowances are as follows:

SCHEDULED ALLOWANCES

Item Number	Description	Amount	Bid Item
General			
1	Miscellaneous Restoration of Municipal Roadways	$100,000	15J.
2	Dense Graded Gravel Roadways	$50,000	15L.
3	Traffic Markings	$100,000	15N.
4	Removal and Relaying and/or Replacement of Existing Gas Mains and Services	$100,000	16C.
5	Removal and Relaying and/or Replacement of Existing Miscellaneous Utilities	$100,000	16D.
Wastewater Treatment Facility			
6	SCADA System Integrator	$20,000	22A.
7	SBR Transfer Pump	$90,000	22B.
8	SBR Blower	$90,000	22C.
9	SBR Aeration Grids	$40,000	22D.
10	Variable Frequency Drives	$150,000	22E.

Item Number	Description	Amount	Bid Item
Pumping Station No. 04			
11	Submersible Pumps	$135,000	23B.
12	Variable Frequency Drives	$150,000	23C.
13	Odor Control System	$40,000	23D.
14	Standby Diesel Engine Drive Generator	$150,000	23E.
15	Davit Crane	$10,000	23F.
16	Electric Company Connection/Service Fee	$50,000	23G.
17	Telephone Company Connection/Service Fee	$10,000	23H.
18	Planting Operations	$20,000	23I.

1.06 - SELECTION OF PRODUCTS UNDER ALLOWANCES

A. Engineer's duties are as follows:

1. Make selection in consultation with the Owner and obtain Owner's written decision, designating:

a. Product, model and finish.

b. Accessories and attachments.

c. Cost to the Contractor, delivered to the Project Site or installed, as applicable.

2. Transmit Owner's decision to the Contractor.

3. Prepare Change Orders.

B. Contractor's duties are as follows:

1. Obtain proposals from suppliers and installers when requested by the Engineer.

2. Make appropriate recommendations for consideration by the Engineer.

3. Notify the Engineer promptly of:

a. Any reasonable objections the Contractor may have against any supplier, or party under consideration for installation.

b. Any effect on the construction schedule anticipated by selections under consideration.

1.07 - ADJUSTMENT OF COSTS

A. Should the net cost be more or less than the specified amount of the allowance, the Contract Price shall be adjusted accordingly by Change Order.

1. The amount of the Change Order will recognize any changes in handling costs at the Project Site, labor, installation costs, overhead, profit and other expenses caused by the selection under the allowance.

B. Submit any claims for anticipated additional costs at the Project Site, or other expenses caused by the selection under the allowance, prior to execution of the Work.

C. Submit documentation or actual additional costs at the Project Site, or other expenses caused by the selection under the allowance, within 60 days after completion of execution of the Work.

D. Failure to submit claims within the designated time will constitute a waiver of claims for additional costs.

E. At Contract closeout, reflect all approved changes in Contract Price in the final statement of accounting.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

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PART 1 - GENERAL

1.01 - SCOPE

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

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

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

D. American Iron and Steel (AIS) certifications for all applicable materials must be included with the product shop drawing or the submittal will be rejected. Certification requires a project specific letter that certifies the manufacturing process and foundry location of the subject products and/or materials. There will be no payment for items that do not have approved AIS certification.

1.02 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.03 - PAYMENT ITEMS

A. SRF Eligible Items

Item	Description
1	Mobilization/Demobilization
2	Sewer Pipelines and Associated Fittings
3	Precast Concrete Manholes and Structures
4	Manhole Frames, Covers and Grates
5	Interior Manhole Drop Connections
6	Chimneys
7	Miscellaneous Cement Concrete
8	Rock and/or Boulder Excavation
9	Replacement of Unsuitable Material
10	Experimental Excavation
11	Fill for Embankments – Not Used
12	Sheeting and/or Shoring Ordered Left in Place – Not Used
13	Soil Compaction Tests
14	Road Gravel
15	Pavement Restoration
16	Remove and Relay or Replace Existing Utilities
17	Uniformed Traffic Police Officers
18	Engineer's Field Office
19	Environmental Protection
20	Dewatering
21	Temporary By-Pass Pumping – Not Used
22	Proprietary Equipment Allowances
23	Pumping Station

C. SRF Ineligible Bid Items

Item	Description
B-1	Replacement of Water Services
B-2	Baxter Lane and Lucy's Lane Water Main
B-3	Water Quality Improvements

1.04 - BASIS OF MEASUREMENT AND PAYMENT – SRF ELIGIBLE ITEMS

ITEM 1 - MOBILIZATION/DEMOBILIZATION

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

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

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

ITEM 2 - SEWER PIPELINES AND ASSOCIATED FITTINGS

A. General. The prices bid under each division of this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include: transportation, handling and dispersal of materials; clearing and grubbing; saw cutting and removal of existing bituminous and cement concrete or reinforced cement concrete pavement; excavation (excluding that which is specified to be paid for under a separate Bid Item); backfill above trench grade including all bedding materials (excluding material used to replace unsuitable material, controlled density fill and road gravel); removal and legal disposal of all existing utility lines not being relaid (including pipes, services, manholes and appurtenances); removal and legal disposal of existing utility materials (as required); compacting trenches (excluding soil compaction tests specified to be paid for separately); sheeting and shoring not ordered left in place; loaming and seeding; landscaping; removing and resetting curbing, property markers, signs and mail boxes; connections to existing pipeline(s) and services; dust control including mechanical sweeping; all permanent and temporary fittings, caps, plugs, restraints and the like; two-way sewer lateral cleanout; service check valves, low pressure sewer corporation stop, low pressure sewer service lateral and curb box, traffic control devices, flushing and testing; dewatering of trenches; polyethylene encasement; cleaning and television inspection of sewer lines, daily cleanup; restoration of all areas disturbed by the Contractor's operations; all Work as specified in DIVISION 1 – GENERAL REQUIREMENTS (excluding Environmental Protection specified to be paid for under a separate Bid Item); and all other incidental Work relative thereto.

B. Measurement. Measurement for furnishing and installing pipelines and associated fittings shall be as follows:

1. The length of pipe and fittings (pipeline), to be paid for shall be the horizontal measured length of pipeline in place from centerline of manhole to centerline of manhole. Measurement shall be by the linear foot with no deductions made for manholes, fittings or valves. The measurement for depth of gravity sewers shall be made vertically from the existing ground surface above the pipeline to the invert of the sewer.

2. The length of pipe and fittings to be paid for shall be the measured length of pipeline in place. Measurement shall be by the linear foot with no deductions made for fittings or valves.

3. Measurement for service connections shall be by the linear foot with no deductions made for fittings or valves.

    a. Measurement for sewer service connections shall be the horizontal measured length of pipeline in place from the face of the wye, tee or chimney to the terminus of the service pipeline.

    b. Measurement shall be as stated above with a minimum payment of five (5) linear feet.

4. Measurement for wyes, blow offs, air vents (manual or automatic), service connections and the like shall be per each installation, as approved by the Engineer.

C. Payment. Payment for furnishing and installing pipelines and associated fittings of the various types, diameters and depths listed in DOCUMENT 00410, FORM OF GENERAL BID, shall be made at the unit prices bid under the applicable divisions of this Bid Item.

1. Only eighty-five (85) percent of the price bid per linear foot of pipeline shall be paid for upon its installation, the balance shall be withheld until such time as pipeline(s) have been successfully flushed and tested (as required), accepted by the Owner for incorporation into the existing pipeline system and the site(s) has been fully restored. This percentage is exclusive of normal Contract retainage.

2. An additional five (5) percent shall be withheld until such time as the complete system has been cleaned and televised with records accepted by the Owner. This percentage is exclusive of normal Contract retainage.

3. The Contractor shall provide water for flushing and testing (as applicable) for each section of pipeline (transmission main and force main only) installed. Water utilizing the Owner's water system may be available, however, the Owner does not guarantee that its water supply will be available at any time during the duration of the Project. If available, water required for testing, puddling and/or jetting of trenches shall be provided by the Owner at no cost to the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

4. Payment for furnishing and installing fittings, restraints, solid sleeves, flexible couplings, transition couplings and the like shall be made under and included in the prices bid per linear foot.

5. Payment for service connections including fittings and/or valves shall be made at the unit price bid per linear foot.

6. Payment for sewer service wyes shall be made at the unit price bid for each approved installation. Payment will be made without regard to size.

ITEM 3 - PRECAST CONCRETE MANHOLES AND STRUCTURES

A. General. The prices bid under each division of this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include excavation, installation, steel reinforced copolymer polypropylene plastic steps, lifting rings, sealing materials in horizontal joints, pipe penetrations, dampproofing, invert, electrical and mechanical equipment, valves and fittings, external manhole encapsulation system, backfill, mancatchers on manholes over twenty (20) feet in depth, removal and legal disposal of existing structures to be replaced, as specified and/or shown on the Contract Drawings and all other incidental Work relative thereto.

B. Measurement. Measurement for furnishing and installing precast concrete manholes shall be as follows:

1. For sewer and drain manholes, measurement for depth shall be from the top of frame to the lowest invert in the manhole, as approved by the Engineer.

2. For air release and flushing/drain manholes, measurement shall be per each installation, regardless of depth, as approved by the Engineer.

3. For sump drain manholes and catch basins, measurement shall be from the top of frame to the lowest invert or sump in the structure, as approved by the Engineer.

4. For leaching catch basins measurement shall be from the top of frame to the lowest invert or sump in the structure, as approved by the Engineer.

C. Payment. Payment for furnishing and installing precast concrete manholes listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the unit prices bid under the applicable divisions of this Bid Item.

1. Payment for air vacuum and air release valve and/or flushing drain manholes shall be per each approved installation.

2. Payment for leaching catch basins shall be per each approved installation.

3. Only eighty-five (85) percent of the price bid for each manhole shall be paid for upon its installation, the balance shall be withheld until such time as the manhole has been successfully tested and accepted by the Owner. This percentage is exclusive of normal Contract retainage.

4. An additional ten (10) percent shall be withheld until such time as the invert, manhole steps, pig catchers, and mancatchers have been installed and accepted by the Owner. This percentage is exclusive of normal Contract retainage.

5. Only twenty (20) percent of the price bid for each:(a) Inline Flushing Manhole with Combination Air Valve; and (b) Terminal Flushing Manhole with Combination Air Valve manhole shall be paid for upon its installation, the balance shall be withheld until such time as the manhole has been successfully tested and accepted by the Owner. This percentage is exclusive of normal Contract re.

ITEM 4 - MANHOLE FRAMES, COVERS AND GRATES

A. General. The prices bid under each division of Item 4 shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include setting frames, covers and grates to existing grade initially and resetting frames, covers and grates to final grade prior to final pavement restoration and all other incidental Work relative thereto.

B. Measurement. Measurement for furnishing and installing manhole frames, covers and grates shall be per each installation as approved by the Engineer.

C. Payment. Payment for furnishing and installing manhole frames, covers and grates of the various types and sizes listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the unit prices bid per each under the applicable divisions of Item 4.

ITEM 5 – INTERIOR MANHOLE DROP CONNECTIONS

A. General. The prices bid under Item 5 shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include excavation, assembly, drop piping, fittings, hardware, and all other incidental Work relative thereto.

B. Measurement. Measurement for furnishing and installing interior manhole drop connections shall be from the invert of the manhole to the top of the drop connection.

C. Payment. Payment for furnishing and installing interior manhole drop connections listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the unit price bid per vertical foot under Item 5.

ITEM 6 - CHIMNEYS

A. General. The price bid under Item 6 shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include excavation, vertical piping, wye fittings, caps, concrete encasement, and all other incidental Work relative thereto.

B. Measurement. Measurement for chimneys shall be from the top of the chimney to the top of the wye fitting for each installation as approved by the Engineer.

C. Payment. Payment for chimneys listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the unit price bid under Item 6.

ITEM 7 - MISCELLANEOUS CEMENT CONCRETE

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, including thrust blocks, support for utilities, pipe encasements, and the like and any other incidental Work relative thereto.

B. Measurement. Measurement of miscellaneous cement concrete shall be the actual cubic yardage placed as approved by the Engineer.

C. Payment. Payment for miscellaneous cement concrete listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the unit price bid per cubic yard under this Bid Item.

1. Payment for concrete used for manhole bases, joints and inverts, for setting frames and covers, for manhole drop connections and for chimneys shall be included as specified under the applicable Bid Item.

ITEM 8 - ROCK AND/OR BOULDER EXCAVATION

A. General. The price bid under Item 8 shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified which shall include excavation, use of drilling and blasting (if allowed); hydraulic hammers; hydraulic splitters; and/or drilling and expansion cement/grout. pre-blast survey(s), permit(s) and license(s), vibration monitoring, removal and legal disposal of rock and/or boulders, furnishing and placing replacement material, backfilling and compaction, and any other incidental Work relative thereto. The Contractor shall assume that Rock and/or Boulders may occur anytime throughout the Project Area and that the unanticipated discovery of Rock and/or Boulders is not a basis for a change in conditions.

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

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

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

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

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

3. Rock or boulders encountered in other excavations, which are to be paid for separately, shall be measured from its surface to a point six (6) inches below the base of structure and to a width of one (1) foot outside the face of the structure.

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

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

1. No additional payment will be made for frost removal or for any other materials encountered in the excavations, no matter how stiff or compact of consistency, even if drilling and blasting (if allowed); hydraulic hammers; hydraulic splitters; and/or drilling and expansion cement/grout is required for removal. Soft or disintegrated rock that can be removed without the use of drilling and blasting (if allowed); hydraulic hammers; hydraulic splitters; and/or drilling and expansion cement/grout shall not be paid for under this Bid Item.

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

3. Masonry or concrete structures encountered during the course of constructing the Work, which require drilling and blasting (if allowed); hydraulic hammers; hydraulic splitters; and/or drilling and expansion cement/grout for removal, shall be paid for subject to the limits and conditions described herein.

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

The unit price for rock and/or boulder excavation shall be a minimum of $80 per cubic yard which shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified using drilling and blasting (if allowed); hydraulic hammers; hydraulic splitters; and/or drilling and expansion cement/grout.

ITEM 9 - REPLACEMENT OF UNSUITABLE MATERIAL

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

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

1. Unsuitable material below trench grade shall be measured from a point six (6) inches below the invert of pipe to the bottom of the excavation and as follows:

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

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

2. Unsuitable material above trench grade shall be measured from a point one (1) foot plus the thickness of permanent pavement thickness below the existing pavement surface or from a point six (6) inches below the existing unpaved surface to a point one (1) foot above the pipe and as follows:

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

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

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

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

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

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

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

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

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

ITEM 10 - EXPERIMENTAL EXCAVATION

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

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

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

ITEM 11 - FILL FOR EMBANKMENTS – Not Used

ITEM 12 - SHEETING AND/OR SHORING ORDERED LEFT IN PLACE – Not Used

ITEM 13 - SOIL COMPACTION TESTS

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include excavation, sampling, sieve analysis, laboratory and field testing, backfill, compaction and any other incidental Work relative thereto.

B. Measurement. Measurement of compaction testing shall be per each test as approved by the Engineer.

C. Payment. Payment for soils compaction tests listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the unit price bid per each under this Bid Item.

1. For the purpose of payment, a test shall include, but not be limited to, exploratory excavation, laboratory analysis (sieve analysis and modified proctor), field testing (density test), backfill and compaction of excavations.

2. No payment will be made for any test that fails to meet the specified compaction requirements.

ITEM 14 - ROAD GRAVEL

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include transportation, preparation of sub-grade, placement, grading, compaction and any other incidental Work relative thereto.

B. Measurement. Measurement of road gravel as a subbase for permanent resurfacing shall be based on the approved volume furnished and placed as approved by the Engineer computed as follows:

1. The length of main trench shall be defined as the length of roadway surface disturbed by the pipeline Work. The length of service trench shall be defined as the length of roadway surface disturbed by the service line Work less three (3) feet from the centerline of the main sewer or water pipeline trench.

2. The width of main or service trench shall be defined as follows:

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

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

3. The width for manholes shall be measured from a width of two (2) feet plus the outside diameter of the manhole.

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

5. The thickness of road gravel in local roadways shall be twelve (12) inches, unless otherwise specified or approved by the Engineer.

6. The thickness of road gravel in State Roadways shall be equal to the thickness of the existing undisturbed road gravel adjacent to the trench.

7. No payment will be made for road gravel course material when suitable excess excavated material is available from other excavations made under this Project.

C. Payment. Payment for furnishing and placing road gravel material listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the unit price bid per cubic yard under this Bid Item.

ITEM 15 - PAVEMENT RESTORATION

A. General. The prices bid under each division of this Bid Item shall be considered as fair compensation for all labor, equipment, tools, and materials necessary to complete the Work as specified, which shall include, preparation of subgrade, cutting and recutting of bituminous and cement concrete pavement, full width pavement removal, reshaping of the roadway surface, reshaping, loaming and seeding of roadway shoulders, furnishing and placing bituminous concrete dense graded gravel, furnishing and placing bituminous concrete (temporary and permanent), maintenance and protection of roadway surfaces, repainting of traffic control lines/wording, resetting of structures and utility boxes, milling of bituminous concrete surfaces, replacement of pavement markings (temporary and permanent), replacement of vehicle loop detectors, repair to roadways used as detours, and all other Work incidental thereto and all other Work incidental thereto.

B. Measurement. Measurement for pavement restoration shall be as follows:

1. Bituminous Concrete Trench Pavement in State Roadways

    a. Measurement for Temporary Bituminous Concrete Trench Pavement in State Roadways shall be based on the horizontal measured length of main line trench defined as the length of roadway disturbed by the main line Work from centerline of manhole to centerline of manhole. Measurement shall be by the linear foot with no deductions made for manholes, fittings or valves.

    b. Measurement for Permanent Bituminous Concrete Trench Pavement in State Roadways shall be based on the horizontal measured length of service trench defined as the length of roadway surface disturbed by the service line Work less three (3) feet from the centerline of the main sewer or water pipeline trench. Measurement shall be by the linear foot with no deductions made for fittings or valves.

    c. Measurement for Permanent Bituminous Concrete Trench Pavement in State Roadway for trenches with more than one (1) pipe laid in the same trench shall be treated as a common trench, unless otherwise approved by the Engineer.

2. Bituminous Concrete Trench Pavement

    a. Measurement for Permanent Bituminous Concrete Trench Pavement shall be based on the horizontal measured length of main line trench defined as the length of roadway disturbed by the main line Work from centerline of manhole to centerline of manhole. Measurement shall be by the linear foot with no deductions made for manholes, fittings or valves.

    b. Measurement for Permanent Bituminous Concrete Trench Pavement shall be based on the horizontal measured length of service trench defined as the length of roadway surface disturbed by the service line Work less three (3) feet from the centerline of the main sewer or water pipeline trench. Measurement shall be by the linear foot with no deductions made for fittings or valves.

    c. Measurement for Permanent Bituminous Concrete Trench Pavement for trenches with more than one (1) pipe laid in the same trench shall be treated as a common trench, unless otherwise approved by the Engineer.

    d. Measurement for Temporary Bituminous Concrete Trench Pavement shall be as described for Permanent Bituminous Concrete Trench Pavement.

3. Permanent Bituminous Concrete Full Width Overlay Pavement. Measurement for Bituminous Concrete Full Width Overlay Pavement with or without milling will be made based on either (a) Certified weight slips delivered daily to the Engineer or (b) the actual length and width of roadway overlaid as approved by the Engineer.

4. Miscellaneous Restoration of Municipal Roadways. The methods of measurement shall be based on the completed installation of the Allowance items, as specified, based on the schedule of values approved by the Owner.

5. Dense Graded Gravel

    a. Measurement for dense graded gravel shall be defined as the length of roadway surface disturbed by the width of the roadway. Measurement shall be by the linear foot with no deductions made for manholes, fittings or valves.

    b. Measurement for Permanent Bituminous Concrete Trench Pavement for trenches with more than one (1) pipe laid in the same trench shall be treated as a common trench, unless otherwise approved by the Engineer.

6. Miscellaneous Bituminous Concrete. Measurement for Miscellaneous Bituminous Concrete placed where directed by the Engineer shall be by the ton based on certified weight slips delivered daily to the Engineer.

7. Replacement of Vehicle Loop Detectors. Measurement for Replacement of Vehicle Loop Detectors shall be based on each location replaced as approved by the Engineer and MassDOT. Each location paid for shall be for the vehicle loop detector replaced following Permanent Bituminous Concrete Trench Pavement and replaced following Permanent Bituminous Concrete Full Width Overlay Pavement.

8. Repainting of Traffic Markings. Refer to SECTION 01020, ALLOWANCES.

9. Tracer Wire. Measurement for Tracer Wire installed as specified shall be by the linear foot

10. Payment limits for pavement restoration specified above supersede the MassDEP Policy Memorandum CG-8.

C. Payment. Payment for pavement restoration listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made under the applicable divisions of this Bid Item.

1. Temporary Bituminous Concrete Trench Pavement – Payment for Temporary Bituminous Concrete Trench Pavement whether placed by machine or by hand listed in DOCUMENT 00410, FORM OF GENERAL BID will be made at the unit price bid per linear foot under the applicable divisions of this Bid Item.

2. Permanent Bituminous Concrete Trench Pavement. Payment for Permanent Bituminous Concrete Trench Pavement whether placed by machine or by hand listed in DOCUMENT 00410, FORM OF GENERAL BID will be made at the unit price bid per linear foot or per ton under the applicable divisions of this Bid Item.

3. Permanent Bituminous Concrete Full Width Pavement. Payment for Permanent Bituminous Concrete Full Width Pavement including milling, if applicable, listed in DOCUMENT 00410, FORM OF GENERAL BID will be made at the unit price bid per ton under the applicable divisions of this Bid Item.

    a. The factor of 0.055 tons per square yard per inch of thickness shall be used for weight-volume conversions for bituminous concrete.

    b. Certified weight slips for all bituminous concrete delivered to the site(s) and certified volume slips for all controlled density fill delivered to the site(s) shall be submitted to the Engineer on a daily basis.

    c. Payment for furnishing and placing permanent bituminous concrete pavement shall be made at the unit price bid per ton computed using one of the following methods:

        1) Method 1 (Measured in Place): The Engineer shall multiply the pavement area by the specified pavement thickness by the factor to obtain the tonnage of bituminous concrete.

        2) Method 2 (Delivered): Certified weight slips shall be used. Any bituminous concrete placed outside the payment limits, unless approved by the Engineer, shall be deducted (using Method 1) from the total tonnage obtained from the certified weight slips.

        3) Payment for furnishing and placing temporary and permanent bituminous concrete will be made based on the number of tons obtained using either Method 1 or Method 2, whichever is less.

4. Miscellaneous Bituminous Concrete. Payment for Miscellaneous Bituminous Concrete whether placed by machine or by hand, for leveling of existing roadways, driveway aprons, sidewalks, repairs to roadways used for detours, and other areas outside the trench limits listed in DOCUMENT 00410, FORM OF GENERAL BID will be made at the unit price bid per ton.

5. Tracer Wire. Payment for installation of tracer wire shall be at the unit price bid per linear foot.

6. The following utility allowance(s) shall be included in the applicable subdivision of this Bid Item:
   a. Miscellaneous Restoration of Municipal Roadways – Refer to SECTION 01020, ALLOWANCES
   b. Dense Graded Gravel Roadways – Refer to SECTION 01020, ALLOWANCES
   c. Repainting of Traffic Markings – Refer to SECTION 01020, ALLOWANCES.
7. Price Adjustment - Liquid Asphalt, Diesel, Gasoline and Portland Cement
   a. The intent of this provision is to insure adequate and fair compensation for unpredictable and fluctuating costs which, from time to time, occur in the prices of Liquid Asphalt, Diesel Fuel, Gasoline and Portland Cement. The price adjustment provisions are made part of the Contract to assure more realistic bidding and encourage competition. Price Adjustments will be based on the variance in price, for the material component only, between the Base Price and the Period Price. They shall not include transportation or other charges. Price Adjustments will occur on a monthly basis for Liquid Asphalt and at the end of the Project for Diesel Fuel, Gasoline and Portland Cement.
   b. Base Price - The Base Price of liquid asphalt on a project is a fixed price determined by the MassDOT at the time of the bid using the same method as the determination of the Period Price detailed below. The Base Price shall be used in all bids.

      The February 2023 base prices are as follows: liquid asphalt at $665.00 per ton and Portland cement at $181.15. The January 2023 base prices are as follows: diesel fuel at $3.830 per gallon and gasoline at $2.767 per gallon. MassDOT posts the Price Adjustments on their Highway Division's website at https://www.mass.gov/service-details/massdot-current-contract-price-adjustments under the following link sequences: (1) Doing Business With Us; (2) Construction; and (3) Price Adjustments.

      1. Hot Mix Asphalt
         a) Period Price - The Period Price is the price of liquid asphalt for each monthly period as determined by the MassDOT using the average selling price per standard ton of PG64-28 paving grade (primary binder classification) asphalt, FOB manufacturer's terminal, as listed under the "East Coast Market - New England, Boston, Massachusetts area" section of the Poten & Partners, Inc. "Asphalt Weekly Monitor". This average selling price is listed in the issue having a publication date of the second Friday of the month and will be posted as the Period Price for that month. The MassDOT will post this Period Price on its website at http://www.mhd.state.ma.us/ within two (2) business days following its receipt of the relevant issue of the "Asphalt Weekly Monitor". Poten and Partners has granted the MassDOT the right to publish this specific asphalt price information sourced from the Asphalt Weekly Monitor. This method of period price determination was formerly called the New Asphalt Period Price Method. Separate website postings using both the New Asphalt Period Price Method and the Old Asphalt Period Price Method were discontinued after June 2013.
         b) Price Adjustment Determination, Calculation and Payment - Price Adjustments, as herein provided, either upwards or downwards, will be made after the work has been performed using the monthly period price for the month during which the work was performed. Price Adjustments will be paid only if the variance from the Base Price is 5 percent or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5 percent from either upward or downward adjustments. The Price Adjustment applies only to the actual virgin liquid asphalt content in the mixture placed on the job in accordance with the Standard Specifications for Highways and Bridges, Division III, Section M3.11.03. No adjustment will be paid for work done beyond the completion date. Price Adjustments for a positive price adjustment (a payment) and a negative price adjustment (a deduction) will be calculated using the following equation:
         c) Price Adjustment = Tons of HMA Placed x Liquid Asphalt Content % x RAP Factor x (Period Price - Base Price).

2. Diesel Fuel` and Gasoline

   a) Price period - The Period Price will be the average of prices charged to the State, including State Tax for the bulk purchases made during each month.

   b) Price Adjustment Determination, Calculation and Payment - Price Adjustments, as herein provided, either upwards or downwards, will be made after the work has been performed using the monthly period price for the month during which the work was performed. This adjustment will be based on fuel usage factors for various items of work developed by the Highway Research Board in Circular 158, dated July 1974. These factors will be multiplied by the quantities of work done in each item during each monthly period and further multiplied by the variance in price from the Base Price to the Period Price. The Base Price of Diesel Fuel and Gasoline will be the price as indicated in the Department's web site (www.MassDOT.state.ma.us) for the month in which the contract was bid, which includes State Tax. This adjustment will be affected only if the variance from the Base Price is 5 percent or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5 percent from either upward or downward adjustments. Any adjustment (increase or decrease) to estimated quantities made to each item at the time of final payment will have the fuel price adjustment figured at the average period price for the entire term of the project for the difference of quantity. No adjustment will be paid for work done beyond the completion date. The fuel price adjustment will apply only to the following items of work at the fuel factors shown:

SRF Eligible Bid Item Covered	Diesel Fuel	Gasoline
2. Sewer Pipelines and Associated Fittings	X	X
3. Precast Concrete Manholes and Structures	X	X
8. Rock and/or Boulder Excavation	X	X
9. Replacement of Unsuitable Material	X	X
10. Experimental Excavation	X	X
14. Road Gravel	X	X
15. Pavement Restoration	X	Does Not Apply

8. No additional payment will be made beyond the payment limits noted or for maintenance or repair of trenches.

9. Payment for joint sealant and/or tack coat shall be included under the applicable division of this Bid Item for bituminous concrete Work.

10. Payment for adjusting frames and covers, valve boxes and all other castings prior to placement of permanent bituminous concrete pavement shall be included under the applicable division of this Bid Item for bituminous concrete Work.

11. Payment for reshaping of roadways and/or road shoulders, roadway reclamation, regrading and compaction of roadway base course materials and or providing leveling course over settled trenches shall be included under the applicable division of this Bid Item for bituminous concrete Work.

ITEM 16 - REMOVE AND RELAY OR REPLACE EXISTING UTILITIES

A. General. The prices bid under each division of this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified which shall include transportation, handling and dispersal of materials, removal and legal disposal of excess materials, furnishing and installation of new replacement materials (including but not limited to pipe and accessories, couplings, fittings, manholes and catch basins), excavation (excluding that which is specified to be paid for separately), backfill above trench grade including all bedding materials (excluding material used to replace unsuitable material and road gravel), compacting trenches, sheeting and shoring not ordered left in place, testing (excluding soil compaction tests specified to be paid for separately), daily cleanup, restoration of all areas disturbed by the Contractor's operations that are not included for payment under another Bid Item, and all other incidental Work relative thereto.

B. Measurement. Measurement for removal and relaying or replacing existing utilities shall be as follows:

1. Measurement for the removal and relaying or replacement of existing water, sewer, storm drain, and/or gas pipelines and appurtenances, within the allowable trench width only, will be made by multiplying the inside diameter of the relaid or replaced pipeline by the length of relaid or replaced pipeline. For measurement purposes, the allowable trench width will be defined as follows:

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

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

2. Measurement for removal and resetting or replacement of manholes and catch basins will be made by multiplying the inside diameter of the manhole or catch basins by its height.

C. Payment. Payment for the removal and relaying or replacement of existing water, sewer, storm drain and/or gas pipelines and appurtenances listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the unit prices bid per inch-foot under the applicable divisions of this Bid Item.

1. Payment will only be made for the removal and relaying or replacement of existing water, sewer, storm drain and/or gas pipelines and appurtenances when (1) such utilities are removed and relaid or replaced as a result of conflicts in elevation with the grade of the new pipelines or (2) the length of such existing utilities within the allowable trench width that cross above the new pipeline is greater than two and one-half (2.5) times the width of the allowable trench limit or (3) such utilities lie completely within the allowable trench width and the existing utility invert is a minimum of two (2) feet above the crown of the new pipeline as approved by the Engineer.

2. Payment for removal and resetting or replacement of manholes and catch basins shall include resetting frames and covers or grates.

3. No payment will be made for the removal and relaying or replacement of utilities which lie either partially or completely beyond the allowable trench width.

4. Payment for the removal and relaying or replacement of miscellaneous utilities shall be made at the unit price bid under this item. Payment for planting materials shall be made based on the actual charges paid by the Contractor. An amount of 100 percent of each paid invoice (no retainage) will be made to the Contractor based on paid invoice receipts.

5. No payment will be made for the removal and relaying or replacement of utilities other water, sewer, storm drain, and/or gas pipelines and appurtenances which are damage due to the contractor’s means and methods of construction.

6. The following utility allowance(s) shall be included in the applicable subdivision of this Bid Item:

   a. Removal and Relaying and/or Replacement of Existing Gas Main and Services. Refer to SECTION 01020, ALLOWANCES.

   b. Removal and Relaying and/or Replacement of Existing Miscellaneous Utilities. Refer to SECTION 01020, ALLOWANCES.

ITEM 17 - UNIFORMED TRAFFIC POLICE OFFICERS

A. General. Payment for the services of uniformed police officers shall be made at the prevailing rates of pay for special duty details in effect at the time of services, for each permanent, special or reserve officer and for graduated rank. Uniformed police officers shall be paid directly by the Owner. The Contractor is responsible for coordination of the police details.

1. Uniformed police officers used for special duty details are paid a four (4) hour minimum.

2. If arrangements have been made for uniformed police officers and inclement weather or other factors prohibit Work, the Contractor must contact the Police Department not later than two (2) hours before the scheduled start time on the day of Work to cancel the police detail.

3. If the Contractor fails to notify the Police Department of the cancellation of a scheduled detail, then it assumes all costs for the (4) hour minimum.

B. Measurement. Not Applicable

C. Payment. Not Applicable

ITEM 18 - ENGINEER'S FIELD OFFICE

A. General. The prices bid under each division of the Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to furnish, install maintain and remove the Engineer's Field Office as specified, including all other incidental Work relative thereto. The Engineer shall notify the Contractor when the Engineer’s Field Office is to be removed from the site.

B. Measurement. Measurement for furnishing, installing, maintaining and removing the Engineer's Field Office shall be as follows:

1. Measurement for payment for furnishing, installing and subsequent removal of the Engineer's Field Office shall be for one (1) complete and acceptable unit as approved by the Engineer.

2. Measurement for payment for maintaining the Engineer's Field Office shall be per week as approved by the Engineer.

C. Payment. Payment for furnishing, installing, maintaining and subsequent removal of the Engineer's Field Office listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the lump sum and unit prices bid under the applicable divisions of this Bid Item.

1. Payment for furnishing, installing and removal of the Engineer’s Field Office shall be made at the lump sum price bid under the applicable division of the Bid Item. The lump sum price bid shall include transporting, mobilization, demobilization, utility connection fees, permits, licenses, insurance, and all other labor, materials, and equipment required to furnish the Engineer's Field Office as specified. An amount of seventy-five (75) percent of the amount bid (exclusive of normal contract retainage) will be made when the Engineer’s Field Office is ready for occupancy and use on the Project. The remaining twenty-five (25) percent (exclusive of normal contract retainage) will be made following the removal of the Engineer’s Field Office from the Project.

2. Payment for maintaining the Engineer’s Field Office shall be made at the unit price bid per week under the applicable division of this Bid Item. Maintaining the Engineer's Field Office shall include all maintenance, rental fees, utility charges, sanitary fees, equipment rental charges, and all other costs related to the weekly operation of the Engineer’s Field Office. Payment will be made for those periods of time that the Engineer has directed the Contractor to provide the Engineer’s Field Office. No payment will be made for the Engineer’s Field Office that was not requested by the Engineer, or that remained on the Project after the Engineer notified the Contractor to remove it.

3. The Owner reserves the right to delete from the Work any or all divisions of this Bid Item without penalty.

4. No payment shall be made once the Contractor’s time for completion has been reached.

ITEM 19 - ENVIRONMENTAL PROTECTION

A. General. The prices bid under each division of this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include furnishing, installing, maintaining and removing sedimentation control barriers and structures and all other incidental Work relative thereto.

B. Measurement. Measurement for Environmental Protection shall be as follows:

1. Measurement for furnishing, placing, maintaining, and removal of sedimentation barriers shall be per linear foot of measured length of in-place barrier as approved by the Engineer.

2. Measurement for furnishing, placing, maintaining, and removal of sedimentation control structures shall be per each as approved by the Engineer.

C. Payment. Payment for Environmental Protection listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made under the applicable divisions of this Bid Item as follows:

1. Payment for sedimentation control barriers shall be made at the unit price bid per linear foot.

2. Payment for sedimentation control structures shall be made of the unit price bid per each approved installation.

3. No additional payment will be made for maintaining or replacing sedimentation barriers or control structures during the course of the Work.

ITEM 20 - DEWATERING

A. General. The price bid under this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified which shall include Work performed by the Contractor, Contractor's Subcontractor(s) or Consultants, design, permits, installation, operation, maintenance and removal of the dewatering system (including but not limited to pumps, well points, header pipes and approved discharge point preparation and restoration), legal disposal of all water discharged during the operation of the dewatering system, restoration of all areas disturbed by the Contractor's operations and all other incidental Work relative thereto. The Contractor shall engage a Commonwealth of Massachusetts Registered Professional Engineer with experience in the design of dewatering systems consisting of only well points in order to pre-drain the area prior to excavation below the groundwater level

B. Measurement. Measurement for dewatering shall be by the linear foot of pipe trench dewatered as approved by the Engineer.

C. Payment. Payment for dewatering listed in DOCUMENT 00410, FORM OF GENERAL BID shall be made at the linear foot price bid under this Bid Item and as follows:

1. Payment will be made for well point dewatering systems utilized to dewater the trench excavation.

2. No payment will be made for other type of dewatering systems including dewatering systems utilized within the limit of the trench excavation.

ITEM 21 - TEMPORARY BY-PASS PUMPING – Not Used

ITEM 22 - PROPRIETARY EQUIPMENT ALLOWANCES

A. General. Allowances specified in SECTION 01020, ALLOWANCES as being part of the Wastewater Treatment Facility shall be included under this Bid Item.

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

C. Payment. Allowances specified in SECTION 01020, ALLOWANCES as being part of the Wastewater Treatment Facility shall be included under this Bid Item. Payment for the allowances under Item 22 which are listed in SECTION 01020, ALLOWANCES shall be based upon the actual time and materials or Lump Sum as approved by the Owner. If the actual costs exceed the allowance, the difference will be paid by the Owner. Should the actual cost be less than the allowance, the Owner will retain the difference. Refer to SECTION 01020, ALLOWANCES.

ITEM 23 - PUMPING STATION

A. General. The prices bid under each division of the Bid Item shall be considered as fair compensation for all labor, equipment, tools, and materials necessary to complete the Work, as specified, located within the limit of Work shown for the construction of Pumping Station 4 shown on the Contract Drawings. This shall include all Work performed by the Contractor, Subcontractor(s) or Contractor's Consultant(s) for the construction of a complete pumping station including but not limited to, wetwell, valve vault, piping, values, flow measurement device, odor control system, control pedestal, emergency generator, planting operations, restoration, utility company coordination/fees, start-up and testing, and all other incidental Work relative thereto.

In addition to the above, the Work shall include the following:

1. Pumping Station No. 4
    a. Coordination of Work to maintain continuous operation of the existing sanitary system, pumping stations and treatment facility and leaching field.
    b. Upon completion and acceptance by the Owner of the new collection system, demolish and legally dispose of the existing on-site sewage disposal system.
    c. Connection of existing sanitary service into the new collection system upon acceptance by the Owner of the new collection system.

B. Measurement

1. Measurement for each pumping station constructed shall be made based on a percentage of the total lump sum amount bid under each subdivision of this Bid Item, as approved by the Engineer.
2. Measurement for utility charge allowance(s) shall be based on the actual paid invoices by the Contractor to each utility company and/or nursery. The following utility and nursey allowance(s) shall be included in the applicable subdivision of this Bid Item:
    a. Submersible Pumps. Refer to SECTION 01020, ALLOWANCES
    b. Variable Frequency Drives. Refer to SECTION 01020, ALLOWANCES
    c. Odor Control System. Refer to SECTION 01020, ALLOWANCES
    d. Standby Diesel Engine Drive Generator. Refer to SECTION 01020, ALLOWANCES
    e. Davit Crane. Refer to SECTION 01020, ALLOWANCES
    f. Electric Company Connection/Service Fee. Refer to SECTION 01020, ALLOWANCES
    g. Telephone Company Connection/Service Fee. Refer to SECTION 01020, ALLOWANCES
    h. Planting Operations. Refer to SECTION 01020, ALLOWANCES

C. Payment.

1. Payment for each pumping station constructed listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum price bid under each subdivision of this Bid Item. Payment for each pumping station constructed shall be made as follows: An amount of 60 percent of applicable division of this Bid Item (exclusive of normal contract retainage) shall be made when each pumping station is completely constructed which includes all site and utilities Work. The remaining 40 percent (exclusive of normal contract retainage) shall be made following acceptance of each pumping station by the Owner, including startup and testing, training of Owner personnel, delivery and approval of Operation and Maintenance Manual(s) and receipt by Owner of all specified spare parts.
2. Payment for submersible pumps, variable frequency drives, odor control system, standby diesel engine drive generator, and davit crane shall be based upon the actual time and materials or Lump Sum as approved by the Owner. If the actual costs exceed the allowance, the difference will be paid by the Owner. Should the actual cost be less than the allowance, the Owner will retain the difference.

3. Payment for utility company charges shall be made based on the actual charges paid to each utility by the Contractor. An amount of 100 percent of each paid invoice (no retainage and not markup) will be made to the Contractor based on paid invoice receipts.

4. Payment for planting operations charges shall be made based on the actual charges paid to each landscaper and/or nursery by the Contractor. An amount of 100 percent of each paid invoice (no retainage and not markup) will be made to the Contractor based on paid invoice receipts.

5. No other payment Item will be used for compensation of Work performed within the limit of work line shown on the Contract Drawings for each pump station.

ITEM 24 – REPLACEMENT OF WATER SERVICES

A. General. The prices bid under each division of this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include, but not limited to, transportation. handling and dispersal of materials; cutting and removal of existing bituminous and cement concrete or reinforced cement concrete pavement; excavation, backfill above trench grade including all bedding materials (controlled density fill and road gravel); removal and legal disposal of all existing water services and appurtenances being replaced; compacting trenches; sheeting and shoring not ordered left in place; loaming and seeding; landscaping; removing and resetting curbing, property markers, signs and mail boxes; connections to existing water pipeline(s) and services; dust control including mechanical sweeping; all permanent and temporary fittings, caps, plugs, restraints and the like; traffic control devices; flushing/cleaning of services; testing (pressure, leakage, bacteriological, compaction, etc.); dewatering of trenches; daily cleanup; restoration of all areas disturbed by the Contractor's operations; all Work as specified in DIVISION 1 – GENERAL REQUIREMENTS; and all other incidental Work relative thereto.

B. Measurement. Measurement for replacement of water services and associated fittings and valves shall be as follows:

1. Measurement shall be the horizontal measured length of water service in place from the face of the corporation to the terminus of the water service at the property line.

2. Measurement shall be as stated above with a minimum payment of five (5) linear feet.

3. Measurement for the following divisions of this Bid Item shall be in accordance with the measurement descriptions under ITEM 15 – PAVEMENT RESTORATION:

   a. Road Gravel Material

   b. Temporary Bituminous Concrete Trench Pavement

   c. Permanent Bituminous Concrete Trench Pavement

4. No other measurement Item will be used for compensation of Work performed under this Bid Item.

C. Payment. Payment for replacement of water services and associated fittings listed in DOCUMENT 00410, FORM OF GENERAL BID, shall be made at the unit prices bid under the applicable divisions of this Bid Item.

1. Payment for water services shall be made at the unit price bid per linear foot.

2. Payment for the following divisions of this Bid Item shall be in accordance with the payment descriptions under ITEM 15 – PAVEMENT RESTORATION:

   a. Road Gravel Material

   b. Temporary Bituminous Concrete Trench Pavement

   c. Permanent Bituminous Concrete Trench Pavement

3. No other payment Item will be used for compensation of Work performed under this Bid Item.

ITEM 25 – REPLACEMENT OF BAXTER LANE AND LUCY'S LANE WATER MAINS

A. General. The prices bid under each division of this Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, which shall include, but not be limited to, transportation. handling and dispersal of materials; cutting and removal of existing bituminous and cement concrete or reinforced cement concrete pavement; excavation, backfill above trench grade including all bedding materials (controlled density fill and road gravel); removal and legal disposal of all existing water mains, water services, fire hydrants, gate valves, etc. being replaced (including pipes, services, and appurtenances); temporary water polyethylene wrap; reconnecting existing fire hydrants; compacting trenches; sheeting and shoring not ordered left in place; loaming and seeding; landscaping; removing and resetting curbing, property markers, signs and mail boxes; connections to existing water pipeline(s) and services; dust control including mechanical sweeping; all permanent and temporary fittings, caps, plugs, restraints and the like; traffic control devices; flushing/cleaning of water mains; testing (pressure, leakage, bacteriological, compaction, etc.); dewatering of trenches; polyethylene encasement; daily cleanup; restoration of all areas disturbed by the Contractor's operations; all Work as specified in DIVISION 1 – GENERAL REQUIREMENTS; and all other incidental Work relative thereto.

B. Measurement. Measurement for furnishing and installing water mains and associated fittings, water services fire hydrants and valves shall be as follows:

1. The length of water mains to be paid for shall be the horizontal measured length of pipeline in place (e.g., connection to existing water main to remain to connection to existing water main to remain). Measurement shall be by the linear foot with no deductions made for fittings or valves.
2. Measurement for water services shall be by the linear foot.
    a. Measurement for water services shall be the horizontal measured length of pipeline in place from the face of the corporation to the terminus of the water service at the property line.
    b. Measurement shall be as stated above with a minimum payment of five (5) linear feet.
3. The number of valves to be paid under the appropriate subdivisions of this Bid Item and shall be equal to the actual number installed.
4. The number of hydrants to be paid under the appropriate subdivisions of this Bid Item and shall be equal to the actual number installed.
5. Measurement for the following divisions of this Bid Item shall be in accordance with the measurement descriptions under ITEM 15 – PAVEMENT RESTORATION:
    a. Road Gravel Material
    b. Temporary Bituminous Concrete Trench Pavement
    c. Permanent Bituminous Concrete Trench Pavement
6. No other measurement Item will be used for compensation of Work performed under this Bid Item.

C. Payment. Payment for furnishing and installing water mains and associated fittings and water services of the various types, diameters and depths listed in DOCUMENT 00410, FORM OF GENERAL BID, shall be made at the unit prices bid under the applicable divisions of this Bid Item.

1. Only eighty-five (85) percent of the price bid per linear foot of water main shall be paid for upon its installation, the balance shall be withheld until such time as water main(s) have been successfully flushed and tested (as required), accepted by the Owner for incorporation into the existing water system and the site(s) has been fully restored. This percentage is exclusive of normal Contract retainage.
2. Payment for water services shall be made at the unit price bid per linear foot.
3. Payment for valves will be paid under the appropriate subdivisions of this Bid Item and shall be equal to the actual number installed.
4. Payment for fire hydrants will be paid under the appropriate subdivisions of this Bid Item and shall be equal to the actual number installed.

5. Payment for the following divisions of this Bid Item shall be in accordance with the payment descriptions under the ITEM 15 – PAVEMENT RESTORATION:
    a. Road Gravel Material
    b. Temporary Bituminous Concrete Trench Pavement
    c. Permanent Bituminous Concrete Trench Pavement
6. The Contractor shall provide water for flushing and testing (as applicable) for each section of water main installed. Water utilizing the Owner's water system may be available, however, the Owner does not guarantee that its water supply will be available at any time during the duration of the Project. If available, water required for testing, puddling and/or jetting of trenches shall be provided by the Owner at no cost to the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.
7. No other payment Item will be used for compensation of Work performed under this Bid Item.

ITEM 26 – WATER QUALITY IMPROVEMENTS

A. General. The lump sum price bid under each division of the Bid Item shall be considered as fair compensation for all labor, equipment, tools and materials necessary to complete the Work as specified, including work performed by the Contractor, Subcontractor, or Contractor's Consultants, necessary to complete the Work as specified, which shall include: transportation. handling and dispersal of materials; cutting and removal of existing bituminous and cement concrete or reinforced cement concrete pavement; excavation, backfill above trench grade including all bedding materials (controlled density fill and road gravel); removal and legal disposal of all excess materials; pipes and fittings; compacting trenches; sheeting and shoring not ordered left in place; removal and relaying/replacement of existing water main; loaming and seeding; landscaping; removing and resetting curbing, property markers, signs and mail boxes; temporary pavement restoration; dust control including mechanical sweeping; traffic control devices; flushing/cleaning of pipe and structures; dewatering of trenches; daily cleanup; restoration of all areas disturbed by the Contractor's operations; all Work as specified in DIVISION 1 – GENERAL REQUIREMENTS; and all other incidental Work relative thereto.

B. Measurement. Measurement for Water Quality Improvements shall made based on a percentage of the total lump sum amount bid under each subdivision of this Bid Item, as approved by the Engineer.

C. Payment. Payment for the Water Quality Improvements listed in DOCUMENT 00410, FORM FOR GENERAL BID shall be made at the lump sum price bid under each subdivision of this Bid Item.
    1. The Lump Sum price bid under this item shall include the removal of 10 cubic feet of rock and/or boulders located within the excavation.
    2. No other payment Item will be used for compensation of Work performed under this Bid Item.

1.05 - BASIS OF MEASUREMENT AND PAYMENT – SRF INELIGIBLE ITEMS – Not Used

PART 2 - PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

END OF SECTION

SECTION 01026

PAYMENT PROCEDURES

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1.01 - FORMAT 1
1.02 - SUBMITTAL PROCEDURES 1
1.03 - APPLICATIONS FOR PAYMENT 2
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PART 3 – EXECUTION – Not Used 3

PART 1 – GENERAL

1.01 - FORMAT

A. Form of General Bid, submitted by the Successful Bidder, as modified by any executed Change Order, will be the basis of all payments to the Contractor. The Engineer may require further breakdown of certain lump sum items to be included as deemed necessary by the Engineer. The Form of General Bid will serve as the basis for progress payments and will be incorporated into a form of Application for Payment as specified herein.

B. Contractor shall submit two Applications for Payment and invoices, covering the Work, less retainage, as specified in the Agreement, performed in each calendar month, for each month for the duration of the Work.

C. Contractor shall submit to the Engineer an Application for Payment on the specified form, provided by the Engineer in Microsoft Excel format, and attach a separate invoice, for the Work completed in the calendar month covered by that Application for Payment. Contractor shall submit each Application for Payment using AECOM Form S702 – Application and Certification for Payment, and AECOM Form S703 – Continuation Sheet, attached to this Specification. The Form of General Bid shall form the basis for Form S703.

D. The Engineer shall return, without review, any invoice not accompanied by completed S702 and S703 forms.

1.02 - SUBMITTAL PROCEDURES

A. Contractor shall submit original Application for Payment and invoice, and one copy of each, to the Engineer's Work Order Representative for review.

B. Once invoice is approved by Engineer, Contractor shall submit invoice to Owner per the requirements in the Agreement.

C. Contractor shall submit invoices at intervals not less than 30 days. Contractor shall submit an invoice for each month no later than the invoice closing date of the following month as set by the Engineer.

D. Contractor shall prepare a final Application for Payment and invoice as specified in Specifications SECTION 01700, CONTRACT CLOSEOUT.

1.03 - APPLICATIONS FOR PAYMENT

A. An Application for Payment form is attached with this Specification. A completed copy of the attached AECOM Forms S702 and S703 shall accompany each invoice.

B. Applications for Payment shall be executed and certified by signature of authorized officer of Contractor in the space indicated on Form S702.

C. Contractor shall list original Work Order amount, and each authorized Change Order and Work Change Directive, listing Change Order or Work Change Directive number and dollar amount.

D. Retainage in the amount of 5 percent shall be withheld as specified in the Agreement. This retainage shall be itemized on the Form S702 and Form S703 form.

E. Fair market value for work not completed shall be withheld as specified in the Agreement. This fair market value shall be itemized on the Form S702 and Form S703 form

1.04 - INVOICES

A. Each invoice shall be accompanied by the specified Application for Payment form and shall show the following:

1. The date of the Contract Documents.
2. Purchase Order Number.
3. Purchase Order Date.
4. A description of the Work performed (the description of the Work shall document site location, Project code number, and detail the actual Work performed and completed).

B. Invoices that include previously approved Work performed on a Time and Materials (T&M) or Cost Plus (CP) basis shall be supported with copies of daily time sheets, and Contractor shall attach photocopies of receipts for all materials and expenses claimed as T&M or CP Work. Lack of complete documentation for T&M or CP Work will be just cause for refusal by the Engineer to certify payment for such claimed costs, pending submittal of required documentation. All documentation shall be submitted and approved prior to invoice submittal. Contractor shall submit backup copies of all required paperwork that was previously submitted as a part of a daily or weekly submittal.

C. Each invoice shall be accompanied by Certified Payroll for the entire period of the invoice.

1.05 - SUBSTANTIATING DATA

A. The Engineer may request substantiating data for any claimed payment. When the Engineer requires substantiating data, Contractor shall submit within 30 days data justifying quantities of Work and dollar amounts in question. The Engineer may conditionally approve any claimed payment pending submittal of acceptable substantiating data. Unsubstantiated claims for payment will result in withholding of the unsubstantiated amounts from subsequent payment claims.

B. Contractor shall submit one copy of substantiating data with cover letter for each request for substantiating data. Each submittal of substantiating data shall show Application for Payment number, date and pay item by number and description.

1.06 - PAYMENT PROCEDURES

A. For unit price bid items, the product of the actual measured quantities suitably installed and accepted and the unit prices from the accepted bid proposal constitutes the extended total for payment. The extended total is the unit price times the quantity indicated. An adjustment of the unit price bid for an item in the proposal will only be considered if the actual quantity furnished and installed is greater than 25 percent above or below the estimated quantity. Said adjustment will only be applicable to that measured quantity which is 25 percent above or below the estimated quantity. For Lump Sum items suitability installed and completed the lump sum amount listed in the accepted bid proposal constitutes the total for payment.

B. Progress Payments; Retainage. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER, and in accordance with the applicable Massachusetts General Law during construction. All such payments will be measured by the schedule of values established in

C. Article 14.01 of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

D. Progress payments will be made in an amount equal to 95 percent of Work completed (with the balance being retainage) but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with the General Conditions.

E. Final Payment. Upon final completion and acceptance of the Work in accordance with the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

END OF TEXT

SEE ATTACHED PAYMENT FORM

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APPLICATION AND CERTIFICATION FOR PAYMENT **Form S702** PAGE ONE OF PAGES

TO: Town of Orleans, MA

PROJECT: Meetinghouse Pond Area Collection System and Pumping Station

APPLICATION NO:

Distribution to:
☐ ENGINEER
☐ CONTRACTOR

FROM CONTRACTOR:

PERIOD ENDING:

ENGINEER'S PROJECT NO:

CONTRACT FOR:

CONTRACT DATE:

Application is made for payment, as shown below, in connection with the Contract. AECOM Form S703 Continuation Sheet is attached.

1. ORIGINAL CONTRACT PRICE $ _____
2. Net change by Change Orders $ _____
3. CONTRACT PRICE TO DATE (Line 1 + 2) $ _____
4. TOTAL COMPLETED & STORED TO DATE (Column G on Continuation Sheet) $ _____
5. RETAINAGE/FAIR MARKET VALUE:
   a. 5% of Completed Work (Column D + E on Continuation Sheet) $ _____
   b. Materials Stored to Date (Column F on Continuation Sheet) $ _____
   c. Fair Market Value for Work Not Completed $ _____
   Total $ _____
6. TOTAL EARNED LESS RETAINAGE / FAIR MARKET VALUE (Line 4 Less Line 5 Total) $ _____
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate) $ _____
8. CURRENT PAYMENT DUE $ _____
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 Less Line 6) $ _____

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief, the Work covered by this Application for Payment has been completed in accordance with the Specifications and Drawings, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By:_____ Date:_____

State of: County of:
Subscribed and sworn to before me this ___ day of _____, ____
Notary Public:
My Commission expires:

ENGINEER'S RECOMMENDATION FOR PAYMENT

In accordance with the Agreement, Specifications and Drawings, based on on-site observations and the data comprising the application, the Engineer recommends that to the best of the Engineer's knowledge, information and belief, the Work has progressed as indicated, the quality of the Work is in accordance with the Specifications and Drawings, and the Contractor is entitled to payment of the Amount Recommended.

AMOUNT RECOMMENDED $ _____

(Attach explanation if Amount Recommended differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner		
Total approved this Month		
TOTALS		
NET CHANGES by Change Order		

ENGINEER:

By: _____ Date: _____

OWNER:

By: _____ Date: _____

CONTINUATION SHEET **Form S703** PAGE __ OF __ PAGES

1. Form S702, APPLICATION AND CERTIFICATION FOR PAYMENT, APPLICATION NO:

   including Contractor's signed certification is attached. APPLICATION DATE:

2. In tabulations below, amounts are stated to the nearest dollar. PERIOD ENDING:

3. Use Column I on contracts where variable retainage for line items may apply.

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED		MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G/C)	BALANCE TO FINISH (C - G)	RETAINAGE / FAIR MARKET VALUE
			TOTAL FROM PREVIOUS APPLICATION	THIS PERIOD					
	GRAND TOTALS								

SECTION 01030

SPECIAL REQUIREMENTS

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes the furnishing of all labor, materials, tools and equipment required to perform Special Requirements as specified herein.

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

1.02 - MEASUREMENT AND PAYMENT

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

1. All costs associated with locating, maintaining location marks, excavation, refilling, compaction, repairing utilities broken due to the Contractor's operations, time delays relative to existing utilities and all other Work associated with utilities shall be included for payment under the applicable pipe laying item included in DOCUMENT 00300, BID FORM.

2. All costs associated with the legal disposal of excess materials shall be borne by the Contractor.

3. No additional payment will be made for corrective work associated with furnishing and installing bedding materials for refill of excavations carried to grades lower than specified. If inadequate dewatering methods cause softening of subgrade areas then remove the unsuitable material and replaced with common fill and shall be borne by the Contractor.

4. No payment will be made for temporary shoring of trench walls utilizing trench boxes and/or steel plates. Where timber or steel sheeting is used and is not specified to be paid for separately and ordered left in place by the Engineer, the Contractor has the option of leaving it in or removing it after it has been cut off one (1) foot above the top of the pipe.

5. Pay all fees for permits associated with blasting operations. Unauthorized excavations in rock, or excavations made beyond or below the specified limits shall be refilled and compacted with common fill and shall be borne by the Contractor. Perform blasting operation(s) in such a manner that no existing utilities are disturbed. All damage to existing utilities or roadway surfaces outside the trench limits caused by the Work of the Contractor or its Subcontractor(s) shall be repaired and/or replaced immediately and shall be borne by the Contractor.

6. No additional payment will be made for the relocation and/or support of any obstruction encountered along the line of Work.

7. Testing, puddling and/or jetting of trenches utilizing the Owner's water system may be available, however the Owner does not guarantee that its water supply will be available at any time during the duration of the Project. Contractor is responsible for making all arrangements and gathering necessary permissions from the Owner's water district for use of water. Use of water shall be at the Contractor's expense. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and shall be borne by the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

8. Provide detailed plan(s) to the Owner and/or appropriate governing body for all proposed detours and/or partial roadway closings made necessary by the Work. Obtain written approval for all proposed detours and/or partial roadway closings prior to the start of Work. No payment will be made for Work performed in areas of the Project that require an approved traffic management plan until it has been secured. All work shall be in accordance with SECTION 01570, TRAFFIC MANAGEMENT AND MAINTENANCE.
9. All costs associated with repairing settlement of trenches shall be borne by the Contractor.
10. All costs associated with meeting the requirements of all environmental permits, state highway permits and the removal and/or reinstallation of existing utilities shall be borne by the Contractor and shall be included for payment under the applicable pipe laying item included in DOCUMENT 00300, BID FORM.
11. American Iron and Steel (AIS) certifications for all applicable materials must be included with the product shop drawing or the submittal will be rejected. Certification requires a project specific letter that certifies the manufacturing process and foundry location of the subject products and/or materials. There will be no payment for items that do not have approved AIS certification.

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

A. Submit to the Engineer for approval, shop drawings, certificates of compliance and/or catalog cuts for all items to be furnished under this Contract. All submittals shall be provided in accordance with DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Digital Videodisc Recording

1. Prior to the start of construction, video record, in color, the entire Project site(s) in the presence of the Engineer. Video recordings shall be in digital videodisc (DVD) format. Particular attention shall be made to the existing condition of roadway surfaces, curbing, berms, sidewalks, driveways, property bounds, landscaped areas, and any other items that might be affected by the Work.
2. Video recordings shall be of excellent quality including clear and concise audio descriptions of the existing site(s) conditions. A copy of the first Existing video recording shall be furnished to the Engineer, prior to the start of construction, in order to establish the requirement for visual and audio quality. Two (2) copies of all video recordings shall be provided to the Engineer. Any recordings furnished which, in the opinion of the Engineer, are of poor quality or incomplete, shall be redone at no additional cost to the Owner.

3. Video recordings shall be made by the Contractor in the presence of the Owner/Engineer.

4. No construction activities shall commence until the video recordings have been Existing, submitted to the Engineer and approved by the Engineer.

C. Health and Safety Plan

1. Prior to the start of construction, prepare and submit a site-specific Health and Safety Plan which includes consideration of all known and potential hazards at the site. Work may not proceed at the project site until the Contractor's Health and Safety Plan has been received by the Engineer.

2. Contractor shall be cognizant of the minimum standards set forth in OSHA 29 CMR 1910.120. The Health and Safety Plan shall include, but not be limited to the following:

a. Identification of Contractor's Site Safety Officer.

b. Identification of hazards and risks associated with the Project.

c. Contractor's standard operating procedures, including personnel training and field orientation.

d. Respiratory protection training requirements.

e. Levels of protection and selection of equipment procedures.

f. Type of medical surveillance program.

g. Personal of hygiene requirements and guidelines.

h. Zone delineation of the Project site.

i. Site security and entry control procedures.

j. Field monitoring of site contaminants.

k. Contingency and emergency procedures.

l. Listing of emergency contacts.

3. The personal protective equipment required to provide the appropriate level of dermal and respiratory protection shall be determined based on the results of continuous air monitoring performed by the Contractor and the standards set forth in the Contractor's Health and Safety Plan.

D. Utilize the Shop Drawing Transmittal Forms supplied by the Engineer for all required submittals.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

1.06 - DESIGN CRITERIA

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

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

1.07 - SPECIFICATIONS AND DRAWINGS

A. All Work shall conform to these specifications and the accompanying drawings entitled:

TOWN OF ORLEANS, MASSACHUSETTS
MEETINGHOUSE POND AREA COLLECTION SYSTEM AND PUMPING STATION
CONTRACT NO. 2022-01
SRF CONTRACT NO. 7150

Dated March 2023 consisting of 121 sheets, all made by the Engineer, on file with the Owner, and any changes, drawings, plans, and directions that may be furnished from time to time by the Engineer.

1.08 - PROGRESS OF WORK

A. Promptly start and continue actual construction Work under this Contract with the necessary equipment to properly execute and complete the Work in the specified time. No cessation of construction activities will be allowed without the written approval of the Owner.

B. Furnish to the Engineer a progress schedule for the Work prior to the start of construction.

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

1.09 - DETOURS AND ROAD ACCESSIBILITY

A. Contact the responsible heads of the MassDOT, Department of Public Works and Natural Resources, Fire Department, Police Department, and other appropriate governing bodies of the municipality having jurisdiction over all or part of the proposed Project, in order to obtain all necessary permits and determine the requirements of these governing bodies, with regards to traffic control.

B. There are no guarantees that total roadway closures will be permitted. Incorporate into the construction schedule the ability to maintain one (1) lane of traffic at all times during the execution of the Work and complete the Work within the Completion date. Where the roadway under construction is the only means of vehicular access to a particular area provide continual access to the area for residents and emergency vehicles.

C. Wherever detours are permitted, the size, construction and location of signs shall conform to local and state requirements and/or standards. Detour routes shall be adequately posted to assist the motorist to return to the normal route of travel for the duration of the Work and for a minimum of two (2) weeks prior to the start of construction in the areas of the Project affected by the Work.

D. Detours and road accessibility shall be in accordance with SECTION 01570, TRAFFIC MANAGEMENT AND MAINTENANCE and as shown of the drawings.

1.10 - CHANGE IN AMOUNT OF WORK

A. The Owner reserves the right to increase or decrease the amount of any item of the Work listed as may be found desirable or necessary during the carrying out of this Contract and the unit prices included in DOCUMENT 00300, BID FORM shall apply without change to such variation in the quantity of each of the Bid items to the extent provided by law.

B. Based on the actual work required, the increase or decrease in the quantity of any bid item of the Work included in DOCUMENT 00300, BID FORM shall apply without changes to the unit prices.

1.11 - SCOPE OF WORK AND SEQUENCE OF CONSTRUCTION

A. The Work to be done under this Contract consists of furnishing and installing wastewater infrastructure, water main replacement water service replacement and water quality improvements as specified and/or as shown on the Contract Drawings.

B. The scope of work includes constructing approximately 15,750 linear feet of 8-inch, 10-inch and 12-inch PVC gravity sewer and appurtenances, approximately 7,500 linear feet of 6-inch and 8-inch PVC force main and appurtenances, approximately 20,750 linear feet of 1.5-inch, 2-inch and 3-inch low pressure sewer and appurtenances and 1 Submersible Pumping Station and appurtenances all to provide wastewater service to the Meetinghouse Pond Area of Orleans, MA.

C. The Work of the Project shall be completed within 880 calendar days following execution of the Contract Document using not more than 529 working days via the following:

1. Preparation, Submittal and Approval of Shop Drawings and Permits

   a) Collection System, Water Main Replacement and Water Improvements – 45 calendar days; and

   b) Pumping Station – 90 calendar days.

   c) Wastewater Treatment Facility Equipment – 90 calendar days.

2. Construction

   a) Main Line (Gravity Sewers and Low-Pressure Sewers), Force Mains, Service Connections, Pumping Station and Appurtenances shall be Existing within 849 calendar days, using not more than 509 working days and working Mondays through Fridays, 8 hours per days and using a minimum of two main line crew, one service connection crew and one cleanup/restoration/paving crew.

   b) Final Roadway Paving and Restoration - 31 calendar days, using not more than 20 working days and working Mondays through Fridays, 8 hours per days and using a minimum of two paving crews and two cleanup/restoration/paving crews.

D. The Work requires the Contractor to utilize a minimum number of two main line crews, one service connection crew and one cleanup/restoration/paving crew all operating simultaneously. Each crew shall consist of all necessary labor, materials and equipment necessary to be self-sufficient. Failure to comply with this requirement will result in no payment for work performed.

E. Additional Construction Constraints

1. Winter Season Work

   a. The Winter Season is defined as October 15 through March 31.

   b. The Contractor is required to place Permanent Bituminous Concrete Trench Pavement each and every Friday. If Permanent Bituminous Concrete Pavement is not available, the Contractor shall place Hot Mix Pavement at no additional cost to the Owner and shall replace the Hot Mix Pavement once Permanent Bituminous Concrete Pavement is available.

   c. The Contractor is responsible for maintaining (e.g., snow plowing, regrading, etc.) the roadways throughout the winter season.

2. Summer Season Work

   a. The project involves work near roadways which are heavily traveled during the summer season (May 15 through September 15). Therefore, work is not allowed on the following roadways:

      - Barley Neck Road
      - Beach Road
      - Great Neck Road
      - Main Street
      - Monument Road
      - Pochet Road
      - Pond Road
      - River Road
      - School Road
      - South Orleans Road (Route 28)
      - Town Hall Parking Lot

   b. The Contractor is required to place Permanent Bituminous Concrete Trench Pavement each and every Friday.

3. Pond Road

   c. The scope of work shown of Drawing 04 C-104, Drawing 04 C-105 and Drawing 04 C-106 shall occur as soon as possible following the award of the contract.

4. Installation of the infrastructure (SMH G-05-08 to Pumping Station No. 4)

   a. Town Hall

      1) The Town Hall has only one entrance/exit which is located off School Road.

         a) The installation of the wastewater infrastructure (gravity sewer, force man, fittings and manholes) from SMH G-05-08 to SMH G-05-04 in the paved entrance/exit shall occur during period of time when the Town Hall is closed.

         b) The installation of the remaining wastewater infrastructure (Pumping Station Components, gravity sewer, force main, fittings, manholes, electrical, demolition, etc.) shall occur as to maximize access to the Town Hall.

      2) Maintain complete operation of the existing on-site wastewater disposal system during installation of the new wastewater infrastructure (pipe, fittings, manholes, pumping station and electrical system). Failure to comply with this requirement will result in a penalty of $5,000 per violation plus any fines imposed by the MassDEP.

      3) Demolition of the existing on-site wastewater system shall occur following written approval by the Engineer that the new wastewater infrastructure (collection system, pumping station, force main, etc.) is substantially complete and ready for service. Obtain a Demolition Permit from the Orleans' Board of Health.

Partial Demolition	**Complete Demolition**
(a) Pump existing structures and legally dispose of all contents; (b) Remove and legally disposal of Pumping System and associated controls and electrical system; (c) Puncture six three-inch diameter holes in bottom of all structures; (d) Plug existing pipes and conduits entering and exiting structures; (e) Demolish top the three-feet of all structures and legally dispose of all debris; and (f) Backfill and compact remaining voids with common fill.	(a) Pump existing structures and legally dispose of all contents; (b) Plug existing pipes entering and exiting structures; (c) Demolish entire structure and foundation and appurtenances and legally dispose of all debris; and (d) Backfill and compact excavations with common fill
• Septic Tank • Pump Chamber	• Distribution Boxes

      4) In addition to the above demolition the Contractor is responsible for the following additional Site Demolition and Site Restoration:

         1) Site Demolition

            • Electrical System: (a) Obtain a Demolition permit from the Orleans's Building Department; (b) Disconnect electrical wiring and control wiring at the Pump Chamber and Control Panel; (c) Remove and legally dispose of all above grade components of the Electrical System; and (d) Cut and legally disposal of and plug existing conduits at the Control Panel three feet below grade.

2) Site Restoration

- Trench Pavement: (a) Cut back each side of trenches by a minimum of 1-foot; (b) Furnish and place 2-inch permanent bituminous concrete trench width pavement (base course); and (c) Furnish and place 1-1/2-inch permanent bituminous concrete trench width pavement (top course).
- Loam and Seed: (a) Grade all disturbed grass areas; (b) Furnish and place 4-inches of loam; and (3) Hydroseed all loam areas.
- Landscaping: (a) Grade all disturbed landscaping areas; and (b) Furnish and place 2-inches of bark mulch.
- Electrical System: If disturbed by the Contractor, Remove and Relay and/or Replace the Existing Underground Electrical System located at the Town Hall. Payment will be made via Bid Item 16D - Removing and Relating/Replacing Miscellaneous Utilities.
- Irrigation System: If disturbed by the Contractor, Remove and Relay and/or Replace the Existing Underground Irrigation System located at the Town Hall. Payment will be made via Bid Item 16D - Removing and Relating/Replacing Miscellaneous Utilities.

It is the Contractor's responsibility to inform all personnel of these requirements, including their staff, subcontractors and suppliers. No exceptions shall be made. Failure to comply with these requirements will result in a penalty of $5,000 per violation.

b. Town Hall - The installation of the pump station control panel, emergency generator, conduits, etc. occurs as shown on the Contract Drawings. The Contractor is required to limit their activities to within the limits of work shown on the Contract Drawings. The Contractor is required to coordinate their activities with the Town Hall. It is the Contractor's responsibility to inform all personnel of these requirements, including their staff, subcontractors and suppliers. No exceptions shall be made. Failure to comply with these requirements will result in a penalty of $5,000 per violation. In addition, the Contractor will be fully responsible for any and all restoration required at no cost to the Owner.

5. Water Services

a. Installation of the wastewater infrastructure includes the crossing of existing water services. The contractor shall coordinate their activities with the Orleans Water Department.

b. Installation of the wastewater infrastructure work includes the replacement of existing water services as shown of the drawings. The contractor shall coordinate their activities with the Orleans Water Department. In addition, these replacement water services will cross existing brick sidewalks. Care shall be taken to minimize the number of bricks removed and to replace the existing brick following installation of the water services. Saw cutting and/or splitting of existing bricks is not allowed. Refer to SECTION 02503, PAVING, CURBING, SIDEWALKS AND ROADWAYS for additional requirements.

c. Water service information is summarized as follows:

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
15	BARLEY NECK ROAD	1" IP		Yes	
25	BARLEY NECK ROAD	1" IP		Yes	
29	BARLEY NECK ROAD	1" IP		Yes	
30	BARLEY NECK ROAD	1" IP		Yes	
33	BARLEY NECK ROAD	1" CTS to CV	6/4/1985		
40	BARLEY NECK ROAD	1" CTS			
44	BARLEY NECK ROAD	1" IP		Yes	

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
46	BARLEY NECK ROAD	1" CTS			
54	BARLEY NECK ROAD	1" IP		Yes	
55	BARLEY NECK ROAD	1" CTS	3/22/2006		
57	BARLEY NECK ROAD	1-1/2 CTS			
60	BARLEY NECK ROAD	1" CTS	7/26/2001		
62	BARLEY NECK ROAD	1-1/2" CTS			
65	BARLEY NECK ROAD	1-1/4" IP		Yes	
67	BARLEY NECK ROAD	1-1/4" IP		Yes	1" CTS To House
68	BARLEY NECK ROAD	1" IP		Yes	
73	BARLEY NECK ROAD	1" CTS			
76	BARLEY NECK ROAD	1" IP		Yes	
78	BARLEY NECK ROAD	1" CTS to CV	10/16/2002		
18	BARLEY NECK ROAD HSE	1-1/2" CTS			
6	BARLEY NECK VILLAGE LANE 1	1-1/2" CTS			
8	BARLEY NECK VILLAGE LANE 2	1" CTS			
10	BARLEY NECK VILLAGE LANE 3	1" CTS			
5	BARLEY NECK VILLAGE LANE 4	1" CTS			Off of 2" CTS From Beach Road
3	BARLEY NECK VILLAGE LANE 5	1" CTS			Off of 2" CTS From Beach Road
1	BARLEY NECK VILLAGE LANE 6	1" CTS			Off of 2" CTS From Beach Road
1	BAXTER LANE	1" CTS		Yes	
3	BAXTER LANE	2" CTS		Yes	
5	BAXTER LANE	1" IP		Yes	
6	BAXTER LANE	1" IP		Yes	
7	BAXTER LANE	1" & 1-1/4" IP		Yes	
9	BAXTER LANE	1" & 1-1/4" IP		Yes	
11	BAXTER LANE	1-1/4" IP		Yes	
12	BAXTER LANE	2" CTS		YES	
15	BAXTER LANE	1-1/2" CTS		Yes	
6	BAYBERRY WAY	2" CTS			
2	BEACH ROAD	1" CTS	12/19/2005		
5	BEACH ROAD	1" CTS to CV			
8	BEACH ROAD	1" IP		Yes	
10	BEACH ROAD	1" IP		Yes	
11	BEACH ROAD	1" IP		Yes	
16	BEACH ROAD	?" IP		Yes	

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
16	BEACH ROAD	1" IP		Yes	
22	BEACH ROAD	1" CTS	10/30/2017		
24	BEACH ROAD	1-1/2" CTS to CV			
26	BEACH ROAD	1" CTS to CV			
27	BEACH ROAD	1" CTS			
30	BEACH ROAD	2" CTS	10/27/2017		
33	BEACH ROAD	1" CTS			
35	BEACH ROAD	1" CTS	10/19/2017		
38	BEACH ROAD	1" CTS to CV	10/10/2017		
39	BEACH ROAD	1" CTS to CV	10/19/2017		
39	BEACH ROAD				Discontinued 9/15/17
40	BEACH ROAD	1" CTS	10/20/2017		
43	BEACH ROAD	1" CTS			
24	BEACH ROAD 1	1-1/2 CTS?			No Good Record
24	BEACH ROAD 2				
24	BEACH ROAD 3				
8	BEACH ROAD 4				
8	BEACH ROAD 5	1-1/2 CTS			
6	BRICK HILL ROAD	1" IP		Yes	
5	CEDAR WAY	1" IP		Yes	
6	CEDAR WAY	1" CTS	7/19/2019		
8	CEDAR WAY	2" CTS			
10	CEDAR WAY	1-1/4" IP		Yes	
12	CEDAR WAY	1" IP			
4	CHENEY ROAD	1" IP		Yes	
7	CHENEY ROAD	1" IP		Yes	
8	CHENEY ROAD	1" IP		Yes	
9	CHENEY ROAD	1" CTS	11/18/2014		
10	CHENEY ROAD	1" CTS	11/15/2016		
14	CHENEY ROAD	1" IP		Yes	
17	CHENEY ROAD	1" CTS			
21	CHENEY ROAD	1-1/4" IP		Yes	
25	CHENEY ROAD	1-1/2" CTS	8/1/2014		
27	CHENEY ROAD	1-1/2" CTS	9/28/2015		
4	COLE PLACE	1" CTS	'9/1989		
6	COLE PLACE	1-1/2" CTS	5/11/1998		
18	COLE PLACE	1" CTS	11/6/2015		
19	COLE PLACE				Off of Nauset Farms Way
20	COLE PLACE	2" IP		Yes	Feed off of Nauset Farms Way

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
9	DEERWOOD LANE	1" CTS			
10	DEERWOOD LANE	1" CTS			
14	DEERWOOD LANE	1" IP		Yes	CV Replaced 11-24-15
15	DEERWOOD LANE	1" IP		Yes	
16	DEERWOOD LANE	1" CTS			
20	DEERWOOD LANE	1" CTS			
21	DEERWOOD LANE	1" CTS			
23	DEERWOOD LANE	1" CTS			
24	DEERWOOD LANE	1" IP		Yes	
104	FINLAY ROAD	1" CTS to CV	4/28/1992		
7	GESNER ROAD	1" CTS	8/26/2019		
8	GESNER ROAD	1" CTS	11/19/1994		
10	GESNER ROAD	1" CTS	11/8/1996		
14	GREAT OAK RD	1-1/2" CTS			
6	GREAT OAK ROAD	1" CTS	4/11/2001		
10	GREAT OAK ROAD	1" IP		Yes	
11	GREAT OAK ROAD	1" CTS	Aug-21		
14	GREAT OAK ROAD	1" IP		Yes	
21	GREAT OAK ROAD	1" CTS	2/3/2012		
22	GREAT OAK ROAD	1" IP		Yes	
26	GREAT OAK ROAD	1" CTS	3/28/2014		
30	GREAT OAK ROAD	1" IP		Yes	
31	GREAT OAK ROAD	1" IP		Yes	
34	GREAT OAK ROAD	1" CTS			
37	GREAT OAK ROAD	1" IP		Yes	
38	GREAT OAK ROAD	1" CTS			
41	GREAT OAK ROAD	?	8/7/1978	?	
43	GREAT OAK ROAD	1" IP		Yes	
45	GREAT OAK ROAD	1" IP		Yes	
47	GREAT OAK ROAD	1" IP		Yes	
48	GREAT OAK ROAD	1" IP		Yes	Off 2" IP Main
51	GREAT OAK ROAD	1" IP		Yes	
52	GREAT OAK ROAD	1" IP		Yes	
53	GREAT OAK ROAD	1" IP		Yes	
55	GREAT OAK ROAD	1" CTS			
59	GREAT OAK ROAD	1" CTS			
18	GREAT OAK ROAD A	2" CTS	1/23/2003		
18	GREAT OAK ROAD B	2" CTS			
11	GRIST ROAD	1" CTS	6/21/1995		

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
12	GRIST ROAD	1" IP		Yes	
15	GRIST ROAD	1" IP		Yes	
2	HARVEY'S LANE	1" IP		Yes	
6	HARVEY'S LANE	1" CTS	3/24/2000		
10	HARVEY'S LANE	2" CTS			
3	HIGH TIDE LANE	1" CTS			
4	HIGH TIDE LANE	1" IP		Yes	
9	HIGH TIDE LANE	1" CTS	4/21/1993		
10	HIGH TIDE LANE	1" CTS			
14	HIGH TIDE LANE	1" IP		Yes	
15	HIGH TIDE LANE	1" IP		Yes	Off 2" IP Main
16	HIGH TIDE LANE	1" IP		Yes	CV Replaced 5-19-95
17	HIGH TIDE LANE	1-1/2" CTS	11/16/2001		
20	HIGH TIDE LANE	1" CTS	2/13/2012		
24	HIGH TIDE LANE	1" CTS	7/2/2002		
25	HIGH TIDE LANE	1" CTS	6/13/2022		
31	HIGH TIDE LANE	1" IP		Yes	
32	HIGH TIDE LANE	1" IP		Yes	
35	HIGH TIDE LANE	1" IP		Yes	
1	HOUSEWRIGHTS WAY	1" CTS			
17	KAREN'S WAY	1" IP		Yes	
18	KAREN'S WAY	1" IP		Yes	
21	KAREN'S WAY	1" CTS	3/27/2019		
22	KAREN'S WAY	1" IP		Yes	
25	KAREN'S WAY	1" IP		Yes	
27	KAREN'S WAY	1" IP		Yes	
31	KAREN'S WAY	1" CTS Poly		Yes	
3	LAKE FARM LANE	1" CTS			
4	LAKE FARM LANE	1" CTS			
6	LAKE FARM LANE	2" CTS			
7	LAKE FARM LANE	1" CTS			
9	LAKE FARM LANE	1-1/2 CTS			
10	LAKE FARM LANE	1" CTS			
15	LAKE FARM LANE	1" CTS			
16	LAKE FARM LANE	1" CTS			
18	LAKE FARM LANE	1" CTS			
21	LAKE FARM LANE	2" CTS			
3	LARBOARD LANE	1" IP		Yes	
4	LARBOARD LANE	1" IP		Yes	

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
7	LARBOARD LANE	1" CTS			Off 1-1/4 or 1-1/2" IP Main in Easement
8	LARBOARD LANE	1" IP		Yes	
9	LARBOARD LANE	1" IP		Yes	
10	LARBOARD LANE	1" IP		Yes	
6	LEWIS ROAD	1" CTS			
7	LEWIS ROAD	1" IP		Yes	Off 2" IP Main
9	LEWIS ROAD	1" IP		Yes	Off 2" IP Main
10	LEWIS ROAD	1" IP		Yes	Off 2" IP Main
12	LEWIS ROAD	1" CTS Poly		Yes	Off 2" Main
14	LEWIS ROAD	2" CTS			2" First 130'
6	LEWIS ROAD REAR	1" CTS			
5	LINDEN LANE	1" CTS			
6	LINDEN LANE	1" CTS			
7	LINDEN LANE	1" CTS			
8	LINDEN LANE	1-1/2" CTS			
9	LINDEN LANE	2" CTS			
29	LOOMIS LANE	1" CTS			
31	LOOMIS LANE	1" CTS			
40	LOOMIS LANE	1" CTS			
42	LOOMIS LANE	2" CTS			
44	LOOMIS LANE	1-1/2 CTS			
46	LOOMIS LANE	1-1/2" CTS			
47	LOOMIS LANE	1-1/2" CTS			
4	LUCY'S LANE	1" CTS		Yes	
7	LUCY'S LANE	1" CTS		Yes	
14	LUCY'S LANE	1" IP		Yes	
15	LUCY'S LANE	1" IP		Yes	
16	LUCY'S LANE	1" CTS		Yes	
17	LUCY'S LANE	1" IP		Yes	
147	MAIN STREET	1-1/4" IP		Yes	Replace with 1-1/2"
157	MAIN STREET	1" IP		Yes	
163	MAIN STREET	1" IP		Yes	
165	MAIN STREET	1" IP		Yes	
168	MAIN STREET	1" CTS	12/9/2005		
169	MAIN STREET	1" CTS to CV			
170	MAIN STREET	1" IP		Yes	
172	MAIN STREET	1" IP		Yes	
174	MAIN STREET	1" IP		Yes	
175	MAIN STREET	1" IP		Yes	

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
178	MAIN STREET	1" IP		Yes	
180	MAIN STREET	1" IP		Yes	
181	MAIN STREET	1" IP		Yes	
184	MAIN STREET	1" IP		Yes	
185	MAIN STREET	1" CTS to CV	9/25/2015		
187	MAIN STREET	1" IP		Yes	
189	MAIN STREET	2" CTS			
191	MAIN STREET	2" CTS			
193	MAIN STREET	1-1/2" CTS			
194	MAIN STREET	1" IP		Yes	
197	MAIN STREET	1" IP		Yes	
197	MAIN STREET	1" IP		Yes	Off 2" IP Main
198	MAIN STREET	2" CTS	7/19/2016		
199	MAIN STREET	1" IP		Yes	
200	MAIN STREET	2" CTS			
202	MAIN STREET	1" IP		Yes	
204	MAIN STREET	2" CTS	8/22/2008		
207	MAIN STREET	1" CTS			
210	MAIN STREET	1" IP		Yes	
210	MAIN STREET	1-1/4" IP		Yes	
210	MAIN STREET	1-1/4" IP		Yes	
210	MAIN STREET	1" IP		Yes	
210	MAIN STREET	3-2" CTS			4" Fire Line
212	MAIN STREET	1" IP		Yes	
216	MAIN STREET	1" IP		Yes	No Info in OWD File
218	MAIN STREET	1-1/4" IP		Yes	Replace with 1-1/2"
219	MAIN STREET	1-1/4" IP		Yes	
219	MAIN STREET	2" CTS			
220	MAIN STREET	1" CTS	12/15/2015		
221	MAIN STREET	1" CTS			Service Relocated off High Tide Lane
222	MAIN STREET	1" CTS to CV			
223	MAIN STREET	1" IP		Yes	
224	MAIN STREET	1" IP		Yes	
235	MAIN STREET	CTS	Jan-20		
195	MAIN STREET 1	1-1/4" IP		Yes	Replace with 1-1/2"
207	MAIN STREET 1	1" CTS			
195	MAIN STREET 2	1-1/4" IP		Yes	
207	MAIN STREET 2	1" CTS			
195	MAIN STREET 3				

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
195	MAIN STREET 4				
195	MAIN STREET 5				
195	MAIN STREET 6				
210	MAIN STREET 6-PO	1-1/4" IP		Yes	
170	MAIN STREET A	1" CTS Poly		Yes	
213	MAIN STREET A	1-1/2 CTS			
209	MAIN STREET APT	1" CTS			
211	MAIN STREET APT				
197	MAIN STREET B	1" IP		Yes	Off 2" IP Main
213	MAIN STREET B				
213	MAIN STREET C				
211	MAIN STREET DELI	1" CTS	1/15/2015		
195	MAIN STREET EAST	1-1/2" CTS			
189	MAIN STREET REAR	2" CTS			
209	MAIN STREET SHOP	1" IP		Yes	
217	MAIN STREET STORE	1" IP		Yes	
195	MAIN STREET WEST				
7	MANITO WAY	6" Fire & 2" CTS			
11	MANITO WAY	1" IP		Yes	
15	MANITO WAY	1" CTS			
17	MANITO WAY	1" CTS			
21	MANITO WAY	1" IP		Yes	Off 2" IP Main
22	MANITO WAY	1" IP		Yes	Off 2" IP Main
3	MILL LANE	1" IP		Yes	
4	MILL LANE A	2" CTS			
4	MILL LANE B				
4	MILL LANE C				
4	MILL LANE D				
4	MILL LANE E	2" CTS			
4	MILL LANE F				
4	MILL LANE G				
4	MILL LANE H				
3	MINISTERS PRIM	1" IP		Yes	Off 2" IP Main
14	MINISTERS PRIM	1" IP		Yes	
15	MONUMENT ROAD	1" CTS			
19	MONUMENT ROAD	1" IP to CV		Yes	
25	MONUMENT ROAD	1-1/2" CTS			
27	MONUMENT ROAD	1" CTS	6/2/2011		
30	MONUMENT ROAD	1" IP		Yes	

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
32	MONUMENT ROAD	1" IP		Yes	
33	MONUMENT ROAD	1" IP		Yes	
38	MONUMENT ROAD	1" CTS	12/16/2020		
40	MONUMENT ROAD	1" IP		Yes	
41	MONUMENT ROAD	1" IP		Yes	
44	MONUMENT ROAD	1-1/2" CTS			
45	MONUMENT ROAD	1" CTS	12/20/2018		
46	MONUMENT ROAD	1" IP		Yes	
47	MONUMENT ROAD	1" CTS			
49	MONUMENT ROAD	1" CTS	1990		
40-A	MONUMENT ROAD				
49	MONUMENT ROAD COTTAGE COT	1" CTS Poly		Yes	
3	NATURAL DRIVE	1" CTS	12/12/2018		
4	NATURAL DRIVE	1" IP		Yes	
6	NATURAL DRIVE	1" CTS			
7	NATURAL DRIVE	1" CTS			
10	NATURAL DRIVE	1" IP		Yes	
11	NATURAL DRIVE	1" CTS	1/20/1992		
16	NATURAL DRIVE	1" IP		Yes	
1	NAUSET FARMS LANE	1-1/2" IP		Yes	
3	NAUSET FARMS LANE	1" CTS Poly		Yes	
5	NAUSET FARMS LANE	1" CTS Poly		Yes	
7	NAUSET FARMS LANE	1" CTS Poly		Yes	
9	NAUSET FARMS LANE	1" CTS Poly		Yes	
11	NAUSET FARMS LANE	1" CTS Poly		Yes	
4	NAUSET FARMS WAY	1" IP		Yes	
8	NAUSET FARMS WAY	1" CTS			
9	NAUSET FARMS WAY	1" CTS			
12	NAUSET FARMS WAY	1" CTS	3/31/2016		
19	NAUSET FARMS WAY	1" CTS			
20	NAUSET FARMS WAY	1" IP		Yes	
21	NAUSET FARMS WAY	1" IP		Yes	
22	NAUSET FARMS WAY	1" IP		Yes	
23	NAUSET FARMS WAY	1" IP		Yes	
4	OAK LANE	1" IP		Yes	
2	PACKET LANDING	1" CTS			
3	PACKET LANDING	1" IP		Yes	
6	PACKET LANDING	1" CTS			
7	PACKET LANDING	1" CTS			

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
9	PACKET LANDING	1" CTS			
10	PACKET LANDING	1" CTS			
13	PACKET LANDING	1" CTS			
14	PACKET LANDING	2" CTS			
15	PACKET LANDING	2" CTS			
16	PACKET LANDING	1" CTS			
2	PINE RIDGE LANE	1" IP		Yes	
5	PINE RIDGE LANE	1" IP		Yes	
6	PINE RIDGE LANE	1" IP		Yes	
8	PINE RIDGE LANE	1" IP		Yes	
12	POCHET ROAD	1" CTS	1/10/2021		
15	POCHET ROAD	1" CTS			
17	POCHET ROAD	1" CTS			
23	POCHET ROAD	1" CTS			
31	POCHET ROAD	1-1/2" CTS			May be 1" CTS
41	POCHET ROAD	1" IP		Yes	
43	POCHET ROAD	1-1/2 IP		Yes (W/1-1/2")	
46	POCHET ROAD	1" IP		Yes	
9	POND ROAD	1" IP		Yes	
10	POND ROAD	1" IP		Yes	
12	POND ROAD	1-1/2" CTS			
14	POND ROAD	1" IP		Yes	
20	POND ROAD	1" IP		Yes	
22	POND ROAD	1" IP		Yes	
23	POND ROAD	1" CTS			
24	POND ROAD	1" IP		Yes	
25	POND ROAD	1-1/2" CTS			
26	POND ROAD	1" IP		Yes	
27	POND ROAD	2" CTS	5/3/2020		
29	POND ROAD	1" IP		Yes	
31	POND ROAD	1" CTS			
32	POND ROAD	1" CTS			
33	POND ROAD	1-1/4 CIP		Yes	Replace with 1-1/2"
35	POND ROAD	1-1/4" IP		Yes	Common Service 2 Houses
40	POND ROAD	1" CTS			
41	POND ROAD	1" CTS	10/22/2010		
43	POND ROAD	1" CTS	Aug-04		
44	POND ROAD	1" CTS			

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
49	POND ROAD	1" IP		Yes	
50	POND ROAD	2" CTS			
54	POND ROAD	1" IP		Yes	
55	POND ROAD	1" IP		Yes	
7	POND ROAD 1	1-1/2" CTS			
7	POND ROAD 2				
5	POND ROAD MAIN	1-1/2" CTS	11/4/2003		
8	POND VIEW ROAD	1" CTS to CV	7/22/1980		
9	POND VIEW ROAD	1" IP		Yes	
14	POND VIEW ROAD	1-1/2" CTS	7/11/2014		
24	R GREAT OAK ROAD BOG	2" IP		Yes	
5	REV. TREAT ROAD	2" CTS			
6	REV. TREAT ROAD	2" CTS			
3	RIVER ROAD	1" CTS	12/9/2008		
3	RIVER ROAD				
14	RIVER ROAD	1" CTS			
15	RIVER ROAD	1" ?	2009?	Yes	May have been replaced
16	RIVER ROAD	1" CTS	4/6/2005		
29	RIVER ROAD	1" CTS	4/5/1996		
32	RIVER ROAD	1-1/2" CTS	7/3/1991		
36	RIVER ROAD	2" CTS			
37	RIVER ROAD	1" CTS			
38	RIVER ROAD				
39	RIVER ROAD	1" CTS	7/26/2010		
40	RIVER ROAD	1" IP		Yes	
43	RIVER ROAD	1" CTS	8/16/2005		
45	RIVER ROAD	1" CTS			
47	RIVER ROAD	1" CTS			
59	RIVER ROAD	1" CTS to CV			
67	RIVER ROAD	1" CTS	8/20/2013		
113	ROUTE 28	1-1/2 CTS			
5	SCHOOL ROAD	1" CTS			
8	SCHOOL ROAD	1-1/2" CTS			
9	SCHOOL ROAD	1" IP		Yes	
19	SCHOOL ROAD	6" Fire & 2" CTS			Old Service cut & capped
19	SCHOOL ROAD	2" CTS	5/17/2007		To Pit
23	SCHOOL ROAD	1" IP		Yes	At Older House (Multiple CV)
9	UNCLE VICK'S WAY	1" IP		Yes	

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
14	UNCLE VICK'S WAY	1" IP		Yes	
15	UNCLE VICK'S WAY	1" CTS			
18	UNCLE VICK'S WAY	1" CTS	6/6/2007		
22	UNCLE VICK'S WAY	1" IP		Yes	
24	UNCLE VICK'S WAY	1" IP		Yes	
27	UNCLE VICK'S WAY	1" IP		Yes	
30	UNCLE VICK'S WAY	1" CTS			
31	UNCLE VICK'S WAY	1" CTS			
3	WINDY HILL LANE	1" CTS			
5	WINDY HILL LANE	1-1/4" IP		Yes	
8	WINDY HILL LANE	1" CTS			
11	WINDY HILL LANE	1" CTS	12/6/2011		
2	WOODLAND PARK LANE	1" IP		Yes	
0	BARLEY NECK ROAD				
3	BARLEY NECK ROAD				
7	BARLEY NECK ROAD				
11	BARLEY NECK ROAD				
19	BARLEY NECK ROAD				
49	BARLEY NECK ROAD				
69	BARLEY NECK ROAD				
5	BAXTER LANE				
7	BAXTER LANE				
20	CHENEY ROAD				
15	COLE PLACE				
6	GESNER ROAD				
0	GREAT OAK ROAD				
25	GREAT OAK ROAD				
10	HARVEYS LANE				
12	HARVEYS LANE				
34	HIGH TIDE LANE				
36	HIGH TIDE LANE				
37	HIGH TIDE LANE				
39	HIGH TIDE LANE				
30	KAREN WAY				
29	LOOMIS LANE				
37	LOOMIS LANE				
4	LUCYS LANE			Yes	
214	MAIN STREET				
11	MINISTERS PRIM				

	Address	Service	Date Replaced	To Be Replaced Under This Project	Notes
0	MONUMENT ROAD				
23	MONUMENT ROAD				
31	MONUMENT ROAD				
42	MONUMENT ROAD				
17	NATURAL DRIVE				
18	NATURAL DRIVE				
15	NAUSET FARMS WAY				
2	POCHET ROAD	1" IP		Yes	
0	POND ROAD				
11	POND ROAD				
34	POND ROAD				
36	POND ROAD				
19	RIVER ROAD	1" CTS			
34	RIVER ROAD				
38	RIVER ROAD				
124	SOUTH ORLEANS ROAD				
9	UNCLE VICKS WAY				
10	UNCLE VICKS WAY				
29	UNCLE VICKS WAY				
4	WINDY HILL LANE				
10	WINDY HILL LANE				

6. Installation of the wastewater infrastructure work includes the installation of service laterals. These service laterals will cross existing brick sidewalks. Care shall be taken to minimize the number of bricks removed and to replace the existing brick following installation of the service laterals. Saw cutting and/or splitting of existing bricks is not allowed. Refer to SECTION 02503, PAVING, CURBING, SIDEWALKS AND ROADWAYS for additional requirements.

7. The intent of the Project is to backfill, compact and place Permanent Bituminous Concrete Trench Pavement on the trenches at the end of each and every Friday. In addition, the Contractor is required to make all roadways passable at the end of each and every workday utilizing utilized Millings and/or Compacted Gravel (at no additional cost to the Owner). However, in order to minimize the construction duration and complete the various project phases within the specified duration, the Contractor may use steel plates over the trenches on a limited basis pending approval by the Owner and MassDOT (if applicable). The use of steel plates is contingent upon meeting the following requirements:

   - Able to withstand H-20 traffic loading without any movement.
   - Not deviate more than 1/4 inch when measured with a 10-foot straight edge along the length of the plate.
   - Fabricated to meet ASTM A36 steel requirements.
   - Minimum of 12-inches overlap and/or tack welded together at each corner to reduce or eliminate vertical movement.

- Before steel plates are installed, the excavation shall be adequately shored to support the bridging and traffic loads.
- Edges properly secured and feathered with asphalt.
- Wedges or other non-asphaltic devices used for leveling as required to eliminate rocking of the plates.
- Compacted temporary asphalt used to fill all gaps between the plates and existing pavement surfaces.
- Edges of the steel plates are marked/painted to improve visibility.
- Roadway and trench wall conditions are constantly reevaluated to ensure safety.
- Minimum of 12-inches beyond the edges of the excavation.
- Plates countersunk due to uneven roadways.
- Plates should be coated with an anti-skid coating.
- Advance warning signs (i.e. Steel Plate Ahead, Bump Ahead, etc.) are installed.
- Written notification of Owner and MassDOT of plate locations.
- Conduct end of the day inspections and provide written notification to the Owner and MassDOT before leaving site.

8. The Work of the Project involves roadways that are heavily traveled. The following requirements shall be maintained during the Work of this Project. Incorporate these requirements into the Project Schedule.

   a. Complete all Work within each section of roadway (intersection to intersection) prior to proceeding to the next section or next roadway.

   b. No Work shall be started on the Project until a detailed Project Schedule and Engineered Traffic Management Plan has been submitted to and approved by the Engineer and MassDOT. In addition, during the construction of the Project update the Project Schedule weekly and inform the Engineer, Owner, MassDOT for work in the State Highway Layout, and all other applicable utilities or other entities affected by the Work in writing of changes to the approved Project Schedule.

   c. For additional requirements refer to SECTION 01570, TRAFFIC MANAGEMENT AND MAINTENANCE.

   d. The Contractor shall provide up to four Portable Changeable Message Signs to provide advance warning to motorists prior to entering the construction area in accordance with SECTION 01570, TRAFFIC MANAGEMENT AND MAINTENANCE. The locations of the Portable Changeable Message Signs shall be as determined by the MassDOT, the Owner and Engineer.

   e. Failure to comply with this requirement will result in no payment for work performed.

9. Roadway Restoration

   a. Permanent Surfacing of State Roadways

      (1) Prior to the start of construction, the Contractor and Contractor's paving subcontractor shall meet with MassDOT, the OWNER and the ENGINEER to review roadway restoration.

      (2) Temporary Trench Pavement - Furnish and place 3-inch permanent bituminous concrete trench width pavement (base course).

      (3) Permanent Trench Pavement - Cut back each side of trenches by a minimum of 1-foot. Furnish and place 9-inch permanent bituminous concrete trench width pavement (base course). Permanent trench pavement shall occur between 90 to 180 days after pipeline installation subject to MassDOT and OWNER approval.

      (4) Full Width Overlay – Not Used

      (5) Full Width Mill and Overlay – Not Used

b. Permanent Surfacing of Local Streets

(1) Prior to the start of construction, the Contractor and Contractor's paving subcontractor shall meet with the Owner and the Engineer to review roadway restoration.

(2) Temporary Trench Pavement - Furnish and place 1-1/2-inch permanent bituminous concrete trench width pavement (base course).

(3) Permanent Trench Pavement - Cut back each side of trenches by a minimum of 1-foot. Furnish and place 3-inch permanent bituminous concrete trench width pavement (base course). Permanent trench pavement shall occur between 90 to 180 days after pipeline installation subject to OWNER approval.

(4) Full Width Overlay - Furnish and place 1-1/2-inch permanent bituminous concrete full width pavement (top course). Overlay shall be placed the following construction season, allowing the trench to settle over a winter freeze thaw cycle and/or as approved by the OWNER.

(5) Full Width Mill and Overlay – Mill 2-inches and furnish and place a 2-inch permanent bituminous concrete full width pavement (top course). Overlay shall be placed the following construction season, allowing the trench to settle over a winter freeze thaw cycle and/or as approved by the OWNER.

(6) Mill and overlay shall occur following the completion of the permanent trench pavement subject to OWNER approval.

c. Dense Graded Gravel of Local Streets

(1) Prior to the start of construction, the Contractor shall meet with the Owner and the Engineer to review roadway restoration.

(2) Full Width Dense Graded Gravel - Furnish and place 12-inches of dense graded gravel. Dense Graded Gravel shall occur between 90 to 180 days after pipeline installation subject to OWNER approval.

d. Miscellaneous Restoration of Local Roadways

(1) Roadways located between and adjacent to the wastewater infrastructure shall be restored by similar methods of the adjacent roadway reconstruction.

e. Roadway Reconstruction Summary

State Roadways

Location	Temporary and Permanent Trench Pavement	Full Width Overlay Pavement	Full Width Mill and Overlay Pavement	Full Width Dense Graded Gravel
South Orleans Road	X			N/A

Town Roadways

Location	Temporary and Permanent Trench Pavement	Full Width Overlay Pavement	Full Width Mill and Overlay Pavement	Full Width Dense Graded Gravel
Barley Neck Road– Main Street to Pochet Road	X		X	
Barley Neck Road – Remainder	X	X		
Bayberry Way	X	X		
Baxter Lane	X	X		
Beach Road	X		X	
Cedar Way	X	X		
Cheney Road	X	X		
Cole Place	X	X		X
Deerwood Lane	X	X		
Finley Road	X		X	
Gesner Road	X	X		
Great Oak Road	X	X		
Grist Road	X	X		
Finlay Road	X	X		
High Tide Lane	X	X		
Karen Way	X	X		
Lake Farm Lane	X	X		
Larboard Lane	X		X	
Lewis Road	X	X		
Linden Lane	X	X		
Loomis Lane	X	X		X
Lucy Lane	X	X		X
Manito Road	X	X		
Meetinghouse Road	X	X		
Mill Lane	X	X		
Minister Prim	X	X		X
Monument Road	X		X	
Natural Drive	X	X		

Town Roadways

Location	Temporary and Permanent Trench Pavement	Full Width Overlay Pavement	Full Width Mill and Overlay Pavement	Full Width Dense Graded Gravel
Nauset Farms Way	X	X		
Oak Lane	X	X		
Off Main Street	X		X	
Packet Landing	X	X		
Pine Ridge Lane	X	X		
Pochet Road	X	X		
Pond Road	X		X	
Pond View Road	X	X		
Reverend Treat Way	X	X		
River Road	X	X		
School Road	X		X	
Uncle Harvey's Lane	X	X		
Uncle Vick's Way	X	X		
Windy Hill Lane	X	X		

F. For the protection of life and property all backfilling operations shall follow closely behind pipe laying. Ensure that no excavation is left open, unguarded, or water filled during any period of time when Work is not actually in progress. It is the purpose and intent that all excavations and backfill, including consolidation operations, and temporary surfacing within an area be accomplished expeditiously before proceeding to other Work areas.

G. The Owner reserves the right to schedule the Work at any location within the Project area. At the same time the Owner may schedule the suspension of Work at any location. Construction in seasonally heavily traveled roadways shall be avoided during the heavily traveled period.

H. The Work of this Contract may require existing utilities to be bypassed, removed and relaid. The Contractor shall pay for all costs associated with this Work at no additional cost to the Owner except as specified in SECTION 01025, MEASUREMENT AND PAYMENT.

I. The Owner has obtained various permits for this Project, which are included as DOCUMENT 00858, SPECIAL CONDITIONS – PERMITS AND LICENSES. Meet all requirements/conditions of these permits during the construction of this Project. All costs associated with this Work shall be borne by the Contractor and included in the prices bid under the applicable items of DOCUMENT 00300, BID FORM.

J. Cleanup/restoration of all disturbed areas shall be Existing each and every week or after a maximum of 500 linear feet of pipeline installation, throughout the duration of the Project. Cleanup/restoration consists of, but is not limited to, restoration of the area to preconstruction conditions, removal of all excess materials, removal of all pipe, fittings, manholes, removal of all construction equipment and materials, and removal of all construction debris. Failure to comply with this requirement may result in withholding the fair market value for the cleanup/restoration of all disturbed areas not Existing from monthly payment requests until this requirement has been met.

K. Pre-blasting of ledge is not allowed on this Project. No payment will be made for ledge removal on this Project in areas where pre-blasting has occurred.

L. All damage to existing utilities, roadways, and the like shall be repaired and/or replaced by the Contractor as approved by the utility company and shall be borne by the Contractor.

M. The control of dust shall be accomplished by the application of clean water. The Contractor is responsible for making all arrangements and gaining necessary permissions from the Owner to utilize the Owner's water system. However, the Owner does not guarantee that water will be available at any time during the duration of the Project. Water required for the control of dust shall be provided by the Contractor at no additional cost to the Owner. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and the costs shall be borne by the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner. The use of calcium chloride to control dust is not allowed.

N. Compaction of Trenches

1. The compaction of trenches shall be accomplished by puddling and/or jetting.

2. The Contractor is responsible for making all arrangements and gaining necessary permissions from the Owner to utilize the Owner's water system. However, the Owner does not guarantee that water will be available at any time during the duration of the Project. Water required for the puddling and/or jetting of trenches shall be paid for by the Contractor.

3. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and the costs shall be borne by the Contractor.

4. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

5. The Metering Systems shall be used by the Contractor on this Project only, refurbished in accordance with the manufacturer's requirements, and shall be provided to the OWNER at the completion of the project.

O. Archaeological Sensitive Areas

1. This Project does not occur in Archaeological Sensitive Areas and therefore no experienced archaeologist is required to monitor construction activities based on available information. Should potentially significant archaeological deposits be discovered during the course of construction work shall immediately cease in that vicinity and the Contractor shall immediately notify the Engineer.

2. Because potentially significant pre- and/or post-contact archaeological deposits could be present beneath the existing roadways and/or other paved areas assigned as having low archaeological sensitivity, an Unanticipated Discoveries Plan (UDP) consistent with the Massachusetts Unmarked Burial Law will be implemented during construction to formalize procedures guiding the discovery of human remains and/or significant cultural resources. The UDP will be developed by the ENGINEER's Subconsultant in consultation with the Massachusetts Historical Commission (MHC), and in accordance with the MGL Chpt. 38, Sec. 6; Chpt 9, Sec. 26A and 27C; and Chpt 7, Sec. 38A; all as amended).

3. Cultural Resources Training

a. The ENGINEER's Subconsultant will prepare action plans for unanticipated discoveries, such as burials and conduct cultural resource training of personnel from the General Contractor and their Subcontractors/Subconsultants as well as personnel from the OWNER, Owners Project Manager and ENGINEER and their Subconsultants who will be monitoring all of the construction excavation.

b. The purpose of this training will be to provide an overview of the general cultural history of the Project area, so that personnel will be aware of the kinds of archaeological resources that may be encountered in the field. In addition, the training program will emphasize the exact procedures to be followed, as outlined in the UDP, regarding actions to be taken and notification required in the event of a significant site discovery, such as human remains, during construction.

c. Personnel from the General Contractor and their Subcontractors/Subconsultants are required to attend the Cultural Resources Training prior to any construction activities occurring in the identified areas. Failure to comply with this requirement will result in a penalty of $10,000 plus any fines and restoration costs required by federal, state and local authorities.

P. The testing of tanks and/or pipelines shall be accomplished by using clean water. The Contractor is responsible for making all arrangements and gaining necessary permissions from the Owner to utilize the Owner's water system. However, the Owner does not guarantee that water will be available at any time during the duration of the Project. Water required for the testing of tanks and/or pipelines shall be paid for by the Contractor. All necessary piping, hoses, fittings, and the like shall be provided by the Contractor and the costs shall be borne by the Contractor. All water shall be metered and the use of backflow prevention device(s) shall be required as approved by the Owner.

Q. Temporary paving, where applicable, is required to be placed whenever the Contractor ceases operations in an area for more than 12 hours or every day of the week, whichever comes first, throughout the duration of the Project and/or as directed by the Engineer. Include all costs associated with completing this Work under the applicable Bid item specified in SECTION 01025, MEASUREMENT AND PAYMENT. No payment will be made for temporary paving placed in areas not prepared in accordance with the Contract Documents. Failure to comply with this requirement may result in withholding the fair market value for temporary pavement not Existing from monthly payment requests until this requirement has been met.

R. Except for an emergency condition as approved by the Owner in writing, premium wages will not be paid for Work performed on Sunday, holiday or workdays longer than eight (8) hours. All costs incurred by the Owner caused by the Contractor's Work performed on Sunday, holiday or workdays longer than eight (8) hours shall be borne by the Contractor which will be deducted from monthly payment requests.

S. Manhole sections, pipe, fittings, frames and covers, and other material and/or equipment shall not be stockpiled along roadways. At the beginning and end of each workday, the Contractor shall transport all materials and/or equipment to and from an offsite temporary storage yard that they have legal access to on a daily basis. The Contractor shall secure use of space that they will use for the temporary storage yard.

T. The Contractor shall secure use of space that they have legal access to for the temporary buildings specified under SECTION 01500, TEMPORARY FACILITIES. The temporary buildings shall not be placed along the edge of roadways. The Contractor shall be responsible for clearing, grubbing, grading, providing of grading materials, permits, and full restoration of the temporary building location(s).

U. All equipment, material and supplies to be provided under this contract shall be American made.

V. No construction activity shall be allowed on the following dates and for the two working days prior to the following dates, unless otherwise approved by the owner:

- New Year's Day - January 1*
- Martin Luther King Jr. Day – Third Monday in January
- Presidents' Day - Third Monday in February
- Patriot's Day – Third Monday in April
- Memorial Day - Last Monday in May
- Juneteenth – June 19th*
- Independence Day - July 4*
- Labor Day - First Monday in September
- Columbus Day - Second Monday in October
- Veterans' Day - November 11*
- Thanksgiving Day - Fourth Thursday in November
- Christmas Day - December 25*

* If a holiday falls on a Saturday, the previous day is observed as the legal holiday; If a holiday falls on a Sunday, the day following is observed as the legal holiday.

All construction equipment and materials not incorporated in the Work to date shall be removed from the Work areas where construction activity is ceased. All excavations shall be backfilled and paved as specified and/or directed by the Engineer. Incorporate this requirement into the Project Schedule. Failure to comply with this requirement will result in no payment for work performed.

W. All shop drawings shall be approved by the ENGINEER prior to any on-site construction activities occurring. Failure to comply with this requirement will result in no payment for work performed.

X. Full mobilization by the Contractor shall occur, including manhole sections, pipe, fittings, frames and covers, and other material and/or equipment and all temporary facilities prior to any on-site construction activities occurring. Failure to comply with this requirement will result in no payment for work performed.

Y. The Town has standardized on the following equipment. Please refer to for the associated specification sections for details on each piece of equipment. See Volume II for the 2019-01 and 2019-02 proprietary equipment shop drawings

1. Wastewater Treatment Facility
    a. SBR Transfer Pump (SBR.TP-4): SECTION 11308 – RECESSED IMPELLER PUMPS AND APPURTENANCES
    b. SBR Blower (SBR.BLW-4): SECTION 11377 – ROTARY POSITIVE DISPLACEMENT BLOWERS
    c. SBR Aeration Grids (One Per SBR Tank): SECTION 11600 - SEQUENCING BATCH REACTORS
    d. Variable Frequency Drives (SBR.BLW-4 VFD and SBR.TP-4 VFD): SECTION 16260 - VARIABLE FREQUENCY DRIVES
2. Pumping Station No. 04
    a. Submersible Pumps (PS4.P-1, PS4.P-2 and PS4.P-3): SECTION 11306 – SUBMERSIBLE SOLIDS HANDLING PUMPS AND APPURTENANCES
    b. Standby Generator (Gen.04-1): SECTION 11398 – DIESEL ENGINE GENERATOR SET AND APPURTENANCES
    c. Davit Crane Flush Mounted Base: SECTION 14200 – HOISTING EQUIPMENT
    d. Odor Control System (PS4.OC-1): SECTION 15857 – ODOR CONTROL SYSTEMS
    e. Variable Frequency Drives (PS4.P-1 VFD, PS4.P-2 VFD and PS4.P-3 VFD): SECTION 16260 - VARIABLE FREQUENCY DRIVES

Z. It is the intent that all equipment be provided by the same manufacturers used at the existing three pumping stations, if available:

1. Pumping Station No. 4
    a. Magnetic Meter (FE 0405) - 13330A INSTRUMENTATION PRODUCT SHEETS, DATA SHEET 416.1 MAGNETIC FLOW METER SPECIFICATION
    b. Magnetic Meter Transmitters (FIT 0405) - 13330A INSTRUMENTATION PRODUCT SHEETS, DATA SHEET 416.1 MAGNETIC FLOW METER SPECIFICATION
    c. Level Float Switch (LSHH 0404, LSLL 0404) - 13330A INSTRUMENTATION PRODUCT SHEETS, DATA SHEET 853.1 LEVEL SWITCH (FLOAT TYPE) SPECIFICATION
    d. Level gauge Transducer (LE/LT 0404): 13330A INSTRUMENTATION PRODUCT SHEETS, DATA SHEET 873.1 SUBMERSIBLE WATER LEVEL SENSOR/TRANSMITTER SPECIFICATION
    e. Discharge Pressure Gauge (PI 0401, PI 0402) - 13330A INSTRUMENTATION PRODUCT SHEETS, DATA SHEET 1454.1 PRESSURE GAUGE SPECIFICATION
    f. Discharge Pressure Isolation Ring (6-inch) - 13330A INSTRUMENTATION PRODUCT SHEETS, DATA SHEET 1457.1 PRESSURE ISOLATOR RING SPECIFICATION
    g. Check valves - 15101 PROCESS VALVES AND APPURTENANCES
        (1) 6” Check valve: Valmatic 506CBFMI
    h. Plug valves - 15101 PROCESS VALVES AND APPURTENANCES

(2) 6” Plug Valve: Valmatic 5606F/5A08

(3) 4” Plug Valve: Valmatic 5804R/7A08

1.12 - EXISTING UTILITIES

A. The location and size of existing sewers, drains, culverts, water mains, gas mains, cables, service pipes, and other utilities shown on the Contract Drawings, were obtained from the results of surveys and existing records and are shown as approximate only, to guide the Bidders in the preparation of their Bid. The various utility companies will determine the location and depth of existing utilities by marking them out upon the ground and by experimental excavations by the Contractor prior to and as the Work progresses. The Contract Drawings do not show the exact location and depth of all utilities, nor do they show all utilities or the number of lines for each utility that may be encountered.

B. Assume that there are existing utility connections to each and every building or structure along the line of Work, whether they appear on the Contract Drawings or not. Notify the proper utility companies and obtain and preserve the marked location(s) of all existing utilities that may be encountered along the line of Work, until such time as such markings are no longer required.

C. Experimental trench excavations are to be made prior to commencing pipe laying operations. Excavate by hand as necessary in advance of the trenching equipment to determine the exact location and depth of each utility that may be encountered. Excavation equipment shall not be used within three (3) feet of the utility to be crossed. Continue to excavate by hand around these utilities after ascertaining their exact location and depth.

D. Experimental excavations shall be made at all existing potable water mains located within ten (10) feet of the proposed gravity sewer(s) and/or force mains prior to commencing trench excavations. Determine the exact location, materials of construction, size and elevation of these existing water main(s). The location and depth of the proposed gravity sewer(s) and/or force mains shown on the Contract Drawings shall be adjusted as approved by the ENGINEER, in order to maintain the required separation as specified herein, and to maintain a continuous upward or downward slope for force mains and to maintain the necessary line and grade for gravity sewers.

E. All utilities interfered with or damaged shall be replaced and/or repaired immediately. Carefully bed, tamp and fully consolidate refill material around and under all existing utilities encountered or crossed unless otherwise specified as approved by the Engineer.

F. Protection of all existing utilities in the vicinity of the Work and the assurance of uninterrupted service from existing utilities throughout construction is the responsibility of the Contractor.

G. In the event that the Contractor’s Work results in damages to existing utilities, provide all necessary materials, equipment and labor necessary to satisfactorily repair damaged utilities immediately at no cost to the Owner.

H. Notify the Water Utility 24 hours prior to connecting to and/or bypassing any existing water main, or as required by the utility. Do not operate any existing water system valves. All such operations shall be coordinated with and performed by Water Utility personnel.

1.13 - VISITS TO THE SITE(S)

A. Before submitting a Bid, visit the site(s) to examine existing conditions and become thoroughly acquainted with the effort required to perform the Work.

B. Study the Contract Documents and compare the same with the information gathered during examination of the site(s), as no extra compensation will be authorized for extra Work caused by unfamiliarity with the site(s) and/or Contract Documents or the conditions peculiar to this Project.

1.14 - DISPOSAL OF EXCESS MATERIAL

A. All pavement road base, surplus suitable material removed from the excavations, loam not required for re-use in the Work shall be legally disposed of by the Contractor.

B. Legally dispose of all unsuitable material removed as part of the Work.

1.15 - TECHNICAL SPECIFICATIONS

A. Where reference is made to ASTM, AWWA, AASHTO specifications or other associations, it is understood that the latest revisions as of the date of the Contract Documents shall apply.

1.16 - PERMITS, FEES AND BONDS

A. Obtain and comply with all required permits, pay all fees and provide all bonds necessary to complete the Work as specified. Be solely responsible for performing any necessary acts and providing any materials required in order to comply with any and all terms and conditions set forth in any permits and licenses.

B. Refer to DOCUMENT 00858, SPECIAL CONDITIONS - PERMITS AND LICENSES for all permits, which have been obtained for the Project. The Owner has not obtained all permits and licenses required for this Project. The Contractor shall obtain and pay for any other permits required to complete the Project including but not limited to Road Opening Permit, Blasting, and Phase II General Stormwater Permit for small construction projects.

1.17 - NOTIFICATION OF CONSTRUCTION

A. At least 5 business days prior to initiating excavation Work, notify the following entities, in writing, of where and when excavation(s) are scheduled.

1. Town of Orleans Department of Public Works and Natural Resources – (508) 240-3790
2. Town of Orleans Highway Department – (508) 240-3790
3. Town of Orleans Water Department – (508) 255-1200
4. Town of Orleans Fire and Rescue – (508) 255-0050
5. Town of Orleans Police Department - (508) 255-0117
6. Dig Safe – 811
7. MassDOT, District 5 Highway Division – (508) 824-6633
8. AECOM – (508)-237-7161

1.18 - BOUNDS AND PROPERTY MARKERS

A. Prior to initiating construction, engage an independent Registered Land Surveyor (in the State where the Project is located) to provide permanent reference points for all bounds and property markers along the line of the Work that may be disturbed during construction. Submit copies of all ties to the bounds and property markers to the Engineer prior to excavation at the site(s).

B. Any bounds or markers disturbed shall be replaced utilizing the services of a Professional Land Surveyor in the State where the Project is located. The cost of replacing markers disturbed by the Contractor's operations shall be at the Contractor's expense.

1.19 - TWENTY-FOUR HOUR EMERGENCY SERVICE

A. Maintain a 24-hour, 7-day a week telephone service. The Contractor’s emergency personnel and equipment shall be within 30 minutes travel time to the Project site(s) in order to handle emergency requirements such as, but not limited to, settled trenches, clogged drains, and rain damage and/or any other emergency situation relating to the Contractor’s Work. A list of the personnel and their telephone numbers, pager numbers, and cell phone numbers, shall be submitted to the Engineer, the Owner and to the local Police and Fire Departments.

B. This requirement shall apply for the duration of the Project and shall be updated as necessary. This list shall be submitted on the Contractor's letterhead and shall state that should an emergency arise during the implementation of the Project, these people are to be contacted. Submit this letter to the Engineer prior to initiating construction.

1.20 - UNIFORMED POLICE OFFICERS

A. Payment of uniformed police officers used for pedestrian and vehicle control on this Project are to be paid for directly by the Owner without any Contractor involvement other than the Contractor's input as to traffic control requirements and canceling of planned details.

B. Uniformed police officers are paid a four (4) hour minimum. If arrangements have been made for uniformed police officers and inclement weather or other factors prohibit Work, contact the Police Department no later than 5:30 a.m. of the day of scheduled Work to cancel the police detail.

C. Should the Contractor fail to notify the Police Department as required, the Contractor shall assume all costs for the four (4) hour minimum police details not canceled in time. Separate billings will be issued by the Police Department for non-canceled police details and the Contractor shall pay such bills on a monthly basis.

D. No uniformed private security forces shall be employed in this capacity without the express written approval of the Owner.

1.21 - HOURS OF OPERATION

A. The Contractor, including all subcontractors, materialmen, and all other relating to this Project, shall conform to the following Work schedule.

1. No outdoor activity on or adjacent to the site will be permitted before 7:00 a.m. or after 5:00 p.m., unless other arrangements are made with the Owner.

2. No outdoor activity shall take place on Saturdays, Sundays, legal holidays recognized by the Owner and the two days preceding legal holidays as noted in herein, except for emergency conditions, which, if practical, shall be reviewed and approved by the Owner.

1.22 - DISPOSAL OF DEBRIS

A. During the prosecution of the Work, maintain the Project site(s) and adjoining areas in a neat and orderly manner and eliminate the accumulation of construction debris. A rubbish container shall be kept at the Project site(s) at all times and be emptied as required to prevent odors and vermin.

B. Store and remove all debris from the Project site(s) and legally dispose of the debris in accordance with federal/state/local regulations. Should the Contractor neglect or refuse to maintain the Project site(s) free of accumulated debris, the Owner reserves the right to have the service performed by others and cost thereof deducted from monthly progress payment requests.

C. At the conclusion of the Work, remove and legally dispose of any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from construction operations, and leave the entire Project site(s) of the Work in a neat and orderly condition.

1.23 - RECORD DRAWINGS

A. Throughout the course of completing the Work, continually maintain a set of record drawings that incorporate all approved changes made by the Contractor and all subcontractors to the Drawings included in the executed Contract between the Owner and the Contractor. Clearly and concisely mark up the individual Drawings and/or incorporate sketches that show approved changes made during the execution of the Work. Following completion of the Work, incorporate all approved changes electronically into one (1) complete set of record drawings. Record drawings shall be complete in every way and shall show the full extent of the executed Work. Special attention shall be given to concealed Work.

B. Change Orders, Addenda items and field changes shall be included where applicable. Additional specific requirements relative to record drawings may be called for in the individual sections of the Specifications. Submit a review copy to the Engineer for approval and make any revisions required by the Engineer in order to make the record drawings complete. After acceptance by the Engineer, deliver a full scale reproducible hard copy and a compact disk with Auto Cad files of the record drawings to the Engineer.

C. Tie cards (8 ½ inches by 11 inches) of all exterior buried utilities such as but not limited to piping, tubing, conduits, wye/tee connections, fittings, cleanouts, and valves, shall be fully dimensioned both horizontally and vertically, so that the exterior buried utilities can be located in the field. A minimum of three (3) ties shall be provided for each item requiring a tie. Submit the tie cards on a weekly basis or as directed by the Engineer. If, in the opinion of the Owner and/or Engineer, insufficient data is provided to properly locate the exterior buried utilities, uncover the buried utilities and perform the necessary measurements and provide updated tie cards at no additional cost to the Owner.

D. GPS coordinates of all exterior buried utilities such as but not limited to manholes, piping, tubing, conduits, wye/tee connections, fittings, cleanouts, and valves shall be fully dimensioned both horizontally and vertically, so that the exterior buried utilities can be located in the field. Submit the electronic information on a weekly basis or as directed by the Engineer. If, in the opinion of the Owner and/or Engineer, insufficient data is provided to properly locate the exterior buried utilities, uncover the buried utilities and perform the necessary measurements and provide updated tie electronic information at no additional cost to the Owner

E. An electronic copy of the Engineer's Auto Cad files shall be made available to the Contractor for the purpose of completing the required computer drafted record drawings.

1.24 - PHOTOGRAPHS OF THE PROJECT

A. Once a month employ the services of a professional photographer to take 48 digital color photographs of the Work in progress. View and orientation of the photographs shall be as determined by the Engineer in the field.

B. Proofs of the digital color photographs shall be submitted to the Engineer for final selection of up to 24 photographs. If 24 photographs cannot be selected from the 48 proofs taken, as determined by the Engineer, then the Contractor shall take an additional 48 photographs for review at no additional cost to the Owner. Formally submit the 24 photographs selected by the Engineer as 8 inch by 10 inch color glossy prints on a monthly basis.

C. In the event that insufficient progress has been made in the previous month to justify the total number of photographs specified above, the Owner reserves the right to have additional views taken in any succeeding month so that the total number will be equal to 24 times the number of months in the Contract period.

D. Each digital photograph shall be identified by a neatly typed index given the Project's name Contractor's name, the date taken, the subject, and the orientation (looking north, looking south, etc.).

E. At the completion of the Contract, all digital images shall become the property of the Owner and shall be delivered to the Owner. Any view not properly identified or otherwise not acceptable will not be counted in the total number of photographs required.

1.25 - INITIAL OPERATION OF NEW FACILITIES

A. Operation and maintenance manuals shall be submitted to the Engineer in accordance with DOCUMENT 00700, GENERAL CONDITIONS at least one (1) month prior to the scheduling of any manufacturers training.

B. Perform pressure and/or leakage testing of all pipelines, storage tanks and basins prior to prestart-up testing of all equipment and/or systems. Provide the initial filling of all pipelines, storage tanks and basins with potable water as necessary for start-up of individual systems throughout the facility.

C. Initial start-up of new equipment and/or systems shall not commence until all of the manufacturers services, checkout, and training have been Existing as approved by the Engineer.

D. Perform an 8 hour, or less if approved by the Engineer, prestart-up test of all individual equipment prior to incorporating equipment into their appropriate systems.

E. Perform an 8 hour, or less if approved by the Engineer, prestart-up test of all systems prior to conducting the performance test of the facility.

F. Provide all labor, power, chemicals, operations and maintenance from the initial start-up of the individual equipment and systems until the final performance test of the facility is accepted by the Owner as substantially complete at no additional cost to the Owner.

1.26 - CONTINUOUS OPERATING CRITERIA

A. Conduct operations in such a manner and sequence that shall neither result in a disruption of the amenities, nor interfere with the functional organization and workings of existing facilities.

B. Furnish, install and operate any piping, equipment and appurtenances necessary to provide the temporary services, facilities, and bypasses required during construction including, but not limited to, bypass pumping, flow barriers and diversions.

C. The Owner will operate and maintain all existing systems and equipment. Notify and coordinate with the Owner all temporary modifications to existing facilities operations required for construction within, or interfacing with, the existing facilities. Operate and maintain all proposed facilities until such time as the Owner accepts them.

D. A carefully planned and detailed construction schedule must be submitted to the Engineer for approval before any construction starts, showing the proposed sequences of operation and the methods to be used for maintaining continued operations of existing facilities.

E. Refer to SECTION 01500, TEMPORARY FACILITIES for additional requirements.

1.27 - SCHEDULE OF VALUES

A. Submit a schedule of values for use in preparing the monthly progress payments described in the DOCUMENT 00700, GENERAL CONDITIONS.

B. The schedule of values shall be prepared in conformance with the following format:

1. General Conditions
    a. Subheadings
2. All Structures
    a. Subheadings by specification division and section
3. General Site Work
    a. Subheadings by specification division and section
4. Unit Prices by Individual Items
5. Filed Sub-bid Categories, if applicable
    a. Subheadings by specification division and section
6. Change orders by individual items shall be added as approved by the Owner.

C. In addition to the above, each equipment line item in the schedule of values shall include the following breakdown:

1. Shop Drawings (10 percent of equipment value)
2. Equipment
3. Installation
4. Manufacturers' Checkout and Startup (2 percent of equipment value)
5. Equipment testing (10 percent of equipment value)
6. Manufacturers' Training of Owner Personnel (1 percent of equipment value)
7. Spare Parts (1 percent of equipment value)
8. Operation and Maintenance Manuals (1 percent of equipment value)

D. The schedule of values shall be submitted to the Engineer for review and approval at least 30 calendar days prior to the first progress payment request. The acceptable schedule of values shall be used for the duration of the Project.

1.28 - OPERATION AND MAINTENANCE MANUALS

A. Except as otherwise specified, four (4) copies of the Manuals shall be provided for each item of equipment, or system provided. Existing manuals shall be submitted to the Engineer no later than 60 days following approval of shop drawings.

B. All elements and components of the equipment or system shall be included in the Manuals.

1. The Manuals shall be customized including but not limited to all options, types, sizes, and configurations, shall be indicated, either as one (1) enclosure within the manuals listing them or by eliminating all incorrect references at each occurrence within a standard type of manual.

2. The Manuals shall contain a bill of materials which shall be a parts list detailing the part manufacturer and his catalog number of each equipment part. The Manuals shall include all necessary instructions for the operation, maintenance, repair, assembly, and disassembly of the equipment or system in accordance with the manufacturer's recommendations including troubleshooting charts and lubrication and maintenance schedules.
3. All drawings, plates, lists, schematics, and the like shall be included in the Manuals.
4. Any malfunction of, or damage to the equipment or system resulting from incomplete or incorrect instructions in the Manuals for the guarantee period specified elsewhere in this specification shall be repaired and/or replaced at no additional cost to the Owner.
5. The Manuals shall include a complete parts list, current parts price list, and recommended spare parts list.
6. Any and all capabilities for specified future modification; alteration or reconfiguration shall be completely indicated and described within the Manual.
7. The manuals shall contain the name, address, business telephone numbers and service telephone numbers for the manufacturer and its local distributor/representative.
8. Each Manual for each item of equipment or system shall be bound separately in a permanent binder.

C. The form entitled "Operation and Maintenance Manual Review checklist" shall be utilized and submitted for each specification section to insure completeness of the manual. The form is attached to the end of this section.

D. The Engineer has the right to reject the Manuals submitted as being unsatisfactory or to require the submittal of additional information. The new Manuals or additional information shall be submitted no later than 30 days following notification by the Engineer.

1.29 - MANUFACTURER'S SERVICES

A. Installation and Start-up

1. Make arrangements with each equipment supplier or manufacturer to furnish the services of a factory-trained service engineer who is specifically trained on the type of equipment being furnished for the sole purpose and use of the Owner and Engineer to assist during installation and start-up of all equipment and systems furnished by that supplier or manufacturer.
2. Minimum length of time specified for this service shall be exclusive of travel time and of correction of defects, testing, and training.
3. The manufacturer's engineer will verify, in writing, that the equipment has been installed and serviced so as to be acceptable to the equipment manufacturer in order that it will provide safe and efficient operation as intended by the Engineer and the manufacturer. The Engineer will provide a form entitled "Certification of Proper Equipment Installation" which is to be signed by the manufacturer’s representative and the Contractor’s representative for each piece of equipment.

B. Correction of Defects

1. Nothing specified herein shall provide relief of the responsibility of providing sufficient service to place all equipment or systems into satisfactory operation.
2. All time and materials needed to correct defective equipment shall be provided at no cost to the Owner.

C. Testing

1. Prior to testing, each equipment supplier or manufacturer shall furnish a written certification that the equipment is ready for operation. A copy of this certification shall be furnished to the Engineer.
2. Furnish the labor, tools, equipment, power, and clean water necessary to perform field-testing to determine that the supplied equipment including controls and alarms meets hydraulic, electric, mechanical and performance requirements. All tests shall be performed in the presence of the Engineer.

D. Training

1. Wherever called for in the Specifications, have each equipment supplier or manufacturer furnish the services of a fully qualified field service engineer to provide operator training in the complete operation and maintenance of all equipment furnished by that supplier or manufacturer.
2. The minimum length of time specified for this service shall be exclusive of travel time and shall follow and be exclusive of installation and start-up, correction of defects and testing.
3. Schedule training sessions in conjunction with and as approved by the Engineer. This training will be witnessed and verified by a representative appointed by the Engineer. The Engineer has the right to reject the training by the equipment supplier or manufacturer and to require additional training. The items addressed by the training session shall include, but not be limited to, system description, system operation, system disassembly and reassembly, lubrication, routine maintenance, corrective maintenance, use of operation and maintenance manual, system troubleshooting and ordering of spare parts.
4. The Engineer will provide a form entitled "Verification of Manufacturer's Equipment Training" which is to be signed by all parties at the completion of each training session.

1.30 - SPARE PARTS

A. Spare parts for all equipment shall be supplied to the Owner as specified. Spare parts shall be individually protected and packaged in a suitable container for long-term storage with the contents therein properly identified on the outside of the container.

B. The Engineer will provide a form entitled "Spare Parts Inventory" which is to be fully Existing and submitted to the Engineer for each piece of equipment requiring spare parts.

1.31 - SPECIALTY TOOLS

A. Any specialty tools required for the adjustment, operation and/or maintenance of any equipment included in the Work shall be furnished with the respective equipment.

1.32 - STATUTORY REQUIREMENTS IN GENERAL

A. Owner and Contractor recognize that other rights, duties, and obligations with respect to public construction contracts are also provided by statute, notwithstanding the fact that they may not be specifically enumerated herein. Accordingly, any provisions required by statute to be included in this contract shall be deemed to be so included as though fully set forth herein. However, compliance with a statute does not diminish the Contractor’s responsibilities hereunder.

B. Contractor shall keep fully informed of all existing and future State and Federal Laws and municipal ordinances and regulations in any manner affecting those engaged or employed in the Work, or the materials used or employed in the Work, or in any way affecting the conduct of the Work, and of all such orders and decrees of bodies or tribunals having any jurisdiction or authority over the same and of all provisions required by law to be made a part of this Contract, all of which provisions are hereby incorporated by reference and made a part thereof.

C. If any discrepancy or inconsistency is discovered in the Contract Documents for this Work in relation to any such law, ordinance, regulation, order or decree, report the same to the Engineer in writing. Contractor shall, at all times, observe and comply with, and cause all agents and employees to observe and comply with all such existing and future laws, ordinances, regulations, orders and decrees; and shall protect and indemnify the Owner and Engineer and all of its and their officers, agents, and servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order or decree, whether by itself or its employees or subcontractors.

D. All materials furnished and Work done shall comply with all State and Federal laws and regulations.

1.33 - RELATION OF SEWER MAINS TO WATER LINES

A. Horizontal Separation

1. Whenever possible, sewers should be laid at least 10 feet, horizontally, from any existing or proposed water mains.
2. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:

a) It is laid in a separate trench;

b) It is laid in the same trench with the water mains located at one side on a bench of undisturbed earth; and

c) In either case the elevation of the crown of the sewer is at least 18 inches below the invert of the water main.

B. Vertical Separation

1. Whenever sewers must cross under water mains, the sewer shall be laid at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirement, the water main shall be relocated to provide this separation or reconstruction with slip-on or mechanical-joint cast-iron pipe, or prestressed concrete cylinder pipe for a distance of 10 feet on each side of the sewer. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.

2. When a sewer crosses above a water main, the following measures will be taken:

a) Both pipes will be encased in concrete for a distance of 10 feet on either side of the crossing; or

b) The sewer will be encased in concrete and the water main will be constructed of mechanical joint ductile iron pipe for a distance of 10 feet on either side of the crossing.

C. Special Conditions

1. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the water main shall be constructed of slip-on or mechanical-joint cast-iron pipe or prestressed concrete cylinder pipe and the sewer constructed of mechanical-joint cast-iron pipe and both services shall be pressure tested to assure water tightness.

1.34 - UTILITY COORDINATION

A. Contractor shall be responsible for contacting and coordinating with utility companies prior to commencing work in the area of utilities.

B. Special requirements may be necessary for work in the vicinity of some utilities and easements. Requirements may include, but are not limited to the following, surface marking of crossings and easements, temporary fencing, temporary pipe support, additional padding or steel plates for heavy equipment, and coordination with utility field personnel.

1.35 - EPA CONSTRUCTION GENERAL PERMIT

A. Construction activities associate with the project are anticipated to disturb one or more acres and as such would be regulated under the National Pollutant Discharge Elimination System (NPDES) stormwater program.

B. Construction stormwater discharges are permitted under the Construction General Permit (CGP) and requires compliance with permit requirements, such as the development of a Stormwater Pollution Prevention Plan (SWPPP). Contractor shall be responsible for preparing and submitting an EPA Notice or Intent (NOI) through the EPA's electronic NOI system (eNOI). A copy of the SWPPP shall be provided to the Owner and Engineer. Contractor shall be responsible for creating the required SWPPP, updating this document as necessary to reflect changes, implementing the SWPPP and performing the required inspections.

1.36 – VIBRATION MONITORING

A. The Contractor shall be aware of the Vibration Monitoring requirement at locations to be determined by the Engineer. Vibration monitoring to conform to the requirements as specified in SECTION 02160, EXCAVATION SUPPORT SYSTEMS.

1.37 – SPARE UNITS

A. Refer to technical specifications for delivery and ownership transfer of the third pump and associated VFD to be located at Pump Station No. 4 (PS4.P-3 and PS4.P-3-VFD).

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION – Not Used

END OF TEXT

SEE THE FOLLOWING FORMS AND APPENDIX ATTACHMENTS

1. Verification of Manufacturer's Equipment Training
2. Operation and Maintenance Manual Review Checklist
3. Spare Parts Inventory
4. Certification of Proper Equipment Installation

SEE VOLUME II FOR 2019-01 AND 2019-02 PROPRIETARY EQUIPMENT SHOP DRAWINGS

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VERIFICATION OF

MANUFACTURER'S EQUIPMENT TRAINING

CLIENT: Town of Orleans, MA		ENGINEER: AECOM Technical Services, Inc.	
PROJECT: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01		CONTRACTOR:	
Equipment:			
Specification Section:			
Date of Training:			
Instructor(s):			
Title:			
Representing:			
Facility Staff in Attendance			
AECOM Representative(s):			
Contractor's Representative(s):			
____ System Description		____ Corrective Maintenance	
____ System Operation		____ Use of Manufacturer's Manual	
____ System Disassembly and Reassembly		____ Ordering Spare Parts	
____ Lubrication		____ Other	
____ Routine Maintenance			
I have performed the training described above and concur with this verification.			
Witnessed by:		Manufacturer's Instructor Signature	
Title	Date	Title	Date

OPERATION AND MAINTENANCE MANUAL

REVIEW CHECKLIST

CLIENT: Town of Orleans, MA		ENGINEER: AECOM Technical Services, Inc.
PROJECT: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01		CONTRACTOR:
Equipment:		
Specification Section:		
Equipment Transmittal No.:		
O&M Manual Transmittal No.:		
	1.	Correct number of copies of Operation and Maintenance Manual Supplied
	2.	General
		a. Manual Customized
		b. Manual contains information on complete system (design, installation, operation and maintenance instructions)
		c. All material contained in manual is legible
		d. Permanent Binder and Labeled
		e. Index
	3.	Contact Information
		a. Name, address, and telephone number of manufacturer
		b. Name, address, and telephone number of nearest source of replacement parts and service
	4.	Equipment Information
		a. Equipment drawings, schematics, plates, and layouts
		b. Equipment Performance Curves
		c. Lubrication Schedule
		d. Maintenance Schedule
		e. Trouble Shooting Guide
		f. Parts List (part manufacturer, catalog number, etc.)
		g. Current Part Costs
		h. Recommended Spare Parts
		I. Special Tools Required
Remarks:		

SPARE PARTS INVENTORY

CLIENT: Town of Orleans, MA	ENGINEER: AECOM Technical Services, Inc.
PROJECT: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01	CONTRACTOR:
Equipment:	
Specification Section:	
AECOM Representative(s):	

Part Number	Part Description	Quantity	Owner	Initial Date	Initial Date

CERTIFICATION OF PROPER

EQUIPMENT INSTALLATION

CLIENT: Town of Orleans, MA	ENGINEER: AECOM Technical Services, Inc.
PROJECT: Meetinghouse Pond Area Collection System and Pumping Station, Contract No. 2022-01	CONTRACTOR:
Equipment:	
Specification Section:	
Date of Equipment Inspection:	
Manufacturer's Representative(s):	
Representing:	
Contractor's Representative(s)	
Equipment Installation	
____ Equipment Mounting / Supports	____ Lubrication
____ Safety (guards and/or signage)	____ Calibration
____ Electrical System	____ Spare Parts
____ Instrumentation and/or Control System	____ Other _____
Corrective Action Required:	
Corrective Action Existing:	
I hereby certify that the above noted equipment is ready for safe and efficient operation.	
Witnessed by: _____ Contractor's Representative Signature Date: _____	Certified by: _____ Manufacturer's Representative Signature Date: _____

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SECTION 01046

CONTROL OF WORK

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 2
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1.06 - DESIGN CRITERIA – Not Used 2
1.07 - REFERENCED STANDARDS – Not Used 2
PART 2 - PRODUCTS AND SERVICES – Not Used 2
PART 3 - EXECUTION 2
3.01 - FACILITY AND HOURS OF CONSTRUCTION 2
3.02 - OCCUPYING PRIVATE LAND 2
3.03 - PIPE LOCATIONS 3
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3.05 - OPEN EXCAVATIONS 3
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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, equipment, tools, and materials necessary for the implementation of the Control of Work during the construction of the facilities.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 – SUBMITTALS – Not Used

1.06 - DESIGN CRITERIA – Not Used

1.07 - REFERENCED STANDARDS – Not Used

PART 2 - PRODUCTS AND SERVICES – Not Used

PART 3 - EXECUTION

3.01 - FACILITY AND HOURS OF CONSTRUCTION

A. Furnish facility and equipment which will be efficient, appropriate, and large enough to secure a satisfactory quality of work and a rate of progress which will insure the completion of the work within the Contract Time. If at any time such facility appears to the Engineer to be inefficient, inappropriate, or insufficient for securing the quality of work required or for producing the rate of progress aforesaid, he may order the Contractor to increase the efficiency, change the character, or increase the facility equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such order shall in no way relieve the Contractor of his obligations to secure the quality of the work and rate of progress required.

B. Normal construction activity shall take place in accordance with SECTION 01030, SPECIAL REQUIREMENTS. only between the hours of 7:00 a.m. to 5:00 p.m., excluding Saturdays, Sundays, and legal holidays. Work outside the above time periods will be permitted only on an emergency basis and only with the approval of the Owner.

3.02 - OCCUPYING PRIVATE LAND

A. The Contractor shall not (except after written consent from the proper parties) enter or occupy with men, tools, materials, or equipment any land outside the rights of way or property of the Owner.

B. A copy of the written consent shall be given to the Engineer.

3.03 - PIPE LOCATIONS

A. Exterior pipelines will be located substantially as indicated on the Drawings, but the right is reserved to the Owner, acting through the Engineer, to make such modifications in location as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings, etc., are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

B. Small interior piping is indicated diagrammatically on the Drawings, and the exact location is to be determined in the field. Piping shall be arranged in a neat, compact, and workmanlike manner, with a minimum of crossing and interlacing, so as not to interfere with equipment or access ways, and, in general, without diagonal runs.

3.04 - DIMENSION OF EXISTING STRUCTURES

A. Where the dimensions and locations of existing structures are of importance in the installation or connection of any part of the Work, the Contractor shall verify such dimensions and locations in the field before the fabrication of any material or equipment which is dependent on the correctness of such information.

3.05 - OPEN EXCAVATIONS

A. Excavation shall be made and mantained in accrodance wth all federal, state and locateal rules and regualtinos includign OSHA.

B. All open excavations shall be adequately safeguarded by providing temporary barricades, fencing, caution signs, lights, and other means to prevent accidents to persons and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access during construction shall be removed when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench shall not remain open overnight.

C. The Contractor shall take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles which could be dangerous to the public shall be well lighted at night.

3.06 - TEST PITS

A. Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the Contractor at the direction of the Engineer. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer.

3.07 - INTERFERENCE WITH AND PROTECTION OF STREETS

A. The Contractor shall not close or obstruct any portion of a street, road, or private way without obtaining permits therefor from the proper authorities. If any street, road or private way shall be rendered unsafe by the Contractor's operations, he shall make such repairs or provide such temporary ways or guards as shall be acceptable to the proper authorities.

B. Streets, roads, private ways, and walks not closed shall be maintained passable and safe by the Contractor, who shall assume and have full responsibility for the adequacy and safety of provisions made therefor.

C. The Contractor shall, at least 24 hours in advance, notify the Police and Fire Departments in writing, with a copy to the Engineer, if the closure of a street or road is necessary. The Contracotr shall cooperate with the Police Department in the establishment of alternate routes and shall provide adequate detour signs, plainly marked and well lighted, in order to minimize confusion.

3.08 - CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the Engineer.

3.09 - PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. The Contractor shall assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. Any damage resulting from the Contractor's operations shall be repaired by him at his expense.

B. Assistance will be given the Contractor in determining the location of existing services. The Contractor, however, shall bear full responsibility for obtaining all locations of underground structures and utilities (including existing water services, drain lines, and sewers). Services to buildings shall be maintained, and all costs or charges resulting from damage thereto shall be paid by the Contractor.

C. Protection and temporary removal and replacement of existing utilities and structures as described in this Section shall be a part of the work under the Contract and all costs in connection therewith shall be included in the Total Price Bid in the Bid Form.

D. If, in the opinion of the Engineer, permanent relocation of a Owner’s utility is required, he may direct the Contractor, in writing, to perform the work. Work so ordered will be paid at the Contract unit prices, if applicable, or as extra work. If relocation of a privately owned utility is required, the Owner will notify the Utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the Owner and Utility, and shall have no claim for delay due to such relocation. The Contractor shall notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays, and Legal holidays) before excavating in any public way. The Contractor shall coordinate the removal and replacement of traffic loops and signals, if required for the performance of the work, at no additional cost to the Owner.

3.10 - INSPECTION OF WORK AWAY FROM THE SITE

A. If work to be done away from the construction site is to be inspected on behalf of the Owner during its fabrication, manufacture, or testing, or before shipment, the Contractor shall give notice to the Engineer of the place and time where such fabrication, manufacture, testing, or shipping is to be done. Such notice shall be in writing and delivered to the Engineer in ample time so that the necessary arrangements for the inspection can be made.

3.11- COOPERATION WITHIN THIS CONTRACT

A. All firms or persons authorized to perform any work under this Contract shall cooperate with General Contractor and his Subcontractors or trades, and shall assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer.

3.12 - CLEANUP AND DISPOSAL OF EXCESS MATERIAL

A. During the course of the work, the Contractor shall keep the site of his operations in as clean and as neat a condition as is possible. He shall dispose of all residue resulting from the construction work and, at the conclusion of the work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations, and shall leave the entire site of the work in a neat and orderly condition.

B. In order to prevent environmental pollution arising from the construction activities related to the performance of this Contract, the Contractor and his subcontractors shall comply with all applicable Federal, State, and local laws, and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and elsewhere in the Specifications.

C. The Contractor is advised that the disposal of excess excavated material in wetlands, stream corridors, and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the Contractor or any person employed by him, will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. Therefore, the Contractor will be required to remove the fill at his own expense and restore the area impacted.

3.13 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 01050

FIELD ENGINEERING

PART 1 – GENERAL 1
1.01 - SCOPE 1
1.02 – MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMTTALS 2
1.05 – PROJECT/SITE CONDITIONS 2
PART 2 – PRODUCTS – Not Used 3
PART 3 – EXECUTION 3
3.01 - EXAMINATION 3
3.02 - APPLICATION 3
3.03 – CONTRACT CLOSEOUT 3

PART 1 – GENERAL

1.01 - SCOPE

A. This work of this Section includes all labor, materials, tools, and equipment required for the providing Field Engineering as specified herein and/or as shown on the Contract Drawings including the following:

1. Examination of site and conditions of construction;
2. Establishment of lines, grades, and easements;
3. Connections to existing facilities; and
4. Restoration and protection of public and private property.

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

1.02 – MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

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

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

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

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

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

1.04 - SUBMTTALS

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

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

1. As-Built Drawings: The Contractor shall be responsible for maintaining two sets of redline "as-built locations and dimensions of work". The As-Built Drawings shall be submitted to the Owner at substantial completion of the project.

2. The Contractor shall submit copies of field records and record drawings each month with project invoices. Field data shall be updated each month as applicable.

1.05 – PROJECT/SITE CONDITIONS

A. Environmental Requirements

1. Unfavorable Construction Conditions

a. During unfavorable weather, wet ground, or other unsuitable construction conditions, confine operations to work which will not be affected adversely by such conditions.

b. No portion of Work shall be constructed under conditions which adversely affect quality or efficiency thereof, unless special means or precautions are taken to perform Work in manner acceptable to the Engineer.

B. Field Measurements

1. Lines and Grades

a. All Work shall be done to lines, grades, and elevations indicated on drawings or specified herein.

b. Basic vertical control points have been established or designated by the Engineer. Contractor shall be responsible for maintaining or subsequently replacing these controls to the satisfaction of the Engineer if these controls are disturbed. The Contractor shall be responsible for verifying all vertical control information that is used.

(1) Points shall be used as datum for work.

(2) Contractor shall be responsible for transferring all lines and grades from basic survey control points.

c. Contractor to perform all additional survey, layout, and measurement work.

(1) The Contractor shall provide survey work by a firm having successfully completed at least two projects of similar size and complexity within the last five years, and who shall employ experienced personnel and provide adequate supervision to satisfaction of the Engineer at all times when operations are in progress.

(2) Surveyor shall be a registered land surveyor in the location of the project.

d. Keep the Engineer informed, in writing, two weeks in advance, of times and places at which work is to be performed, so that horizontal and vertical control points may be established, and any checking deemed necessary by the Engineer may be performed.

e. Remove and reconstruct Work which is improperly located as determined by the Engineer and at no additional cost to the Owner.

2. Easements and Rights-of-Way

a. Easements and rights-of-way for utilities, if required, will be provided by the Owner.

b. Confine construction operations within limits indicated on drawings and/or within limits of easements or public ways.

c. Place construction tools, equipment, excavated materials, and pipeline materials and supplies, so as to cause least possible damage to property and interference with traffic.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

3.01 - EXAMINATION

A. Examination of Site and Verification of Conditions

1. Before starting operations, examine site to become acquainted with conditions to be encountered.

2. Verify exact locations of sewers, water mains, gas mains, above or below ground electrical wires, other utilities, conduits and structures which may interfere with work.

3.02 - APPLICATION

A. Connections to Existing Facilities

1. Make connections to existing facilities as indicated on drawings or as specified.

2. Plan in advance all connections to existing facilities which are in service.

a. All equipment, materials, and labor shall be on hand at time of undertaking connections to existing facilities in service.

b. Work shall proceed continuously if necessary, to complete connections within the time designated by the Engineer.

3. Operation of valves or other appurtenances on existing utilities, when required, shall be performed by respective utility personnel unless otherwise noted. a. A tight shutdown of existing Owner's or Community valves is not guaranteed; Contractor shall control leakage past valves to satisfaction of the Owner and Engineer and at no additional cost to the Owner.

B. Restoration and Protection of Public and Private Property

1. Protect, shore, brace, support, and maintain all underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by construction operations.

2. Restore all public and private property including pavement, surfacing, curbs, walks, utility poles, guy wires, fences, and other surface structures affected by construction operations, together with all sod and landscaping to their original condition or better, whether within or outside easements.

3.03 – CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

END OF SECTION

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SECTION 01090

REFERENCE STANDARDS

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PART 1 - GENERAL

1.01 - QUALITY ASSURANCE

A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids unless otherwise specified in Product Sections.

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

D. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.02 - SCHEDULE OF REFERENCES

Abbreviation	Name and Address	Abbreviation	Name and Address
AA	Aluminum Association 818 Connecticut Avenue, N.W. Washington, DC 20006	AABC	Associated Air Balance Council 1000 Vermont Avenue, N.W. Washington, DC 20005
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W. Washington, DC 20001	ACI	American Concrete Institute Box 19150 Reford Station Detroit, MI 48219
ADC	Air Diffusion Council 230 North Michigan Avenue Chicago, IL 60601	AI	Asphalt Institute Asphalt Institute Building College Park, MD 20740
AISC	American Institute of Steel Construction 400 North Michigan Avenue Eighth Floor Chicago, IL 60611	AISI	American Iron and Steel Institute 1000 16th Street, N.W. Washington, DC 20036
AITC	American Institute of Timber Construction 333 W. Hampden Avenue Englewood, CO 80110	AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004
ANSI	American National Standards	APA	American Plywood Association

Abbreviation	Name and Address	Abbreviation	Name and Address
	Institute 1430 Broadway New York, NY 10018		Box 11700 Tacoma, WA 98411
ARI	Air-Conditioning and Refrigeration Institute 1501 Wilson Boulevard Arlington, VA 22209	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017	ASPA	American Sod Producers Association 4415 West Harrison Street Hillside, IL 60162
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103	AWI	Architectural Woodwork Institute 2310 South Walter Reed Drive Arlington, VA 22206
AWPA	American Wood-Preservers' Association 7735 Old Georgetown Road Bethesda, MD 20014	AWS	American Welding Society 550 LeJeune Road, N.W. Miami, FL 33135
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235	BIA	Brick Institute of America 11490 Commerce Park Drive Reston, VA 22091
CDA	Copper Development Association 57th Floor, Chrysler Building 405 Lexington Avenue New York, NY 10174	CLFMI	Chain Link Fence Manufacturers Institute 1101 Connecticut Avenue, N.W. Washington, DC 20036
CRSI	Concrete Reinforcing Steel Institute 933 Plum Grove Road Schaumburg, IL 60195	DHI	Door and Hardware Institute 7711 Old Springhouse Road McLean, VA 22102
EJCDC	Engineers' Joint Contract Documents Committee American Consulting Engineers Council 1015 15th Street, N.W. Washington, DC 20005	EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591
FGMA	Flat Glass Marketing Association 3310 Harrison White Lakes Professional Building Topeka, KS 66611	FM	Factory Mutual System 1151 Boston-Providence Turnpike P.O. Box 688 Norwood, MA 02062

Abbreviation	Name and Address	Abbreviation	Name and Address
FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Bldg. 197 Washington, DC 20407	GA	Gypsum Association 1603 Orrington Avenue Evanston, IL 60201
ICBO	International Conference of Building Officials 5360 S. Workman Mill Road Whittier, CA 90601	IEEE	Institute of Electrical and Electronics Engineers 345 East 47th Street New York, NY 10017
IMIAC	International Masonry Industry All-Weather Council International Masonry Institute 815 15th Street, N.W. Washington, DC 20005	MBMA	Metal Building Manufacturer's Association 1230 Keith Building Cleveland, OH 44115
MFMA	Maple Flooring Manufacturers Association 60 Rivere Drive Northbrook, IL 60062	MIL	Military Specification Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120
ML/SFA	Metal Lath/Steel Framing Association 221 North LaSalle Street Chicago, IL 60601	NAAMM	National Association of Architectural Metal Manufacturers 221 North LaSalle Street Chicago, IL 60601
NCMA	National Concrete Masonry Association P.O. Box 781 Herndon, VA 22070	NEBB	National Environmental Balancing Bureau 8224 Old Courthouse Road Vienna, VA 22180
NEMA	National Electrical Manufacturers' Association 2101 'L' Street, N.W. Washington, DC 20037	NFPA	National Fire Protection Association Battery March Park Quincy, MA 02269
NFPA	National Forest Products Association 1619 Massachusetts Avenue, N.W. Washington, DC 20036	NSWMA	National Solid Wastes Management Association 1730 Rhode Island Ave., N.W. Washington, DC 20036
NTMA	National Terrazzo and Mosaic Association 3166 Des Plaines Avenue Des Plaines, IL 60018	NWMA	National Woodwork Manufacturers Association 205 W. Touhy Avenue Park Ridge, IL 60068

Abbreviation	Name and Address	Abbreviation	Name and Address
OSHA	Occupational Safety and Health Administration	PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077
PCI	Prestressed Concrete Institute 201 North Wells Street Chicago, IL 60606	PS	Product Standard U. S. Department of Commerce Washington, DC 20203
SDI	Steel Door Institute 712 Lakewood Center North 14600 Detroit Avenue Cleveland, OH 44107	SDI	Steel Deck Institute P.O. Box 9506 Canton, OH 44711
SIGMA	Sealed Insulating Glass Manufacturers Association 111 East Wacker Drive Chicago, IL 60601	SJI	Steel Joist Institute 1205 48th Avenue North Suite A Myrtle Beach, SC 29577
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 8224 Old Court House Road Vienna, VA 22180	SSPC	Steel Structures Painting Council 4400 Fifth Avenue Pittsburgh, PA 15213
TCA	Tile Council of America, Inc. Box 326 Princeton, NJ 08540	UL	Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062
WWPA	Western Wood Products Association 1500 Yeon Building Portland, OR 97204		

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

SECTION 01110

ENVIRONMENTAL PROTECTION PROCEDURES

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PART 1 - GENERAL

1.01 - SCOPE

A. Provide and compact bank-run gravel as indicated and specified.

B. The work covered by this Section consists of furnishing all labor materials and equipment and performing all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this Specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

C. The control of environmental pollution requires consideration of air, water, and land, and involves management of noise and solid waste, as well as other pollutants.

D. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching, or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to any construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in SECTION 01568, EROSION CONTROL, SEDIMENTATION AND CONTAINMENT OF CONSTRUCTION MATERIALS.

E. These Specifications are intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

F. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the Massachusetts Department of Environmental Protection and local Conservation Commission.

G. Schedule and conduct all work in a manner that will minimize the level of noise escaping the site, especially at night and on weekends.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 – SUBMITTALS – Not Used

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA

A. Comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement.

B. The Engineer will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectional acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. The Contractor shall, after receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 - IMPLEMENTATION

A. Prior to commencement of the work, meet with the Engineer to develop mutual understandings relative to compliance with this provision and administration of the environmental pollution control program.

B. Remove temporary environmental control features, when approved by the Engineer, and incorporate permanent control features into the project at the earliest practicable time.

3.02 - EROSION CONTROL

A. Provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures such as siltation basins, hay check dams, mulching, jute netting, and other equivalent techniques shall be used as appropriate. Offsite surface water shall be diverted around the site to a downstream channel ahead of siltation barriers. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled and the ground surface restored to original condition.

3.03 - PROTECTION OF STREAMS, WETLANDS, AND SURFACE WATER

A. Care shall be taken to prevent or reduce to a minimum any damage to any stream, drainage ditch, storm drain of sewer from pollution by debris, sediment, or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Such water will be diverted through a settling basin or filter before being directed into the streams.

B. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water, or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.

C. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action drawing or plan approved by the Massachusetts Department of Environmental Protection. Contractor shall submit to copies of approved contingency drawings or plans to the Engineer.

D. Water being flushed from structures or pipelines after disinfection, with a Cl2 residue of 2 mg/l or greater, shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

3.04 - PROTECTION OF LAND RESOURCES

A. Land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of construction, that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Drawings.

B. Outside of areas requiring earthwork for the construction of the new facilities, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Where trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's equipment, dumping or other operations, protect such trees by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly before beginning operations near them.

D. Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition. The Engineer will decide what method of restoration shall be used and whether damaged trees shall be treated and healed or removed and disposed of.

E. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in. in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.

F. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer, shall be immediately removed and replaced.

G. The locations of the Contractor's storage, and other construction building, required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Drawings and shall require written approval of the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the Engineer.

H. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling, and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and seeded as described in SECTION 01568, EROSION CONTROL, SEDIMENTATION AND CONTAINMENT OF CONSTRUCTION MATERIALS or as approved by the Engineer.

I. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.05 - PROTECTION OF AIR QUALITY

A. Burning. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control. The Contractor will be required to maintain all excavations, embankments, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of chlorides may be permitted with approval from the Engineer.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

3.05 - MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. During the life of this Contract, maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

3.06 - NOISE CONTROL

A. The Contractor shall make every effort to minimize noises caused by his operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with State and Federal (OSHA) regulations.

3.07 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 01171

ELECTRIC MOTORS

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PART 1 - GENERAL

1.01 - SCOPE

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

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

C. Unless otherwise specified, all electric motors furnished and installed by the Contractor shall conform to the requirements specified herein.

1. Motors rated at 460 V which are powered from Variable Frequency Drives shall be inverter duty rated as per NEMA-MG-1.

2. Motors shall be NEMA Premium Efficient as per NEMA-MG-1.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Descriptive literature and motor characteristics, including thermal limit curves and speed vs. torque curves. Provide thermal limit curves for motors 75 Hp and greater and all motor data.
2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
    a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are re-submitted with the entire package.
3. Submit motor data with the associated driven equipment submittals.
4. Shop drawings and descriptive data to include:
    a. Complete list of all motors to be furnished.
    b. Outlines, dimensions, weights, and wiring diagrams.
    c. Location of main and accessories boxes with size of conduit entrance.
    d. Efficiency and power factor at 1/2, 3/4 and full load.
    e. Bearing life data and grease requirements.
    f. Nameplate data.
    g. Prototype test data.
    h. Ground pad locations.
    i. Strip heaters KW and voltage ratings.
    j. Statement certifying that motor insulation system is compatible with output of VFD system provided under SECTION 16260, VARIABLE FREQUENCY DRIVES.
    k. Full load current
    l. Locked rotor current

m. Full load torque in lb.-ft.

n. Starting and breakdown torque in percent of full-load torque

o. Number and frequency of permissible starts under specified conditions

p. Horsepower versus current curves

q. Moment of inertia of rotor

r. The zero load, rated speed (with no load connected) kW and kvar input

s. The locked rotor KVA and power factor at rated voltage

t. Service factor

u. Descriptive bulletins or catalog cuts with full description of the insulation system

v. Manufacturer, type, size and rating of bearings

w. Motor thermal limit or damage curves

5. Submit certified copies of all factory shop test results.

6. Submit list of recommended spare parts and maintenance tools for each type of motor.

7. Provide manufacturer's printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated on the structural drawings.

8. Performance Test Reports: Upon completion of installed system, submit in booklet form all field tests performed.

1.05 - PRODUCT HANDLING

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

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

1.06 - DESIGN CRITERIA

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

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

1.07 - QUALITY ASSURANCE

A. Motors shall comply with the latest reference standards specified.

B. Routine tests shall be performed on representative motors less than 100 Hp in size and shall include the information described on NEMA MG1-12.54 Report of Test Form for Routine Tests on Induction Motors. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

C. The Contractor shall obtain the pumps, motors, and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. Where motors are driven by variable frequency drives (VFDs) the Contractor shall coordinate the variable frequency motor controllers with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

2. Variable frequency drives shall be provided in accordance with Specification SECTION 16260, VARIABLE FREQUENCY DRIVES.

D. Provide equipment rated in accordance with the Area Classification Schedule on Contract Electrical drawing 00 E-601.

1.08 - REFERENCES

A. National Electrical Code (NEC)

B. Massachusetts Electrical Code

C. Underwriters Laboratories, Inc. (UL)

D. National Electrical Manufacturers Assoc. (NEMA)

1. NEMA Standard MG-1 – Motors and Generators

2. NEMA WP-1 – Enclosed Electric Motor

E. American Bearing Manufacturers Association (ABMA)

F. American National Standard Institute (ANSI)

G. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE Standard 112 – Test Procedures for Polyphase Induction Motor and Generators

2. IEEE Standard 85 – Airborne Sound Measurements on Rotating Electric Machinery, Test Procedure for

3. IEEE Standard 429 – Evaluation of Sealed Insulation Systems for AC Electric Machinery Employing Form – Wound Stator Coils

4. IEEE Standard 841 – Service Duty Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Induction Motors

PART 2 - PRODUCTS

2.01 - ACCEPTABLE MOTOR MANUFACTURERS

A. Reliance Electric

B. Toshiba

C. U.S. Electric Motors

D. Or equal

2.02 - ELECTRIC MOTOR RATINGS

A. Voltage Ratings:

1. Unless otherwise specified, motors with ratings of 1/2 to 500 Hp shall be rated 460-volt (nameplate rating), three-phase, 60-Hertz; motors of 1/3 Hp or less to be rated 115-volt, single-phase, 60 Hertz.

B. The following specific motor requirements shall be identified in each equipment specification:

1. RPM.

2. Motor enclosure type.

2.03 - MOTOR REQUIREMENTS

A. Motor heaters shall be supplied on all motors located outdoors. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 volt, single phase with wattage. The heater wattage and voltage shall be embossed on the motor nameplate.

B. Every motor shall be of capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit at rated voltage. Each motor shall develop the necessary torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where indicated on the electrical drawings to be operated on a reduced voltage starter, the motor shall develop the necessary torque under the conditions imposed by the reduced voltage starting method.

C. The motor shall have capacity to operate the driven equipment as given in the equipment detail specifications. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

D. Type of Motors

1. All motors shall be NEMA Design B or of a type having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be for full-voltage starting.

E. Insulation

1. All motors shall have Class B (fractional horse power only) and Class F insulation for all other size motors.

2. Insulation systems shall be manufacturer’s premium grade, resistant to attack by moisture, acids, alkalies and mechanical or thermal shock for 480 Volt motors. Provide a Class F insulation system for an ambient temperature motor operation of 0 to 40 degrees C at no more than 3300 feet above sea level for inverter duty motors. This temperature rise shall be met when motors are operated and controlled with the VFD(s). The motor insulation system shall have full capability to handle the common mode voltage conditions imposed by the VFD.

3. Motors shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.

4. Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H insulation shall be used.

F. Enclosures

1. Motors shall have a steel or cast-iron frame and a cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-in. diameter, shall be provided inside the conduit box for motor frame grounding.

    a. Totally enclosed fan cooled: TEFC motors shall have a steel or cast-iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40 degrees C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

    b. Totally enclosed non-ventilated: TENV motors shall include the same rating and accessories as specified for TEFC motors.

    c. Explosion proof motors shall comply with all requirements of Class I, Division 1, Group D, hazardous locations as defined by the National Electrical Code and with all other safety codes pertaining thereto.

    d. Motors in NEMA 4, NEMA 4X and classified areas shall be provided with severe duty rating. Motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as “Corro-Duty”, “Mill and Chemical”, “Custom Severe Duty”, or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box and 1.15 service factor at 40 degrees C and tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).

G. Special Purpose Motors

1. Hermetically sealed air conditioning units, hoists, cranes and other devices complying with special safety codes shall be furnished with motors, control equipment, accessories and safety devices, in accordance with the manufacturer's standards and to be rated for the duty cycle as specified for the driven equipment. Service factor 1.15 above 3 hp.

2. Submersible motors shall be equipped with three thermal switches (one in each phase winding) connected to stop motor operation if the temperature exceeds 125 deg. C (255 deg. F). Also a leakage sensor for sensing water intrusion into the stator housing shall be provided.

3. Inverter duty rated: Motors for operation on variable frequency drives shall meet current power quality levels published in NEMA MG1, Part 31.

    a. Enclosures shall be equal to those furnished for severe duty or explosion proof motors. Motor shaft and bearings shall be insulated.

    b. Motors nameplate service factor shall be 1.0. Internal service factor shall be 1.15 that of the nameplate.

    c. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics. Rotors shall be configured to minimize skin-effect heating.

    d. Provide each variable frequency drive motor with an internal normally closed motor thermostat per phase wired in series

    e. Provide VFD driven motor shafts with grounding rings.

H. Auxiliary Devices

1. Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and to be provided with a single conduit box.

I. General Design of Motors

1. Motors shall comply with the latest NEMA Standards Publication No. MG1 for Motors and Generators, unless otherwise specified.
2. All polyphase non-explosion proof motors shall be provided with energy efficient operation and meet the requirements of MG1-12.53 a and b.
3. Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with an insulating compound that protects against moisture and slightly acid or alkaline conditions.
4. Bearings shall be of the self-lubricating type, provided so that there is proper alignment of rotor and shaft and to prevent leakage of lubricant.
    a. Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment.
    b. Bearings for totally enclosed and explosion proof motors shall be of the ball type.
    c. Bearing L-10 fatigue life in hours at 100 percent load shall be 50,000.
    d. Bearing grease shall be of the 120 deg. C thermal capability type.
    e. Bearings for 50 HP and larger VFD driven motors shall be isolated type bearings.
5. Vertical motors shall be provided with thrust bearings for all thrusts to which they can be subjected in operation.
6. All three phase two speed motors shall be of the two-winding design.
7. All non-VFD driven three phase motors shall be provided with a 1.15 service factor.
8. Three phase motors shall be of cast iron construction including frame and end brackets.
9. Motor nameplates shall be Type 316 stainless steel.
10. Motor Terminal Boxes and Leads:
    a. Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections, and with flexible leads of sufficient length to extend for a distance of not less than 4 in. beyond the face of the box. Solderless lugs shall be furnished. Totally enclosed and explosion proof motors to have cast-iron terminal boxes.
    b. Leads for space heaters shall be brought out into an auxiliary, cast, conduit box on the motor side opposite to the main terminal box. Auxiliary box to have 1" threaded conduit openings and shall be so constructed that conduit entrance may be placed at top, bottom, or either side.
    c. A grounding terminal shall be provided in the main terminal box and a bronze grounding bolt to be furnished at the conduit side of the motor frame.
    d. For inverter rated motors, provide oversized terminal boxes with oversize conduit opening and oversized cable lugs for cables as indicated.

J. Motor Efficiencies

1. Three phase motors rated 1 Hp and larger shall be of the premium efficiency, "Design E", type per Table 12.1 of NEMA MG1 Part 12. Efficiency values shall be based on tests performed in accordance with IEEE Publication No. 112, Method B. Motors with horsepower or rpms not listed shall conform to comparable standards of construction and materials as those for listed motors.

K. Shop Painting

1. Unless otherwise specified, motors shall be given a shop application of paint filler or enamel sealer, a flat coat of undercoater for enamel, and two coats of enamel or, in lieu of this treatment, other corrosion-resistant treatment customary with the manufacturer.

L. Motor Data

1. The Contractor shall furnish five certified copies of characteristic curves of each motor furnished, except 115-volt motors. Curves shall be supplied as a part of the driven equipment submittal.

M. Motor Shop Tests

1. Motor shop tests shall be made in accordance with the IEEE Test Codes as specified in the NEMA MG1 Standards for Motors and Generators. NEMA report-of-test forms to be used in submitting test data.

2. Motor efficiency shall be determined by use of IEEE Standard 112 Test Method B, and by use of MGI-12.53 a and b.

3. For motors rated 100 hp and larger, complete tests of each motor furnished to be made and certified test data sheets to be submitted. Each motor shall be tested at rated voltage for: efficiency and power factor at 25, 50, 75, and 100 percent of it rated horsepower; for temperature rise, torque, no-load current, starting current, full load current, and dielectric strength; and for compliance with all specified performance requirements.

4. For induction motors 5 hp, up to 100 hp, copies of routine test reports of electrically duplicate motors shall be furnished.

5. For motors 3 hp or less, no test data need be furnished.

6. Where required by the load equipment specifications, provide testing support for shop testing at the equipment manufacturer's facility.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Verify heaters are energized when supplied on motors.

B. After motor installation but before connection to power wiring, test motor winding insulation.

C. After connection to power wiring, check for operating temperature, correct rotation, vibration, alignment and operating current drawn under load.

D. Submit all motor test results for review and record.

3.02 - TESTING

A. Inspect physical and mechanical condition.

B. Inspect for correct anchorage, mounting, grounding, connection, and lubrication.

C. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturers published data.

D. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.

E. Megger test motor winding insulation.

F. Provide testing in accordance with SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

3.03 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 01300

SUBMITTALS

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PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section specifies the general methods and requirements of submissions applicable to the following Work-related submittals:

1. Shop Drawings, Product Data and Samples.
2. Mock Ups.
3. Construction Photographs.
4. Contractor’s Responsibilities.
5. Submission Requirements.
6. Review of Shop Drawings, Product Data, Working Drawings and Samples.
7. Distribution.
8. General Procedures for Submittals.
9. Certificate of Design.
10. Certificates of Compliance.
11. Schedules.

B. American Iron and Steel (AIS) certifications for all applicable materials must be included with the product shop drawing or the submittal will be rejected. Certification requires a project specific letter that certifies the

manufacturing process and foundry location of the subject products and/or materials. There will be no payment for items that do not have approved AIS certification.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

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

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

12. Submittals: written and graphic information and physical samples that require Engineer’s responsive action. Action submittals are those submittals indicated in individual Specification sections as "action submittals."

13. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

14. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

15. Shop drawings, as defined in the General Conditions, and as specified in individual Work Sections include, but are not necessarily limited to: custom-prepared data such as fabrication and erection/installation

(working) drawings of concrete reinforcement, structural details and piping layout, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications as applicable to the Work

1.04 - SUBMITTALS

A. Shop drawings and brochures shall be submitted for all items to be furnished in accordance with the provisions of DOCUMENT 00700, GENERAL CONDITIONS and this Section.

B. Detailed submittal requirements are specified in the Technical Specifications sections.

C. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of Subcontractors, the schedule of values, and Contractor’s construction schedule.

2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

   a. Scheduled date for first submittal.

   b. Specification section number and title.

   c. Submittal category: Action; informational.

   d. Name of Subcontractor.

   e. Description of the Work covered.

   f. Scheduled date for Engineer’s final release or acceptance.

   g. Scheduled date of fabrication.

1.05 - SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer's Digital Data Files: Electronic digital data files of the Drawings will be provided by Engineer for Contractor's use in preparing Project Record Drawings.

1. Engineer will furnish Contractor one set of digital data drawing files of the Drawings for use in preparing Project record drawings.

2. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

3. Digital Drawing Software Program: The Contract Drawings are available in AutoCad Civil 3D 2017 format.

4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to the Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification section concurrently unless partial submittals for portions of the Work are indicated on accepted submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. All shop drawings shall be submitted using the transmittal form furnished by the Engineer.

D. All shop drawings submitted by Subcontractors for approval shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.

E. Processing Time. Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review. Allow 15 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review. If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review. Allow 15 working days for review of each resubmittal.
4. Sequential Review. Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 20 working days for initial review of each submittal.

F. Paper Submittals. Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6-inches by 8-inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
3. Number of submittals required:
    a. Shop Drawings: Unless otherwise stated in the respective Specifications sections, submit six (6) copies.
    b. Product Data: Unless otherwise stated in the respective Specifications submit six (6) copies.
    c. Samples: Submit the number stated in the respective Specification Sections.
4. Include the following information for processing and recording action taken:
    a. Project name.
    b. Date.
    c. Name of Engineer.
    d. Name of Contractor.
    e. Name of Subcontractor.
    f. Name of supplier.
    g. Name of manufacturer.

h. Submittal number or other unique identifier, including revision identifier. Engineer's Shop Drawing Transmittal Form includes spaces for the submittal number (e.g. 12) and the Specification section number (e.g., SECTION 09940, SHOP PAINTING). Submittal numbering shall be sequential. Resubmittals shall include an alphabetic suffix after the original submittal number (e.g. 12A).

i. Number and title of appropriate Specification section.

j. Drawing number and detail references, as appropriate.

5. Additional Paper Copies. Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

6. Transmittal for Paper Submittals. Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form to be supplied by the Engineer. Engineer will discard submittals received from sources other than Contractor.

G. Options. Identify options requiring selection by Engineer.

H. Deviations and Additional Information. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

I. Resubmittals. Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block and clearly indicate extent of revision.

3. Resubmit submittals until they are marked with acceptance notation from Engineer's action stamp.

J. Distribution. Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.

K. Use for Construction. Retain complete copies of submittals on the Project Site. Use only final action submittals that are marked with acceptance notation from Engineer's action stamp.

1.06 - CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall provide construction photographs in accordance with requirements specified in SECTION 01030, SPECIAL REQUIREMENTS.

PART 2 - PRODUCTS

2.01 - SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements. Prepare and submit submittals required by individual Specification sections. Types of submittals are indicated in individual Specification sections.

B. Product Data. Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.

b. Manufacturer's product specifications.

c. Standard color charts.

d. Statement of compliance with specified referenced standards.

e. Testing by recognized testing agency.

f. Application of testing agency labels and seals.

g. Notation of coordination requirements.

h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.

b. Printed performance curves.

c. Operational range diagrams.

d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.

6. Submit Product Data in the following format. Six (6) paper copies of Product Data unless otherwise indicated. Engineer will return three (3) copies.

C. Shop Drawings. Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.

1. Contractor shall submit certified shop and erection drawings of the proposed equipment in the capacity, size, and arrangement as indicated and specified.

a. Drawings shall include plan views, sectional views, title block, Tag Numbers, serial numbers, Parts List (identifying each component), dimensions, connection sizes and types and all details of all related items. In cases where certain information is proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

b. Drawings shall be in conformance with all other requirements as specified in this Specification.

2. Preparation. Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.

b. Schedules.

c. Compliance with specified standards.

d. Notation of coordination requirements.

e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.

g. Seal and signature of professional engineer if specified.

3. Sheet Size. Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8 ½ inches by 11 inches, but no larger than 24 inches by 36 inches.

4. Submit Shop Drawings in the following format. Submit Product Data in the following format. Six (6)paper copies of Product Data unless otherwise indicated. Engineer will return three (3) copies.

D. Samples. Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one (1) submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of applicable Specification Section.
    e. Specification paragraph number and generic name of each item.
3. Disposition: Maintain sets of accepted Samples at Project Site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    a. Number of Samples: Submit two (2) sets of Samples. Engineer will retain one (1) sample set; remainder will be returned.
    b. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    c. If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of variations.

E. Test and Inspection Report Submittal. Comply with requirements specified in SECTION 01400, QUALITY ASSURANCE.

F. Welding Certificates. Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

G. Installer Certificates. Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

H. Manufacturer Certificates. Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

I. Product Certificates. Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

J. Material Certificates. Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

K. Field Test Reports. Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

2.02 - DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit three (3) paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.01 - CONTRACTOR'S REVIEW

A. Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Mark with approval stamp before submitting to Engineer.

B. Contractor review shall verify the following:

1. Field measurements
2. Field construction criteria
3. Catalog numbers and similar data
4. Conformance with the Specifications

C. If a shop drawing shows any deviation from the requirements of the Contract Documents, the Contractor shall make specific mention of the deviations in the Transmittal Form furnished by the Engineer and provide a description of the deviations in a letter attached to the submittal.

D. The review and approval of shop drawings, samples or product data by the Engineer shall not relieve the Contractor from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will not have responsibility therefor.

E. No portion of the Work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to accepted shop drawings and data shall be at the Contractor's risk. The Owner and Engineer will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

F. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.02 - ENGINEER’S ACTION

A. The Engineer's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Contract Drawings and Specifications or from departures therefrom. The Contractor remains responsible for details and accuracy, for coordinating the Work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

B. The review of shop drawings, data, and samples will be general. They shall not be construed:

1. As permitting any departure from the Contract requirements;

2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials; or

3. As approving departures from details furnished by the Engineer, except as otherwise provided herein.

C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which the Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting an exception.

D. Three (3) (maximum) copies of shop drawings or product data will be returned to the Contractor via First Class United States Postal Service. Samples will not be returned.

E. Submittals will be returned to the Contractor under one of the action codes indicated below and defined on the transmittal form furnished by the Engineer.

1. Marking: No Exception Taken.

a. When submittals are marked as “No Exception Taken,” Work covered by submittal may proceed provided it complies with Contract Documents. Acceptance of Work depends on that compliance.

2. Marking: Make Corrections Noted.

a. When submittals are marked as “Make Corrections Noted,” Work covered by submittal may proceed provided it complies with Engineer’s notations or corrections on submittal and with Contract Documents. Acceptance of Work depends on that compliance. Resubmittal not required.

3. Marking: Amend and Resubmit.

a. When submittals are marked as “Amend and Resubmit,” do not proceed with Work covered by submittal. Do not permit Work covered by submittals to be used at Project Site or elsewhere where Work is in progress.

b. Revise submittal or prepare new submittal in accordance with Engineer's notations in accordance with resubmittal requirements of this section. Resubmit without delay. Repeat if required to obtain different action marking.

4. Marking: Rejected; See Remarks.

a. When submittals are marked as “Rejected; See Remarks,” do not proceed with Work covered by submittal. Work covered by submittal does not comply with Contract Documents.

b. Prepare new submittal for different material or equipment supplier or different product line or material of same supplier complying with Contract Documents.

5. Marking: For Information Only.

a. When submittals are marked as “For Information Only,” the Engineer will review the submittal but take no action.

b. It will be recorded as “For Information Only”. Work covered by this submittal may proceed provided it complies with the Contract Documents.

6. Marking: Not Required for Review.

a. When submittals are marked as “Not Required for Review,” the Engineer has not reviewed the submittal and it is being returned.

b. Work covered by this submittal may proceed provided it complies with the Contract Documents.

F. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing, on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the Engineer, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the Contractor. The Contractor shall make corrections to any Work done because of this type revision that is not in accordance to the Contract Documents as may be required by the Engineer.

G. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Rejected" until resubmitted. The Engineer may at his option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

H. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the Engineer within five working days after the date of the Engineer's review of the shop drawing and prior to the release for manufacture.

I. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

3.03 - DISTRIBUTION

A. Distribute reproductions of accepted shop drawings and copies of accepted product data and samples, where required, to the Project Site file and elsewhere as directed by the Engineer. Number of copies shall be as directed by the Engineer but shall not exceed six (6).

3.04 - CERTIFICATE OF DESIGN

A. If specifically specified in other sections of these Specifications, the Contractor shall submit the applicable Certificate of Design for each item required, and in the form attached to this Section, completely filled in and signed and sealed by a registered professional engineer.

3.05 - CERTIFICATES OF COMPLIANCE

A. Certificates of Compliance as specified in the specifications shall include and mean certificates, manufacturer's certificates, certifications, certified copies, letters of certification and certificate of materials.

B. The Contractor shall be responsible for providing Certificates of Compliance as specified in the technical specifications. Certificates are required for demonstrating proof of compliance with specification requirements and shall be executed in six (6) copies unless otherwise specified. Each certificate shall be signed by an official authorized to certify on behalf of the manufacturing company and shall contain the name and address of the Supplier, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Supplier from furnishing satisfactory material, if after tests are performed on selected samples, the material is found not to meet the specific requirements.

3.06 - SCHEDULES

A. Provide all schedules as specified.

B. Progress Payments shall be subject to meeting the Schedule Requirements of this section (Refer to Table 01300-1). No progress payment identified in Table 01300-1 over the limits identified will be made until the milestones set in this table are satisfied.

Table 01300-1

Section Number	Section Name	Submittal	Schedule Requirement/ Payment Milestone
01311	Construction Progress Schedule	Project schedule is submitted and reaches no exceptions taken status.	Prior to Mobilization to the Project Site
01300	Submittals	Shop drawings are submitted and reach no exceptions taken status.	Prior to 75% payment of Mobilization/Demobilization.
01030	Special Requirements	Record documentation is submitted and reaches no exceptions taken status.	Prior to 95% payment.
01311	Construction Progress Schedule	Punch list is completed and corrected.	Prior to 95% payment.

END OF SECTION

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SECTION 01310

MISCELLANEOUS TESTING AND SOIL DATA

PART - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING – Not Used 2
1.06 - DESIGN CRITERIA 2
PART 2 - PRODUCTS - Not Used 2
PART 3 - EXECUTION - Not Used 2

PART - GENERAL

1.01 - SCOPE

A. The Work of this section includes the furnishing of all labor, materials, tools and equipment required to perform miscellaneous testing as required in the Contract Documents and/or as directed by the Engineer.

B. Existing testing and subsurface soil data, if available, is included in this section.

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

1.02 - MEASUREMENT AND PAYMENT

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

B. In addition to the above, measurement and payment shall be in accordance to the following:

1. Payment for testing shall be as specified under the applicable Payment Items included under SECTION 01025, MEASUREMENT AND PAYMENT.

2. Pay all up front costs associated with additional testing. If the testing proves the Work is defective or materials are unsatisfactory then correct all defective Work at no cost to the Owner. If the testing proves the Work and/or materials are satisfactory, then the Owner will pay for costs associated with additional testing.

3. Where the technical section of the Specifications required that a piece of equipment be tested at the manufacturer's facility or at the site, the cost of such tests shall be included in the price of the equipment.

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings including at least the following:

1. Additional Testing.

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA

A. Subsurface soil data, if included in the Contract Documents, is for general information only. The information pertains to the subsoil conditions in the vicinity of the Work and is given to assist in properly evaluating the amount and character of the Work required hereunder. Such data is represented as being the best factual information available.

1. The Owner and Engineer assume no responsibility for the accuracy thereof or for any conclusions that might draw therefrom.
2. It is understood and agreed that, by careful examination, you have satisfied yourself as to the nature and location of the Work, have examined such logs of test borings and/or records made of underground exploration as may be available, understand the character of equipment and facilities needed for the prosecution of the Work, the general and local conditions, and all other matters which could in any way affect the Work under this Contract.
3. Jar samples, if available, may be examined during normal business hours, at the Owner’s office.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF TEXT

SEE ATTACHMENT - GEOTECHNICAL DATA REPORT

SEE ATTACHMENT – BORING LOGS

GEOTECHNICAL DATA REPORT

Town of Orleans
Pumping Station No.4
Orleans, Massachusetts

June 2022

AECOM Project No.: 60652634

1.1 PROJECT DESCRIPTION

AECOM is providing engineering services for the design phase associated with the installation of a Pump Station behind Orleans Town Hall that will service a hybrid wastewater collection system. The hybrid system consists of 15,570 linear feet of gravity sewer, 20,750 linear feet of low-pressure sewer, and 7,500 linear feet of force mains.

1.2 PURPOSE OF REPORT

The purpose of this Geotechnical Data Report (GDR) is to provide supporting data for the design services associated with the construction of the Pump Station behind Orleans Town Hall. The proposed Pump Station will service the wastewater collection system in the Meetinghouse Pond area. The data was collected during a subsurface investigation that involved the drilling of test borings, the installation of a groundwater monitoring well, and the laboratory testing of selected soil samples.

1.3 SUBSURFACE INVESTIGATION

The subsurface investigation was performed from May 2 to May 5, 2022 and consisted of the drilling of a total of three (3) test borings. The test borings ranged in depth from 30.0 to 90.0 feet approximately and were drilled by Desmond Well Drilling Inc., based in Orleans, MA.

1.3.1 Drilling and Sampling

Utility locating efforts were implemented prior to the start of borehole drilling. These efforts included Call Before You Dig mark-out and vacuum to 6 feet below the existing ground surface in selected boring locations.

Test borings were typically drilled using 4.25”- I.D. hollow stem augers as noted on the boring logs. Standard penetration test (SPT) split-spoon soil sampling was typically conducted at 5-foot intervals. The SPT soil samples were logged by an AECOM representative in accordance with ASTM D2488.

The as-drilled boring location plan is provided in Attachment 1. The test boring logs from the current subsurface investigation program are provided in Attachment 2.

1.3.2 Groundwater Levels

Groundwater levels at each boring location were estimated at the time of drilling and were recorded on the boring logs. In addition, boring PS4-MW was completed as a groundwater monitoring well and subsequent readings were made on May 05, 2022. The readings are shown in Table 1 below. The groundwater monitoring well installation log is provided in Attachment 3.

Table 1- Summary of Monitoring well readings, (Depth in feet)

Monitoring Well ID	Readings at the time of drilling	Readings on May 5, 2022
PS4-MW	16’	15’

1.3.3 Laboratory Testing

A laboratory testing program was performed to determine the engineering properties of the soil samples collected in the field. Representative soil samples were selected and tested for Sieve Analyses and Hydrometer Analyses. The soil samples were tested by GeoTesting Express in Acton, Massachusetts.

A summary of the soil laboratory testing designation is provided in Table 2. The detailed laboratory test results are provided in Attachment 4.

Table 2: Summary of soil laboratory testing

Boring ID	Sample ID	Depth (ft)	Sieve Analyses (ASTM D6913)	Hydrometer Analyses (ASTM D7928)
PS4-1	SS2	8-10	**X**	
PS4-1	SS4	18-20	**X**	
PS4-1	SS5	23-25	**X**	**X**
PS4-1	SS6	28-30	**X**	
PS4-1	SS16	78-80	**X**	**X**
PS4-2	SS1	6-8	**X**	
PS4-2	SS3	13-15	**X**	**X**
PS4-2	SS6	28-30	**X**	

1.4 REPORT LIMITATIONS

Subsurface conditions may vary beyond a borehole’s location and conditions at and beyond a borehole may change over time as a result of construction activity. Groundwater levels will fluctuate with precipitation, season, construction activities, run-off controls, and other factors. As a result, water levels during construction may vary from those observed during the investigation program.

1.5 REFERENCES

ASTM D1586/D1586M-18e1, “Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel sampling of Soils.” ASTM International, West Conshohocken, PA, 2022, www.astm.org.

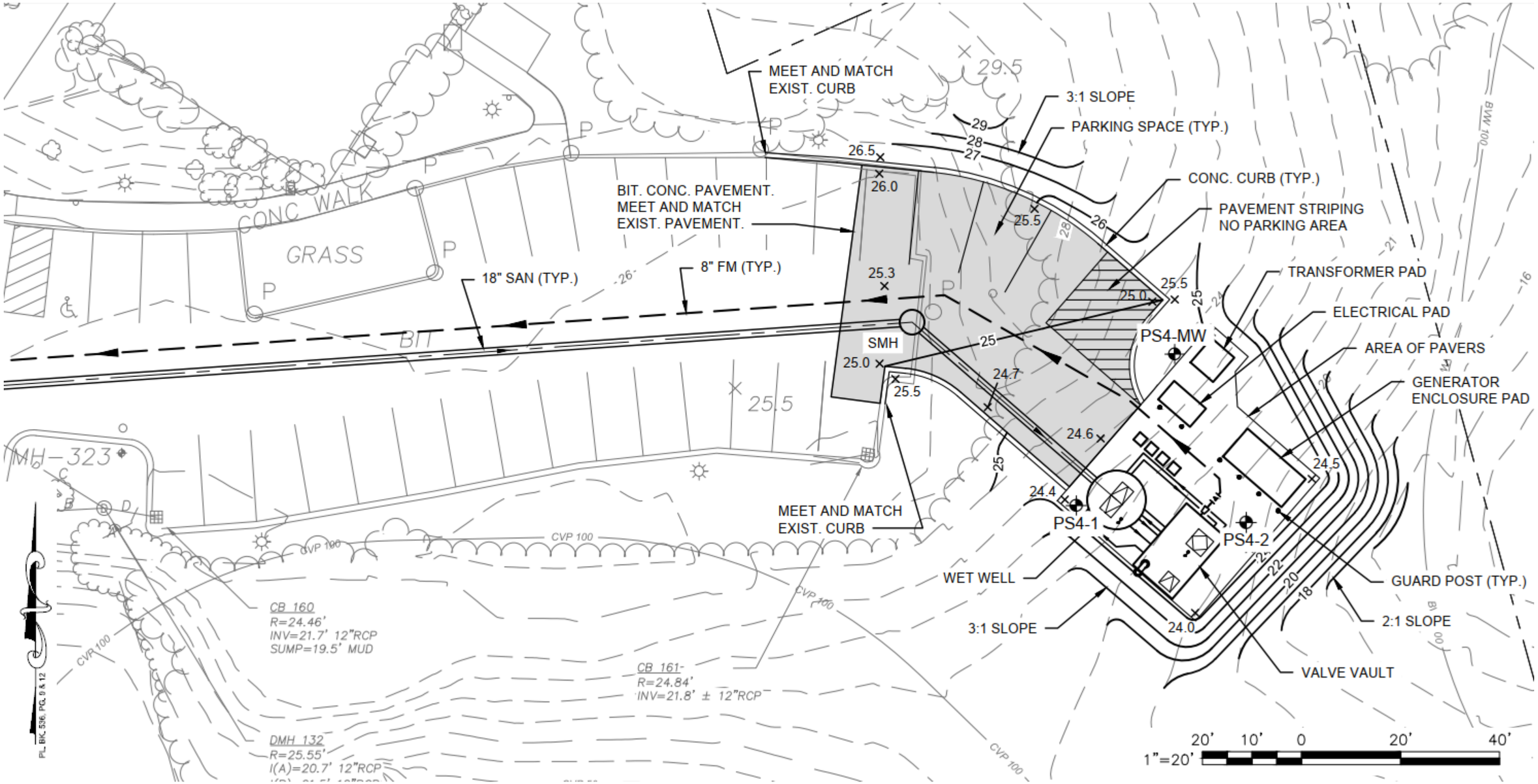
ASTM D2488-17e1, “Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).” ASTM International, West Conshohocken, PA, 2018, www.astm.org.

ASTM D6913 / D6913M-17, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis, ASTM International, West Conshohocken, PA, 2021, www.astm.org.

ASTM D7928-21e1, Standard Test Methods for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis, ASTM International, West Conshohocken, PA, 2021, www.astm.org.

ATTACHMENT 1

Boring Location Plan



Note – Figure based on Site Plan – Pumping Station No.4 Drawing by AECOM

Legend

⊕ Location of Borings performed by Desmond Well Drilling, Inc. between May 2 and May 5, 2022.

Client: Town of Orleans, MA	Project: Pumping Station No.4	**Boring Location Plan**
AECOM	Project Location: Orleans, Massachusetts	Date: June, 2022

ATTACHMENT 2

Test Boring Logs

Report: GEO_CR_WITH_N_VALUE; File \\NA.AECOMNET.COM\LFS\AMER\CHELMSFORD-USCHL1\SECURE_DCS\RESOURCES\LEGACY\PRIVATEVAE_DEPTS\GEOT\PROJECT FILES (GEOTECH)\ORLEANS PUMP STA. 4 - 60652634\GINT LOGS\ORLEANS PUMP ...

Project: Orleans Pump Station 4
Project Location: Orleans, MA
Project Number: 60652634

Log of Boring PS4-1

Sheet 1 of 3

Date(s) Drilled	5/3/2022	Logged By	B. Reyes	Checked By	W. Song
Drilling Method	4.25" ID HSA	Drill Bit Size/Type	N/A	Total Depth of Borehole	90.0′ bgs
Drill Rig Type	CME 75	Drilling Contractor	Desmond Well Drilling Inc.	Surface Elevation	22.7 ft NAVD 88
Borehole Backfill	Soil Cuttings	Sampling Method(s)	2" O.D. SPT	Hammer Data	140 lb./30 in. Automatic Hammer
Boring Location	Orleans, MA	Groundwater Level(s)	16 ft		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance Blow/6 in.	SPT N-Value (Uncorrected)	Recovery, inches	Pocket Pen and TV, tsf	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
	0								22.7 0.0 22.2 Light brown to red, Poorly graded SAND (SP), fine to coarse grained, trace roots upper 3 feet 0.5	*Vacuumed to 6 feet.*
20										
	5									
		SS	SS1	8 7 8 7	15	16			Light brown to red, Poorly graded SAND (SP), fine to coarse grained	
15		SS	SS2	3 4 4 4	8	17			Grey to red, Silty SAND (SM), mostly fine to medium grained sand, little non-plastic fines, trace fine grained gravel, finer sand at bottom	*%G=0.9 %S=79.9 %F=19.2*
	10									
10		SS	SS3	3 3 4 3	7	18			Brown to red, Poorly graded SAND (SP), fine to medium grained, trace non-plastic fines, wet	
	15									
5									4.7 18.0	
		SS	SS4	3 4 6 6	10	16			Brown to red to grey, Clayey SAND (SC), mostly fine to medium grained sand, interbeded with thin layers of medium plasticity clay, wet	*%G=0.0 %S=60.3 %F=39.7*
	20									
0		SS	SS5	3 4 6 6	10	17			Brown to grey, Sandy Lean CLAY (CL), low plasticity, some fine to coarse grained sand, transitioning to poorly graded SAND (SP) at bottom, wet	*%G=0.3 %S=48.9 %F=50.8*
	25									
-5									-5.3 28.0	
		SS	SS6	3 4 6 6	10	13			Light brown, Poorly graded SAND (SP), fine to coarse grained sand, trace low plasticity fines, trace fine grained gravel, wet	*%G=2.0 %S=95.9 %F=2.1*
	30									

Report: GEO_CR_WITH_N_VALUE; File \\NA.AECOMNET.COM\LFS\AMER\CHELMSFORD-USCHL1\SECURE_DCS\RESOURCES\LEGACY\PRIVATEVAE_DEPTS\GEOT\PROJECT FILES (GEOTECH)\ORLEANS PUMP STA. 4 - 60652634\GINT LOGS\ORLEANS PUMP ...

Project: Orleans Pump Station 4
Project Location: Orleans, MA
Project Number: 60652634

Log of Boring PS4-1

Elevation, feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance Blow/ 6 in.	SAMPLES: SPT N-Value (Uncorrected)	SAMPLES: Recovery, inches	SAMPLES: Pocket Pen and TV, tsf	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
-10	30									
	35		SS7	3 6 6 7	12	11			Light brown, Poorly graded SAND (SP), fine to coarse grained, wet	
-15									-15.3	38.0
	40		SS8	4 6 7 9	13	7			Light brown to grey, Well-graded SAND (SW), fine to coarse grained, wet	
-20									-20.3	43.0
	45		SS9	5 9 9 12	18	18			Brown to grey, Poorly graded SAND (SP), fine to coarse grained, few coarse grained gravel, wet	
-25			SS10	6 9 12 13	21	14			Light brown, Poorly graded SAND (SP), fine to medium grained, wet	
-30	50								-30.3	53.0
	55		SS11	8 12 19 22	31	7			Light grey to red, Silty SAND (SM), fine to medium grained sand, little low plasticity fines, wet	
-35									-35.3	58.0
	60		SS12	6 10 12 14	22	6			Light brown, Well-graded SAND (SW), fine to coarse grained, trace of fine grained gravel, wet	
-40			SS13	7 11 14 16	25	0			No Recovery	*Lost sample due to SPT basket breaking.*
	65									

Report: GEO_CR_WITH_N_VALUE; File \\NA.AECOMNET.COM\LFS\AMER\CHELMSFORD-USCHL1\SECURE_DCS\RESOURCES\LEGACY\PRIVATEVAE_DEPTS\GEOT\PROJECT FILES (GEOTECH)\ORLEANS PUMP STA. 4 - 60652634\GINT LOGS\ORLEANS PUMP ...

Project: Orleans Pump Station 4
Project Location: Orleans, MA
Project Number: 60652634

Log of Boring PS4-1

Elevation, feet	Depth, feet	SAMPLES: Type	Number	Sampling Resistance Blow/ 6 in.	SPT N-Value (Uncorrected)	Recovery, inches	Pocket Pen and TV, tsf	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
-45										
		SS	14	10 18 18 12	36	11			-46.0 Top 8" - Light brown, Well-graded SAND (SW), fine to medium grained, trace non-plastic fines, wet 68.7 Bottom 3" - Grey silty SAND (SM), fine grained sand, little non-plastic fines, clay at tip	
70										
-50										
		SS	15	9 15 18 16	33	14			Top 12" - Brown to red SILT (ML), low plasticity, fine grained sand at top, wet Bottom 2" - Grey, lean CLAY (CL), low plasticity, wet	
75										
-55										
		SS	16	6 12 15 18	27	19			Grey, SILT (ML), low plasticity, trace fine grained sand, wet	*%G=.1 %S=2.1 %F=97.8*
80										
-60									-60.3 83.0 -60.6 Top 4" - Grey SILT (ML), medium plasticity, few medium plasticity clay 83.3 Bottom 11" - Brown, Well-graded SAND (SW), fine to coarse grained, trace low plasticity fines, wet	
		SS	17	11 12 16 20	28	15				
85										
-65									-65.3 88.0 Light brown, Poorly graded SAND (SP), fine grained, wet	
		SS	18	2 6 17 37	23	7			-67.3 90.0 Boring Terminated at 90 ft bgs	
90										
-70										
-75										

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Project: Orleans Pump Station 4
Project Location: Orleans, MA
Project Number: 60652634

Log of Boring PS4-2

Sheet 1 of 3

Date(s) Drilled	5/2/2022	Logged By	B. Reyes	Checked By	W. Song
Drilling Method	4.25" ID HSA	Drill Bit Size/Type	N/A	Total Depth of Borehole	90.0′ bgs
Drill Rig Type	CME 75	Drilling Contractor	Desmond Well Drilling Inc.	Surface Elevation	20.0 ft NAVD 88
Borehole Backfill	Soil Cuttings	Sampling Method(s)	2" O.D. SPT	Hammer Data	140 lb./30 in. Automatic Hammer
Boring Location	Orleans, MA	Groundwater Level(s)	18 ft		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance Blow/ 6 in.	SPT N-Value (Uncorrected)	Recovery, inches	Pocket Pen and TV, tsf	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
20	0								20.0 / 0.0 19.5 .5" Top soil, roots 0.5 3.5' Red to grey, Poorly graded SAND (SP), fine to coarse grained, trace roots 5.5' Grey, Poorly graded SAND (SP), fine to coarse grained	*Vacuumed to 6 feet.*
15	5								14.0 / 6.0	
		SS	SS1	3 4 7 8	11	17			Red to brown, Silty SAND (SM), fine to coarse grained sand, little to some non-plastic fines, trace fine grained gravel,	*%G=5.0 %S=65.4 %F=29.6*
		SS	SS2	3 7 10 9	17	19			11.3 / 8.7 Top 8" - Grey to red, Silty SAND (SM), fine to medium grained, some non-plastic fines 10.0 / 10.0 Bottom 11" - Red, Poorly graded SAND (SP), fine to coarse grained, trace non-plastic fines, non-plastic Silt on bottom 1"	
10	10									
		SS	SS3	3 7 9 9	16	20			Brown to red to grey, Silty SAND (SM), fine to coarse grained sand, little non-plastic fines, trace fine grained gravel, wet	*%G=0.1 %S=76.1 %F=23.8*
5	15									
		SS	SS4	3 4 5 5	9	18			0.8 / 19.2 Top 14" - Brown to grey, Silty SAND (SM), fine to coarse grained sand, little non-plastic fines, wet	
0	20								Bottom 4" - Brown, Poorly graded SAND (SP), medium to coarse grained, wet	
		SS	SS5	2 4 4 5	8	17			Brown to grey, Poorly graded SAND (SP), fine to coarse grained, wet	
-5	25									
		SS	SS6	3 4 7 7	11	10			Brown to grey, Poorly graded SAND (SP), mostly fine to medium grained sand, trace non-plastic fines, wet	*%G=0 %S=96.2 %F=3.8*
-10	30									

Report: GEO_CR_WITH_N_VALUE; File \\NA.AECOMNET.COM\LFS\AMER\CHELMSFORD-USCHL1\SECURE_DCS\RESOURCES\LEGACY\PRIVATEVAE_DEPTS\GEOT\PROJECT FILES (GEOTECH)\ORLEANS PUMP STA. 4 - 60652634\GINT LOGS\ORLEANS PUMP :

Project: Orleans Pump Station 4
Project Location: Orleans, MA
Project Number: 60652634

Log of Boring PS4-2

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance Blow/ 6 in.	SPT N-Value (Uncorrected)	Recovery, inches	Pocket Pen and TV, tsf	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
-10	30									
		SS	SS7	3 5 7 7	12	16			Brown to grey, Poorly graded SAND (SP), fine to coarse grained, wet	
-15	35									
		SS	SS8	6 8 7 7	15	12			Similar to SS7, finer sand at tip, wet	
-20	40									
		SS	SS9	6 10 12 15	22	11			Grey, Poorly graded SAND (SP), fine to medium grained, wet	
-25	45									
		SS	SS10	7 7 11 15	18	16			Brown to grey, Poorly graded SAND (SP), fine to coarse grained, finer near top, wet	
-30	50									
		SS	SS11	8 14 16 15	30	12			Top 9" - Similar to SS10 Bottom 8" - Brown to grey, Poorly graded SAND with Clay (SP-SC), fine to coarse grained, few low plasticity fines, wet	
-35	55									
		SS	SS12	4 7 11 15	18	10			Light Brown, Poorly graded SAND (SP), medium to coarse grained, wet	
-40	60									
-43.0	63.0									
		SS	SS13	12 17 24 24	41	11			Red to brown, Silty SAND (SM), fine to medium grained, some low plasticity fines, wet	
-45	65									

Report: GEO_CR_WITH_N_VALUE; File \\NA.AECOMNET.COM\LFS\AMER\CHELMSFORD-USCHL1\SECURE_DCS\RESOURCES\LEGACY\PRIVATEVAE_DEPTS\GEOT\PROJECT FILES (GEOTECH)\ORLEANS PUMP STA. 4 - 60652634\GINT LOGS\ORLEANS PUMP ...

Project: Orleans Pump Station 4
Project Location: Orleans, MA
Project Number: 60652634

Log of Boring PS4-2

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance Blow/ 6 in.	SPT N-Value (Uncorrected)	Recovery, inches	Pocket Pen and TV, tsf	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
									-48.0 / 68.0	
-50	70	SS	14	4 5 12 18	17	19			Grey to Brown to Red, Well-graded SAND with Silt (SW-SM), fine to coarse grained sand, few non-plastic fines, wet	
									-53.0 / 73.0	
-55	75	SS	15	3 4 6 8	10	14			Light brown to grey, Poorly graded SAND (SP), fine to coarse grained, wet	
-60	80	SS	16	5 8 13 15	21	11			Similar to SS15, fine to medium grained, wet	
									-63.0 / 83.0	
-65	85	SS	17	5 6 7 13	13	1			Light brown, Sandy Lean CLAY (CL), medium plasticity, some fine grained sand, wet -65.0 / 85.0	*Lost part of sample due to SPT basket breaking.*
-70	90	SS	18	2 9 15 15	24	13			Light brown, Poorly graded SAND (SP), fine grained, wet -70.0 / 90.0 Boring Terminated at 90 ft bgs	
-75										
-80										

Report: GEO_CR_WITH_N_VALUE; File \\NA.AECOMNET.COM\LFS\AMER\CHELMSFORD-USCHL1\SECURE_DCS\RESOURCES\LEGACY\PRIVATEVAE_DEPTS\GEOT\PROJECT FILES (GEOTECH)\ORLEANS PUMP STA. 4 - 60652634\GINT LOGS\ORLEANS PUMP ;

Project: Orleans Pump Station 4
Project Location: Orleans, MA
Project Number: 60652634

Log of Boring PS4-MW

Sheet 1 of 1

Date(s) Drilled	5/5/2022	Logged By	E. Dasilva	Checked By	W. Song
Drilling Method	4.25" ID HSA	Drill Bit Size/Type	N/A	Total Depth of Borehole	30.0′ bgs
Drill Rig Type	CME 75	Drilling Contractor	Desmond Well Drilling Inc.	Surface Elevation	24.2 ft NAVD 88
Borehole Backfill	Completed as Ground Water Monitoring Well	Sampling Method(s)	2" O.D. SPT	Hammer Data	140 lb./30 in. Automatic Hammer
Boring Location	Orleans, MA	Groundwater Level(s)	15 ft		

Elevation, feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance Blow/ 6 in.	SPT N-Value (Uncorrected)	Recovery, inches	Pocket Pen and TV, tsf	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
	0								24.2 / 0.0	
									23.7 Reddish brown, Poorly Graded SAND (SP), fine to medium grained, trace roots on upper 2.5', trace boulders 0.5	*Vacuumed to 6 feet.14 inch boulder observed at 2 feet.*
20	5									
		SS	SS1	3 4 5 5	9	15			Reddish brown, Poorly graded SAND (SP), fine grained	
15	10	SS	SS2	3 6 6 8	12	14			Top 12" - Similar to SS1 Bottom 2" - Grey, Silty SAND (SM), fine grained, little non-plastic fines	
10	15	SS	SS3	4 4 4 4	8	18			Top 14" - Red to grey, Poorly graded SAND (SP), fine to medium grained, interbedded with silty sand Bottom 2" - Grey, Silty SAND (SM), fine grained, some low plasticity fines	
5	20	SS	SS4	1 3 3 5	6	10			Grey, Poorly graded SAND (SP), fine to medium grained, trace coarse, wet	
0	25	SS	SS5	2 2 3 5	5	13			Light brown to grey, Poorly graded SAND (SP), fine to medium grained, trace coarse, wet	
-5	30	SS	SS6	3 4 5 7	9	12			Light brown to grey, Poorly graded SAND (SP), fine to medium grained, wet -5.8 / 30.0	*Borehole completed as groundwater monitoring well. Refer to installation log for details.*

Boring Terminated at 30 ft bgs

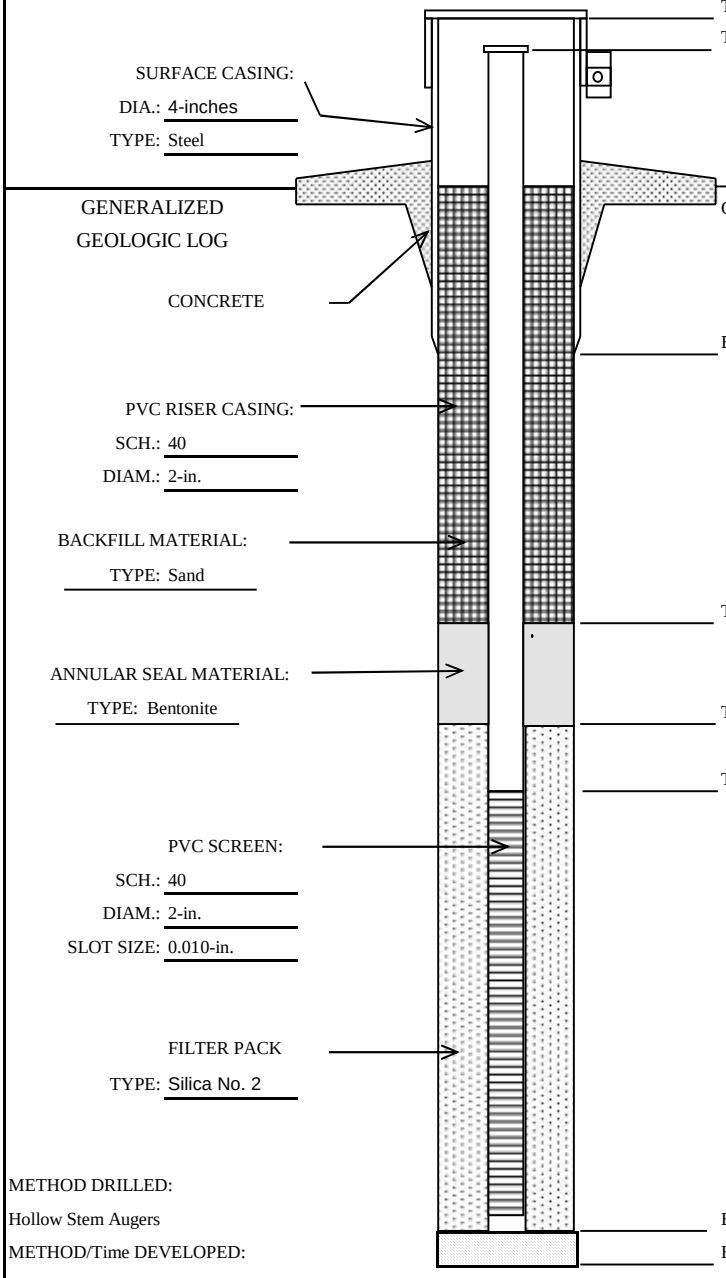
AECOM

ATTACHMENT 3

Monitoring Well Installation Log

MONITORING WELL INSTALLATION LOG

PROJECT:	**Orleans Pump Station No. 4**		JOB NO.	**60652634**	WELL NO. **PS4-MW**
DRILLING CONTRACTOR:	Desmond Well Drilling Inc.		COORDINATES:		
BEGUN:	5/5/2022	GEO/ENG:	E. daSilva	WATER LEVEL (Depth)	
FINISHED:	5/5/2022	DRILLER:	Tom Desmond	15 feet	



	DEPTH BGS HEIGHT AGS (FT)	ELEV. (FT) NGVD DATUM
TOP OF STEEL CASING	3.0	27.2
TOP OF PVC RISER		
GROUND SURFACE	0.0	24.2
BOTTOM OF PROTECTIVE PIPE	2.00	22.20
TOP OF ANNULAR SEAL	4.0	20.20
TOP OF FILTER PACK	8.0	16.20
TOP OF WELL SCREEN	10.0	14.20
BOTTOM OF SCREEN	25.0	-0.80
BOTTOM OF HOLE	30.0	-5.80

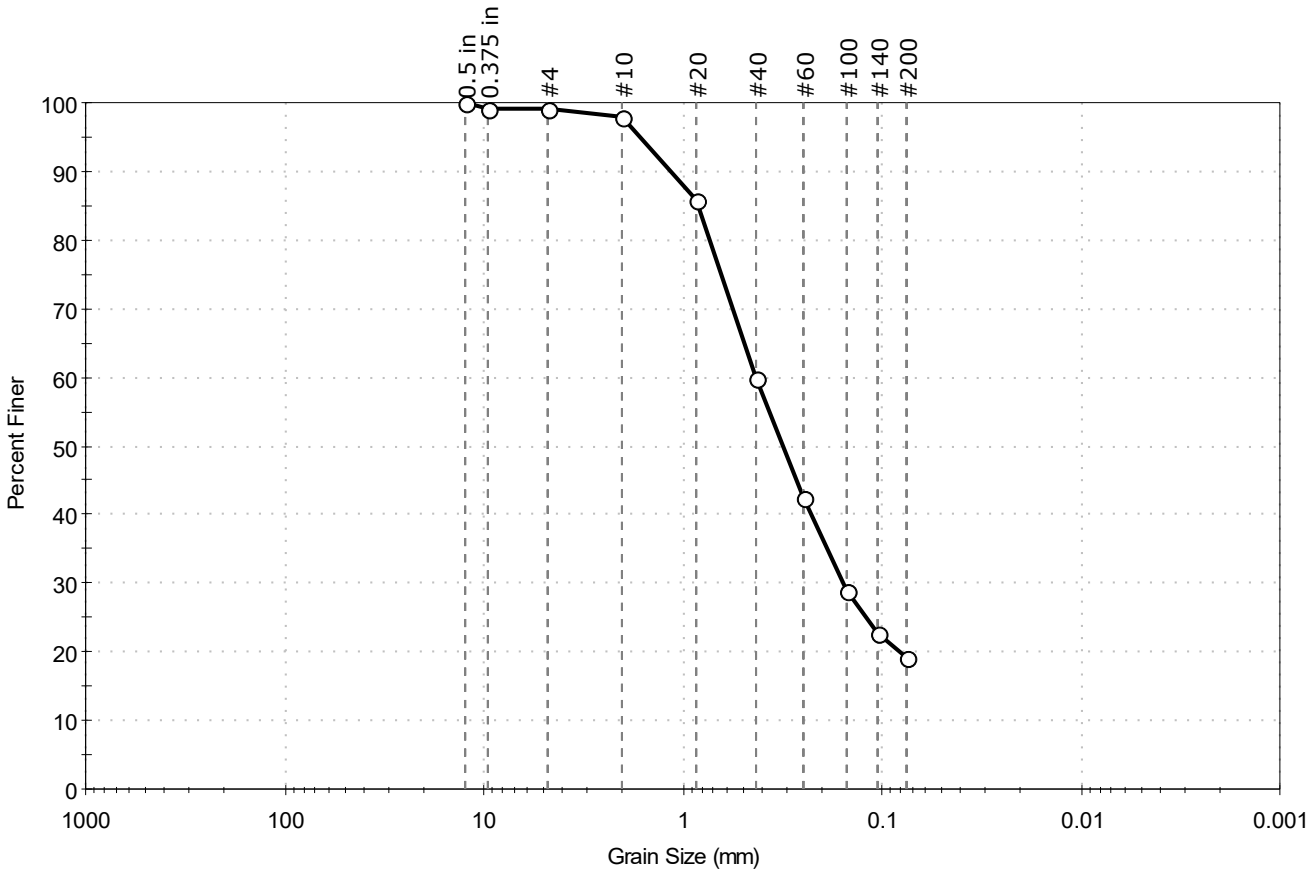
AECOM

ATTACHMENT 4

Geotechnical Laboratory Testing Results

Client:	AECOM				
Project:	Orleans Pump Sta. 4				
Location:	Orleans, MA			Project No:	GTX-315460
Boring ID:	PS4-1	Sample Type:	jar	Tested By:	ckg
Sample ID:	SS2	Test Date:	05/13/22	Checked By:	bfs
Depth :	8-10	Test Id:	668138		
Test Comment:	---				
Visual Description:	Moist, reddish yellow silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.9	79.9	19.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	99		
#10	2.00	98		
#20	0.85	86		
#40	0.42	60		
#60	0.25	42		
#100	0.15	29		
#140	0.11	23		
#200	0.075	19		

Coefficients

D_{85} = 0.8341 mm D_{30} = 0.1558 mm

D_{60} = 0.4274 mm D_{15} = N/A

D_{50} = 0.3156 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

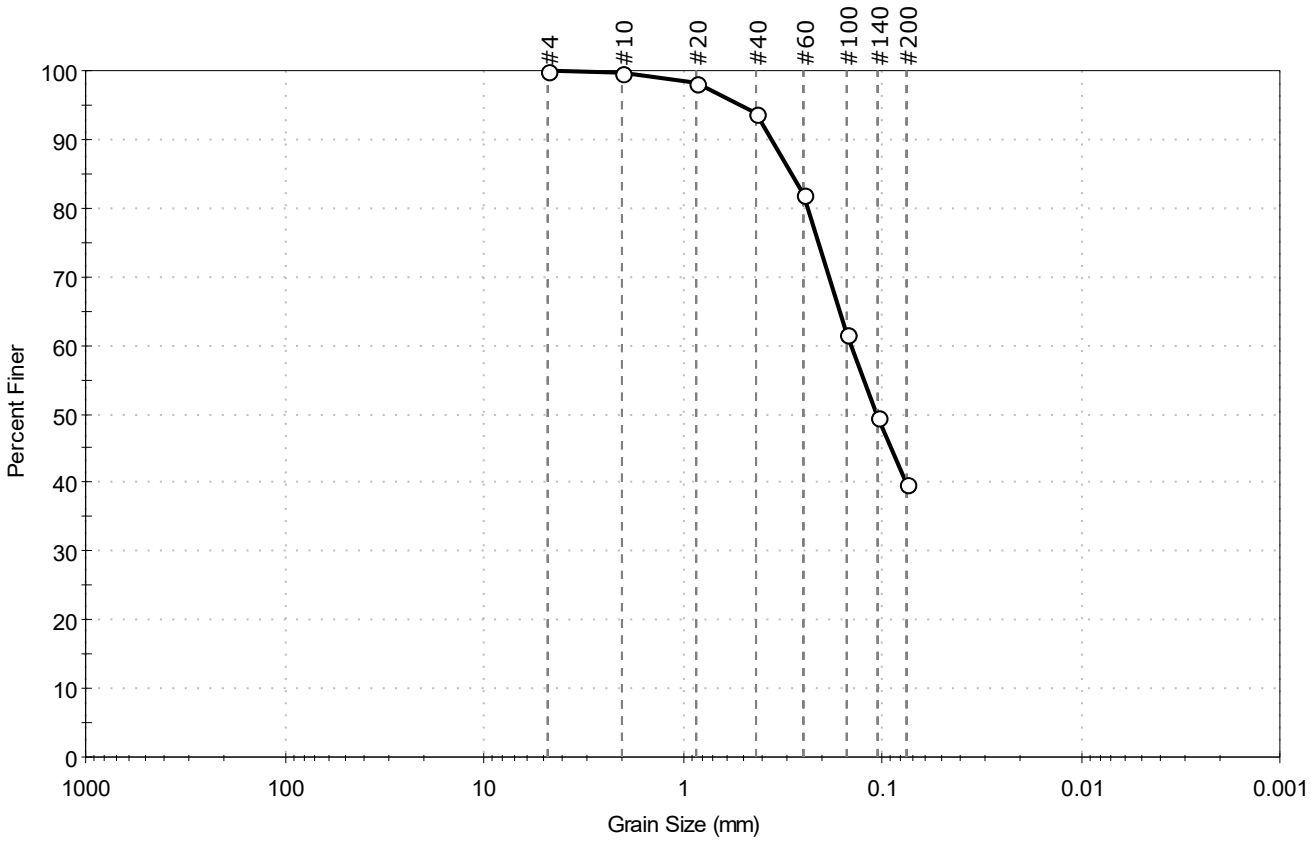
Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Client:	AECOM				
Project:	Orleans Pump Sta. 4				
Location:	Orleans, MA			Project No:	GTX-315460
Boring ID:	PS4-1	Sample Type:	jar	Tested By:	ckg
Sample ID:	SS4	Test Date:	05/13/22	Checked By:	bfs
Depth :	18-20	Test Id:	668139		
Test Comment:	---				
Visual Description:	Moist, light brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	60.3	39.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	98		
#40	0.42	94		
#60	0.25	82		
#100	0.15	62		
#140	0.11	50		
#200	0.075	40		

Coefficients

D_{85} = 0.2847 mm	D_{30} = N/A
D_{60} = 0.1428 mm	D_{15} = N/A
D_{50} = 0.1072 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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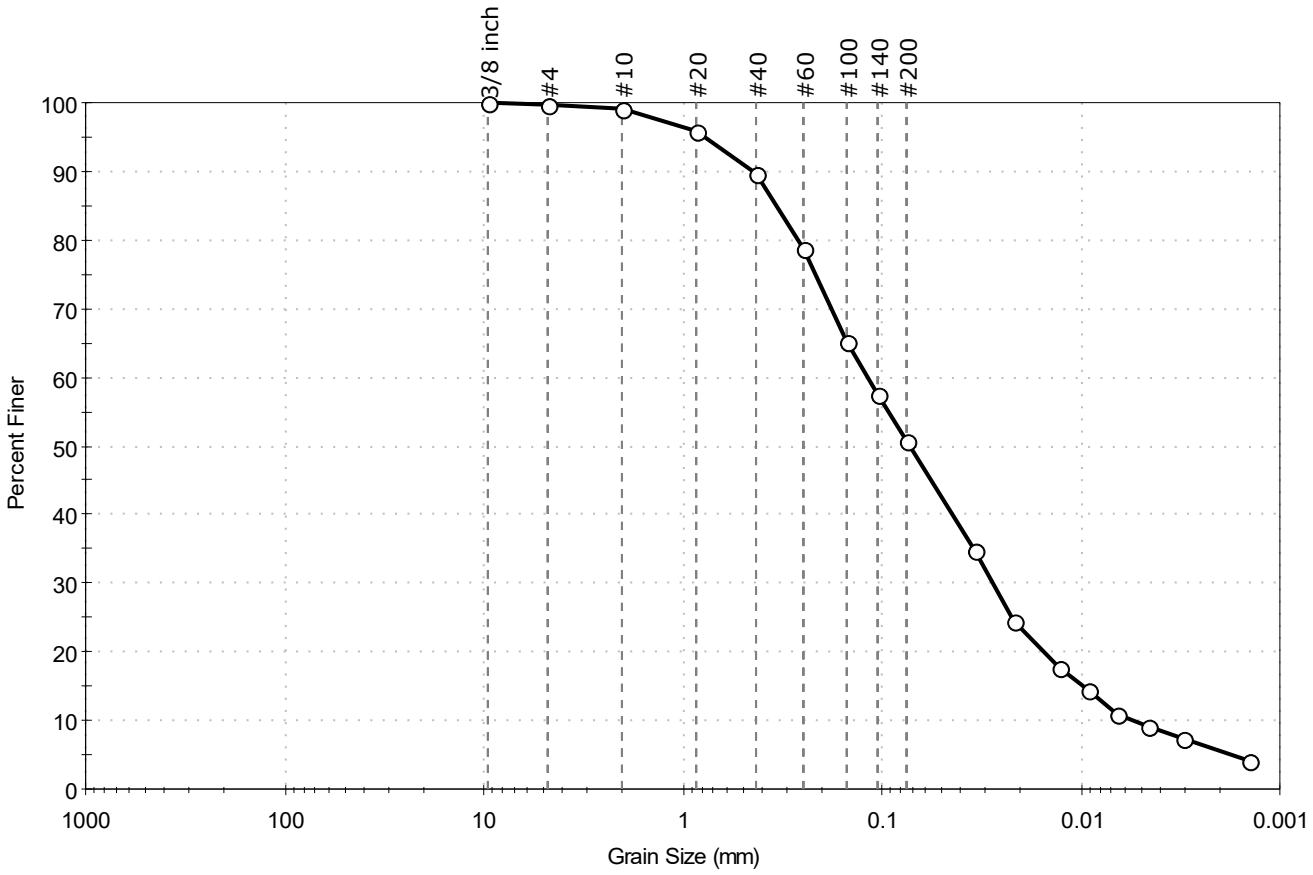
GeoTesting EXPRESS

Client:	AECOM				
Project:	Orleans Pump Sta. 4				
Location:	Orleans, MA			Project No:	GTX-315460
Boring ID:	PS4-1	Sample Type:	jar	Tested By:	ckg
Sample ID:	SS5	Test Date:	05/19/22	Checked By:	bfs
Depth :	23-25	Test Id:	668136		

Test Comment: ---
Visual Description: Moist, reddish yellow sandy silt
Sample Comment: ---

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.3	48.9	50.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	100		
#10	2.00	99		
#20	0.85	96		
#40	0.42	90		
#60	0.25	79		
#100	0.15	65		
#140	0.11	58		
#200	0.075	51		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0342	35		
---	0.0219	25		
---	0.0130	18		
---	0.0092	14		
---	0.0066	11		
---	0.0046	9		
---	0.0031	7		
---	0.0014	4		

Coefficients

D_{85} =0.3373 mm	D_{30} =0.0277 mm
D_{60} =0.1183 mm	D_{15} =0.0098 mm
D_{50} =0.0722 mm	D_{10} =0.0055 mm
C_u =21.509	C_c =1.179

Classification

ASTM N/A

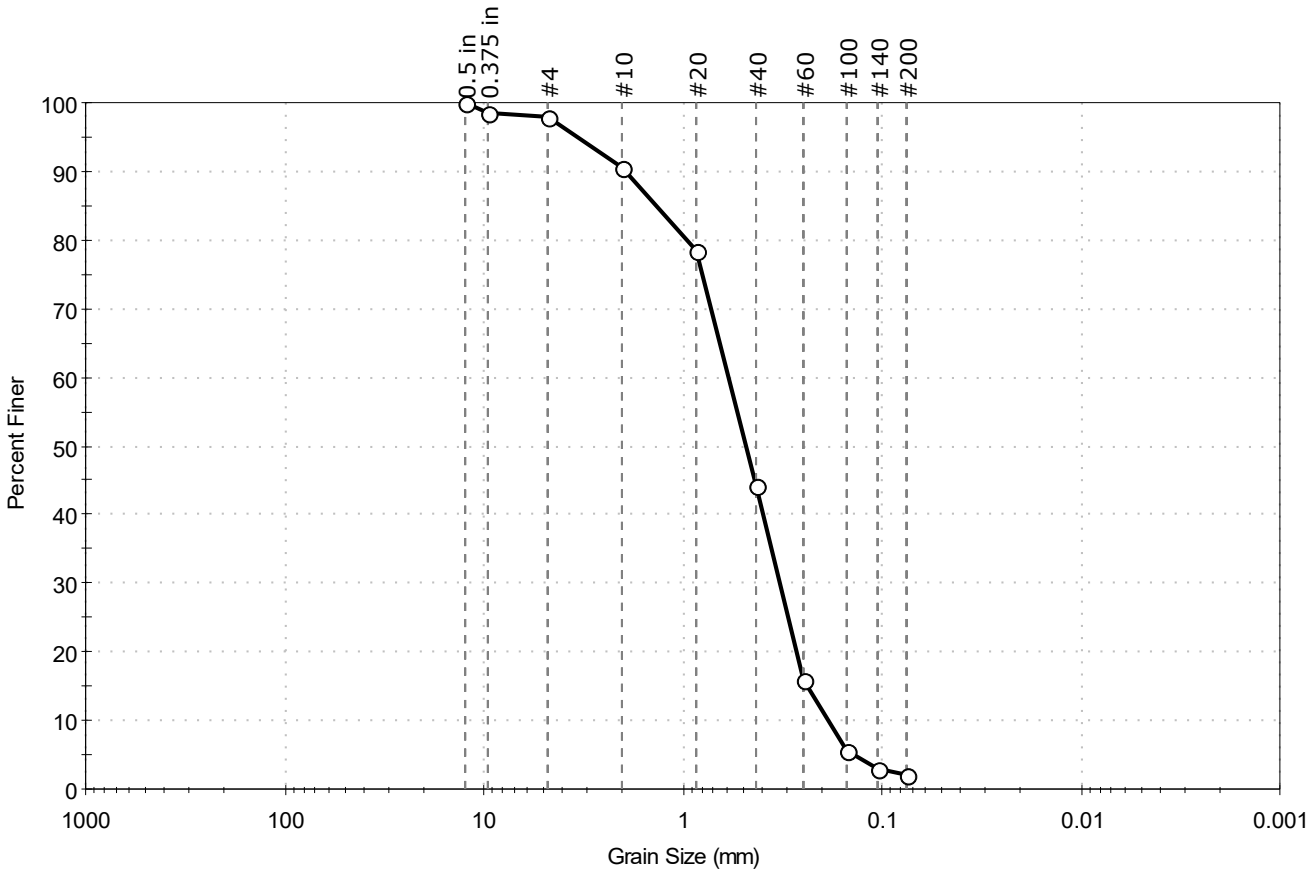
AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Orleans Pump Sta. 4				
Location:	Orleans, MA			Project No:	GTX-315460
Boring ID:	PS4-1	Sample Type:	jar	Tested By:	ckg
Sample ID:	SS6	Test Date:	05/13/22	Checked By:	bfs
Depth :	28-30	Test Id:	668137		
Test Comment:	---				
Visual Description:	Moist, light brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
--	2.0	95.9	2.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	99		
#4	4.75	98		
#10	2.00	91		
#20	0.85	78		
#40	0.42	44		
#60	0.25	16		
#100	0.15	6		
#140	0.11	3		
#200	0.075	2.1		

Coefficients

D_{85} = 1.3460 mm	D_{30} = 0.3257 mm
D_{60} = 0.5854 mm	D_{15} = 0.2395 mm
D_{50} = 0.4780 mm	D_{10} = 0.1869 mm
C_u = 3.132	C_c = 0.970

Classification

ASTM: Poorly graded SAND (SP)

AASHTO: Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description

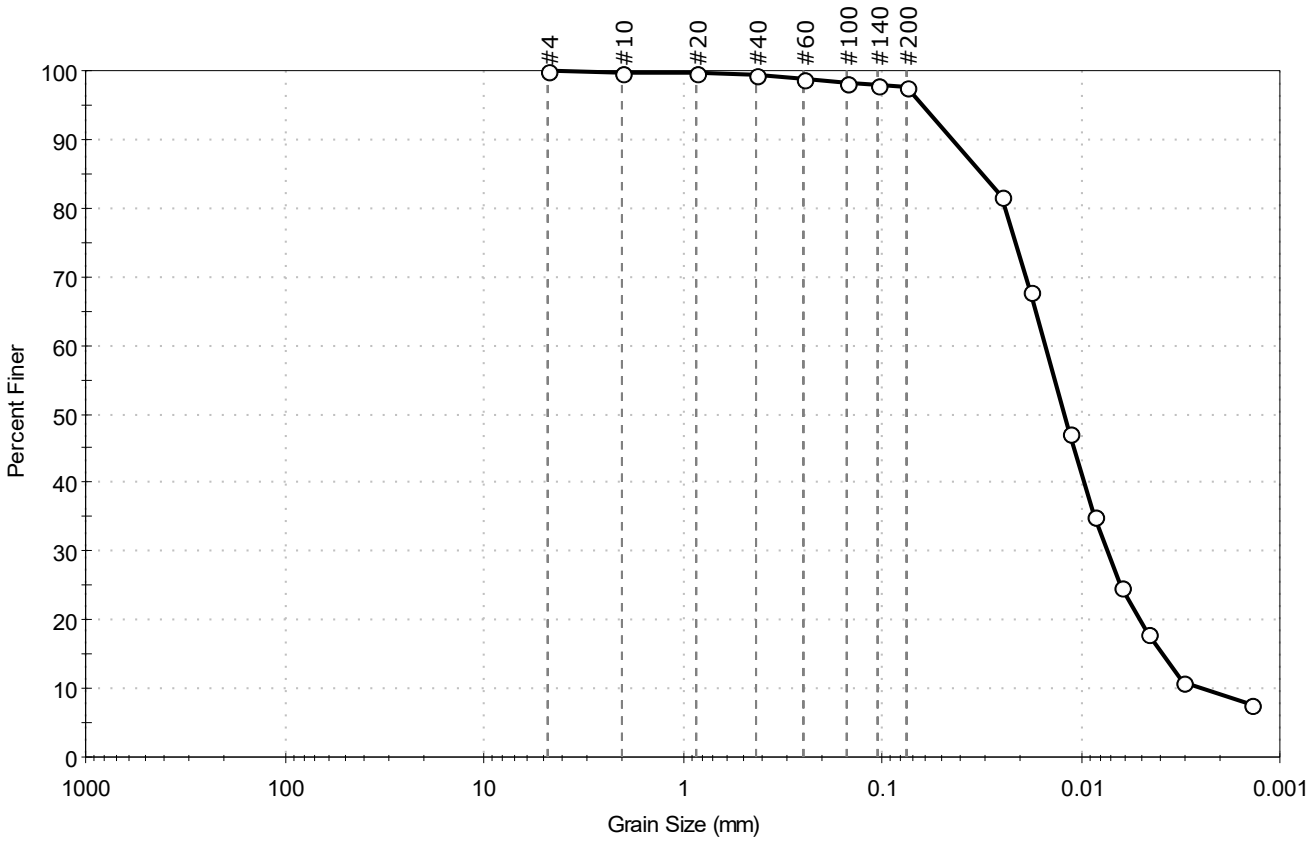
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

GeoTesting EXPRESS

Client:	AECOM				
Project:	Orleans Pump Sta. 4				
Location:	Orleans, MA			Project No:	GTX-315460
Boring ID:	PS4-1	Sample Type:	jar	Tested By:	ckg
Sample ID:	SS16	Test Date:	05/19/22	Checked By:	bfs
Depth :	78-80	Test Id:	668135		
Test Comment:	---				
Visual Description:	Moist, gray silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.1	2.1	97.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	99		
#100	0.15	98		
#140	0.11	98		
#200	0.075	98		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0252	82		
---	0.0179	68		
---	0.0114	47		
---	0.0085	35		
---	0.0062	25		
---	0.0046	18		
---	0.0031	11		
---	0.0014	8		

Coefficients

D_{85} =0.0316 mm	D_{30} =0.0073 mm
D_{60} =0.0151 mm	D_{15} =0.0039 mm
D_{50} =0.0121 mm	D_{10} =0.0024 mm
C_u =6.292	C_c =1.470

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

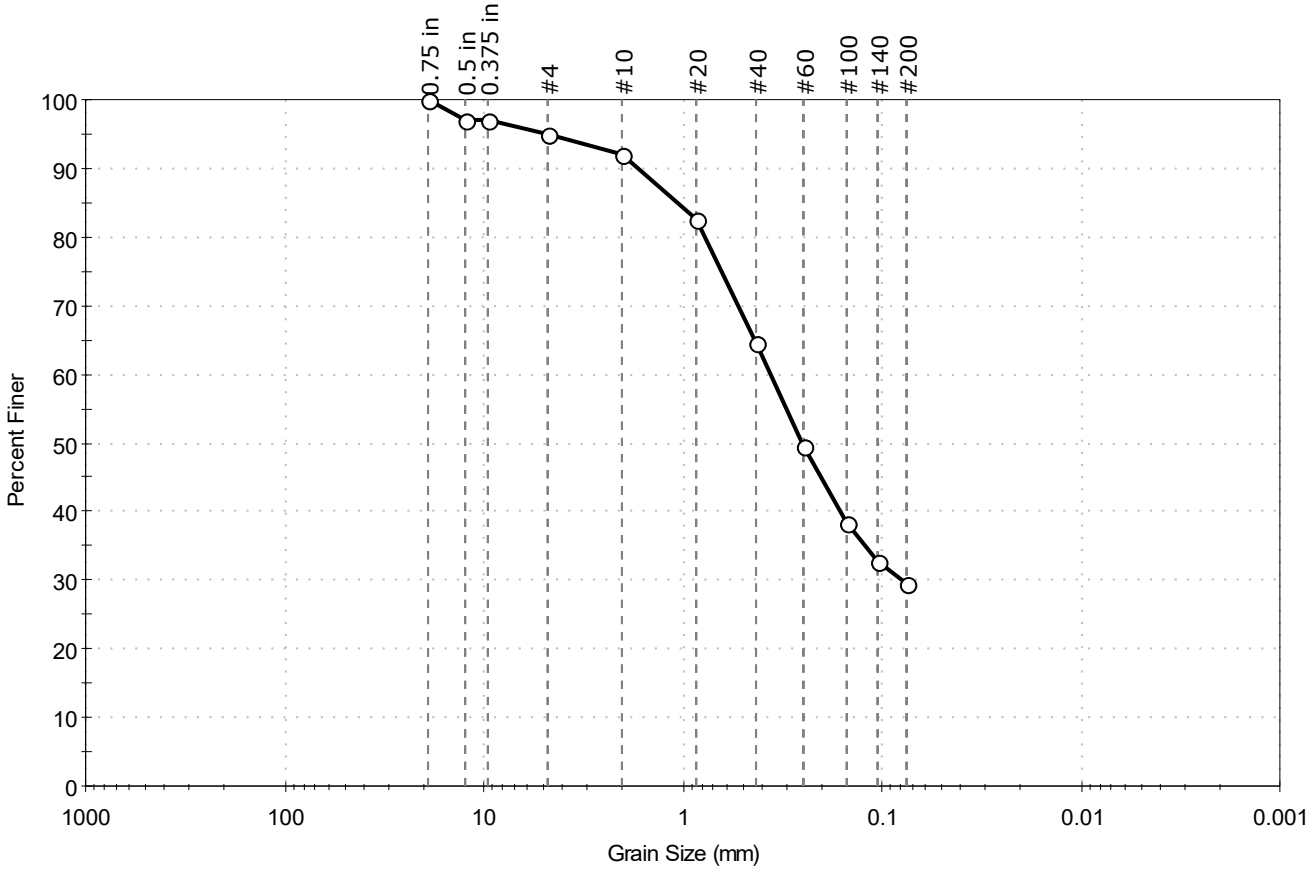
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Orleans Pump Sta. 4				
Location:	Orleans, MA			Project No:	GTX-315460
Boring ID:	PS4-2	Sample Type:	jar	Tested By:	ckg
Sample ID:	SS1	Test Date:	05/13/22	Checked By:	bfs
Depth :	6-8	Test Id:	668141		
Test Comment:	---				
Visual Description:	Moist, brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	5.0	65.4	29.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	97		
0.375 in	9.50	97		
#4	4.75	95		
#10	2.00	92		
#20	0.85	82		
#40	0.42	65		
#60	0.25	50		
#100	0.15	38		
#140	0.11	33		
#200	0.075	30		

Coefficients

D_{85} = 1.0621 mm D_{30} = 0.0786 mm

D_{60} = 0.3599 mm D_{15} = N/A

D_{50} = 0.2532 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

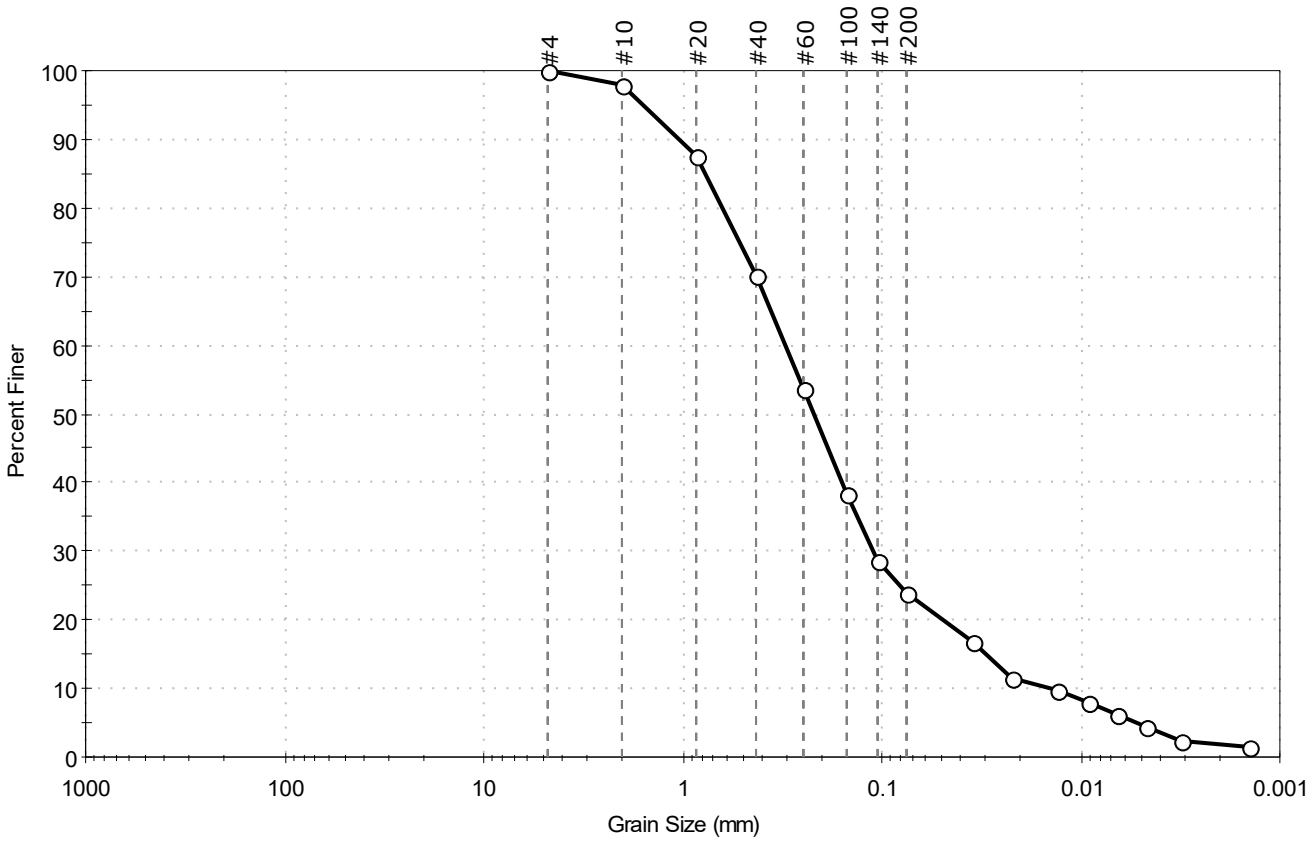
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	AECOM				
Project:	Orleans Pump Sta. 4				
Location:	Orleans, MA			Project No:	GTX-315460
Boring ID:	PS4-2	Sample Type:	jar	Tested By:	ckg
Sample ID:	SS3	Test Date:	05/19/22	Checked By:	bfs
Depth :	13-15	Test Id:	668134		
Test Comment:	---				
Visual Description:	Moist, light brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.1	76.1	23.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	98		
#20	0.85	88		
#40	0.42	70		
#60	0.25	54		
#100	0.15	38		
#140	0.11	29		
#200	0.075	24		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0351	17		
---	0.0225	11		
---	0.0131	10		
---	0.0092	8		
---	0.0065	6		
---	0.0047	4		
---	0.0031	2		
---	0.0014	2		

Coefficients

D_{85} = 0.7682 mm
D_{30} = 0.1115 mm
D_{60} = 0.3054 mm
D_{15} = 0.0300 mm
D_{50} = 0.2208 mm
D_{10} = 0.0143 mm
C_u = 21.357
C_c = 2.847

Classification

ASTM N/A

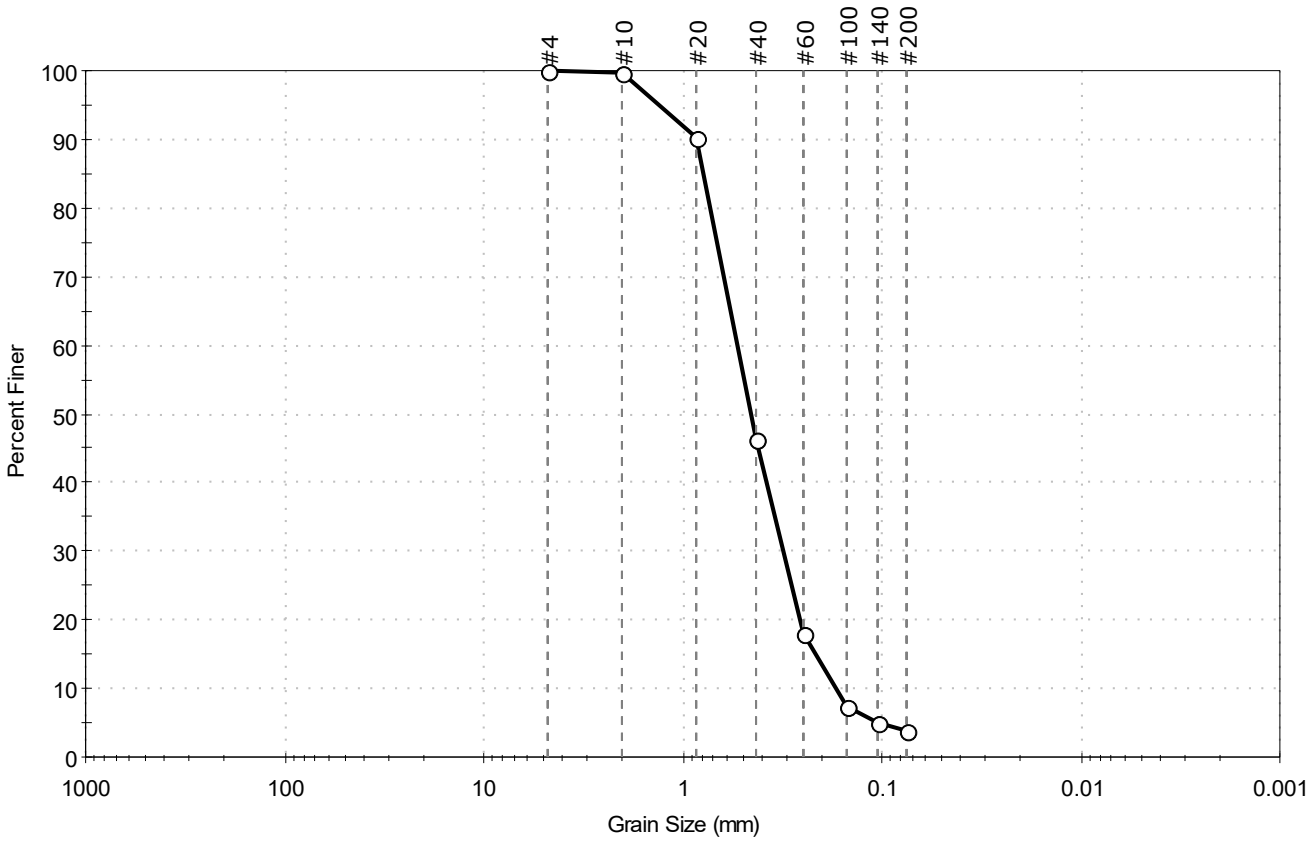
AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Est. Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Orleans Pump Sta. 4				
Location:	Orleans, MA			Project No:	GTX-315460
Boring ID:	PS4-2	Sample Type:	jar	Tested By:	ckg
Sample ID:	SS6	Test Date:	05/13/22	Checked By:	bfs
Depth :	28-30	Test Id:	668140		
Test Comment:	---				
Visual Description:	Moist, light brown sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	96.2	3.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	90		
#40	0.42	46		
#60	0.25	18		
#100	0.15	7		
#140	0.11	5		
#200	0.075	3.8		

Coefficients

D_{85} = 0.7810 mm	D_{30} = 0.3133 mm
D_{60} = 0.5267 mm	D_{15} = 0.2177 mm
D_{50} = 0.4499 mm	D_{10} = 0.1709 mm
C_u = 3.082	C_c = 1.090

Classification

ASTM: Poorly graded SAND (SP)

AASHTO: Stone Fragments, Gravel and Sand (A-1-b (1))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Harveys Lane Orleans, MA		

AECOM
9 Jonathan Bourne Drive
Pocasset, Massachusetts
(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-309**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	5" - 6" : Pavement Dense, tight-packed silt, few gravel (4' down), hand augard, few large cobble through boring end, large cobble @ 5.5', fine sand, dense silt, few gravel, orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	5.0	dry	6' - 6.9' : Fine sand, loose, dry, light brown, large cobble @ 6.9'				6
7			dry	7' - 7.3' : silt, brown, dense				7
8			moist	7.3' 7.7' : Fine to medium sand with trace silt, little coarse sand, loose, moist				8
9			dry	7.7' - 10.5' : Silt light brown, dense, few gravel				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Harveys Lane Orleans, MA		

AECOM
9 Jonathan Bourne Drive
Pocasset, Massachusetts
(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-310**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	8" - 9" : Pavement Fine sand, trace silt, little cobble and gravel, orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	5.0	moist	6' - 10' : Fine sand with trace silt, loose, light tan, slightly moist				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Barley Neck Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-35**		
Date:	Friday, April 9, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15		
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	Pavement: 12", precleared to 6', most of hole very dense, tightly packed, some cobble noted Fine sand with little medium sand and trace silt, few small to medium gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.3	moist	5' - 6.5' : Orange-brown fine to coarse sand, few gravel, few silt, moist, loose				6
7			damp	6.5' - 9.3' : Tan-orange-brown very fine to fine sand, silt, damp, firm				7
8								8
9								9
10								10
11	10 ft to 15 ft	2.9	damp	10' - 12.4' : Tan-orange-brown, very fine to fine sand and silt, damp, firm				11
12			damp	12.4' - 12.9' : Tan, light brown, gray, medium fine to fine sand and silt, trace clay, damp, firm				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-36**
Date:	Friday, April 9, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	Pavement: 7", precleared to 6' Fine to medium sand with trace silt and small to medium few gravel, large cobbles observed at top on hole side walls				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.6	dry	5' - 7.6' : Tan-orange-brown fine to coarse sand, trace gravel, trace silt, cobble @ 6.6', dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	4.2	dry	10' - 11' : Tan-orange-brown fine to medium sand, trace silt, dry, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-37**
Date:	Friday, April 9, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	Pavement: 8", precleared to 6', observed some roots and large cobbles on sidewalls of hole Fine sand with little medium sand with trace silt, few small gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.6	wet	5' - 5.7' : Light brown very fine sand and silt, wet, dense, reached water				6
7			damp	5.7' - 6.4' : Light brown-orange fine to coarse sand and silt, trace gravel, damp, firm				7
8			moist	6.4' - 8.6' : Light brown-orange brown fine to coarse sand, trace silt to little silt, moist, loose to slightly compact				8
9								9
10								10
11	10 ft to 15 ft	4.7	moist	10' - 11.3' : Light brown-orange brown fine to coarse sand, trace to little silt, moist, loose to slightly compact				11
12			wet	11.3' - 13' : Gray clay and silt, fine to very fine sand, wet, reached water, plastic, firm				12
13			damp	13' - 14.7' : Tan-light brown fine to coarse sand, trace silt, damp, loose, no water				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-38**
Date:	Friday, April 9, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	Pavement: 9"-11", precleared to 6', large cobbles removed from the hole and noted on sidewalls of the hole Fine to medium sand with little gravel, brown-orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.2	Moist	5' - 8.3' : Gray-orange brown, ****, very fine sand & silt, moist, firm				6
7								7
8			damp	8.3' - 9.2' : Orange brown fine to coarse sand, trace silt, damp, loose				8
9								9
10								10
11	10 ft to 15 ft	2.5	damp	10' - 12.5' : Tan-orange brown fine to coarse sand, trace silt, damp, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Barley Neck Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-39**
Date:	Friday, April 9, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 7", precleared to 6'				1
2	to 6 ft	5.0		Fine sand with little medium sand, few gravel, few large cobble noted along sidewalls of hole				2
3								3
4								4
5								5
6	5 ft		dry	5' - 7.2' : Light brown, fine to very fine sand and silt, cobble @ 6'				6
7	to 10 ft	3.5	damp	7.2' - 7.8' : Light brown-orange brwon,mottled, damp, firm.				7
8			damp	7.8' - 8.5' : Tan-orange brown fine to medium sand, trace silt, damp, loose				8
9								9
10								10
11	10 ft		damp	10' - 10.7' : Tan finr to medium sand, trace silt, damp, loose.				11
12	to 15 ft	3.5	damp	10.7' - 12.3' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose.				12
13			moist	12.3'-12.7' : Gray silt and clay, trace to little very fine sand, moist, firm, mod plastic				13
14			moist	12.7' - 13.5' : Tan-orange brown fine to medium sand, trace silt, moist, loose.				14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-45**
Date:	Thursday, April 8, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Asphalt : 7" - 8" 8" - 24" : light brown silty sand, dense 24" - 54" : cobble, root (small) 54" - 72" : light brown fine to very fine sand, some silt, some medium to large rounded gravel fairly loose				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.7	dry	5' - 6.5' : Brown fine to coarse sand, trace gravel, trace silt, slightly compact, loose, dry				6
7			damp	6.5' - 7.7' : Brown very fine to fine sand and silt, trace clay, dense, damp				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-46**
Date:	Thursday, April 8, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Asphalt : 8", 8" -20" dense light brown silty sand 20"-22":light brown fine to very fine sand, some silt, slightly compact, trace large rounded gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.0	dry	5' - 5.4' : Brown fine to medium sand, trace silt, loose, dry				6
7			damp	5.4' - 8' : Brown fine to medium sand, trace gravel, some silt, dense, dry to damp				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft	3.6						11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck
Date:	Thursday, April 8, 2021		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620
Date:	Monday, April 19, 2021		

Boring Number:	**MH-47**
Sheet:	1 of 1
Surface Elevation (ft-asl):	TBD
Boring Depth (ft):	10
Boring Diameter (in):	2
Screen Depth:	N/A
Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Asphalt: 8", very rubbery and soft, 1" gravel 1"-2' : fine dense sand and silt 2' -6' : fine to medium sand with silt, trace gravel, loose				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.8	damp	5'- 7.5' : Tan-light brown fine to coarse sand, trace gravel, trace silt, damp, loose				6
7			damp	7.5' - 7.9' : Brown fine to coarse sand, trace gravel, trace silt, damp, loose				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-133**
Date:	Monday, April 8, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 5" - 6"				1
2	to 6 ft	5.0		Precleared to 6' with air knife, cobble @ bottom, silt with gravel in it, some fine sand, medium-dark brown				2
3								3
4								4
5								5
6	5 ft to	3.6	dry	5'-7.8' : Light brown fine to coarse sand, trace gravel, trace silt, dry, loose.				6
7	10 ft		dry	7.8'-8.6' : Brown fine to coarse sand, little gravel, trace silt, dry, loose				7
8								8
9								9
10								10
11	10 ft to	4.5	dry	10' - 12.9' : Light brown fine to coarse sand, trace gravel, trace silt, dry, loose				11
12	15 ft		damp	12.9' - 14.1' : Brown fine to very fine sand, some silt, damp, dense				12
13			dry	14.1' - 14.5' : Gray fine to coarse sand, little gravel, trace silt, dry, loose.				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Barley Neck Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-134**
Date:	Monday, April 8, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 6"-7", precleared to 6' air knife Small, medium and large cobble (most cobbley one), orange-tan fine sand, some silt, gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.0	dry	5' - 8' : Brown fine to coarse sand and silt, trace to little gravel, trace cobble, dry to damp, dense				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.2	dry-damp	10' - 12.2' : Brown fine to coarse sand and silt, trace gravel, dry to damp, dense				11
12			dry	12.2' - 13.2' : Brown fine to coarse sand, little silt, dry, slighty compact				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-135**
Date:	Monday, April 8, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement :6" -7" small, medium, large cobble, organics and roots, fine to coarse sand, some silt, tan-orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.1	dry	5' - 8.1' : Tan-light brown fine to medium sand, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	0.8	dry	10' - 10.8' : Tan fine to medium sand, trace gravel, trace silt, dry, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-136**
Date:	Monday, April 8, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8" Fine sand, some coarse sand, tan, few small gravel, few silt				1
2								2
3								3
4								4
5								5
6	5 ft to	3.0	dry	5' - 8' : Light brown fine to medium sand, trace silt, dry, loose				6
7	10 ft							7
8								8
9								9
10								10
11	10 ft to	2.8	dry	10' - 17.8' : Light brown fine to medium sand, trace silt, dry, loose				11
12	15 ft							12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-137**
Date:	Monday, April 8, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 10" 2 ft down clay, dense silt Few small cobble, few large gravel, fine sand, dark brown, small gravel, fine to coarse sand and silt, light tan				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.4	damp	5'-6': Gray silt, little clay, little very fine sand, damp, dense				6
7			dry	6' - 8.4' : Brown-gray fine to medium sand and silt, trace gravel, dry, slightly dense				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-143**
Date:	Monday, April 8, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	0 - 5' : Fine sand with little silt and little gravel, brown-orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.0	moist	5'-7.1': Brown very fine to fine sand, some silt, dry to moist, dense				6
7			moist	7.1'-9' : Brown very fine to fine sand and silt, trace clay, moist, dense				7
8								8
9								9
10								10
11	10 ft to 15 ft	3.1	moist	10'-10.9' : Brown, very ine to fine sand and silt, trace clay, mist, dense				11
12			moist	10.9' - 13' : Brown very fine to fine sand, some silt, moist, dense				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Barley Neck Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-302**
Date:	Monday, April 8, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 8"-9", end at cobble @ 5' down Fine sand, some coarse sand, some small to medium gravel, some silt				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.5	damp	5' - 6' : Gray silt, fine to very fine sand, dense, damp				6
7			dry	6' - 6.6' : gray-brown very fine to medium sand, some silt, slightly dense, dry				7
8			dry	6.6' - 8.5' : Orange- brown fine to medium sand, trace gravel, little silt, slightly compact, dry				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Windy Hill Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-138**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 4" - 5", some large cobble encountered within the hole, precleared to 6' Fine sand with little silt and medium sand, trace subangular gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	5.0	dry	6' - 12' : silt, dense, dry, mottle, gray-orange				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	5.0	moist	12' - 15' : Fine medium sand, loose to medium dense, moist, transition from brown to light tan				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Windy Hill Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-139**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pre-cleared to 6' Fine sand with little silt and little gravel, brown-orange				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft to	5	dry	5' - 7.5' : Fine sand with silt, medium dense, dry, orange-brown				6
7	10 ft		dry	7.5' - 10' : Silt with trace fine sand, dense, dry, sampled				7
8								8
9								9
10								10
11	10 ft to		dry	10' - 11' : Silt with trace fine sand, dense, dry				11
12	15 ft		dry dry	11' - 11.5' : fine to medium sand with gravel layer, loose, dry, brown 11.5' - 11.6 : Fine sand, loose, dry, orange				12
13			dry	11.6' - 13' : Silt with trace fine sand, dense, dry, orange-gray motting, sampled				13
14			dry dry	13' - 14.2' : Fine to medium sand, loose, medium dense, dry, orange 14.2' - 14.5' : Silt, dense, orange				14
15			dry	14.5' -15' : Fine sand, loose, dry, orange ---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Bayberry Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-301**
Date:	Wednesday, April 28, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		damp	No pavement, 6" gravel 6" - 6' : Dark gray very fine to coarse sand, gravel and cobble @ 2' - 6' , damp				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		damp	5' - 7' : Pre-clear backfill				6
7	to 10 ft		dry	7' - 8' : Medium to coarse sand, light tan, loosly compacted, dry				7
8			wet	8'- 8.8' : Fine to medium sand, wet, tan, slightly compact				8
9				8.8' - 9' : Coarse sand, gravel, red-brown, slightly compact 9' -9.8' : Stratified layer				9
10				---------- End of Boring at 10' ----------				10
11	10 ft							11
12	to 15 ft							12
13								13
14								14
15								15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond View Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-142**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear			Pavement 9" - 10"				1
2	0 ft to 6 ft		dry	Large medium gravel, fine sand, little silt, little coarse sand, tan-brown				2
3								3
4								4
5								5
6	5 ft to 10 ft	5.0	dry	5' - 6' : Pre-clear back fill				6
7			dry	6' - 8' : Fine to medium sand with trace silt, loose to medium dense, dry, light brown				7
8			dry dry	8' - 8.5' : Silt with little fine sand, medium dense to dense, dry, light brown 8.5' - 9.5' : Fine to medium sand, loose, dry, orange-light tan				8
9			dry	9.5' - 10' : Silt with trace fine sand, medium dense to dense, dry, light tan, sampled				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond View Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-141**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 7" - 8" Fine sand, little silt, small gravel				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	5' - 6' : Pre-clear back fill				6
7	to 10 ft		dry	6' - 9.5' : Silt with trace fine sand, dense, dry, sampled				7
8								8
9				9.5' - 10' : Rock				9
10				---------- End of Boring at 10' ----------				10
11	10 ft							11
12	to 15 ft							12
13								13
14								14
15								15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	High Tide Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-126**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5" Some organic root material, cobble (large) encountered, medium to large cobble, fine sand with silt, dark medium tan and brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.5	dry	6' - 7.6' : Brown-tan, slightly mottled, fine to coarse sand, trace gravel, dry, loose				6
7			dry	7.6' - 8.4 : Tan fine to coarse sand, mottled, dry, loose				7
8			dry	8.4' - 9' : Brown-tan, slightly mottled, fine to coarse sand, trace gravel, dry, loose				8
9			moist	9' - 10' : Brown fine to coarse sand and silt, trace fine gravel, moist, very dense				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	High Tide Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-127**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	No pavement, crushed stone, very cobbly, water at 5' (4.5') Orange-dark brown sand, lots of gravel, difficult to reach 6" @ bottom, organic root material, medium to fine sand with silt, cobble and gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	5.0	wet	6' - 7.5' : Brown-tan fine to coarse sand, trace fine gravel, wet, medium dense				6
7			wet	7.5' - 10' : Brown silty sand, trace silt, fine gravel, dense, wet, sampled				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	High Tide Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-144**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 5" - 6" Fine orange sand with trace silt				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft to	5.0	dry	5' - 6' : Pre-cleared soils				6
7	10 ft		moist	6' - 7.5' : brown fine to medium sand, trace silt, fine gravel, moist, medium dense				7
8			moist moist	7.5' - 7.9' : Gray, mottled, oxidized silt, trace fine sand, very dense, moist 7.9' - 9.8' : brown fine to medium sand, trace silt, fine gravel, moist, medium dense				8
9			moist	9.8' - 10' : Tan fine to medium sand, loose, moist				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	High Tide Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-145**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 5" water at 4', difficult to get full vacuum hose down the hole, but air knife and ruler confirm pre-clearing to 6' Fine to medium sand with some silt, orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	5' - 6' : Pre-cleared solis				6
7			wet	6' - 8.6 ' : Brown-tan fine to medium sand and silt, some coarse sand, wet (saturated), dense				7
8			wet	7.8' - 8.1' : Dark brown medium to coarse sand, wet				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	High Tide Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-146**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		wet	Pavement: 5", water @ 4', air knife down to 6' Cobble, gravel, very wet, fine to medium sand with some silt, saturated				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.5	dry	5' - 6.6' : Pre-cleared materials mixed with driller sand used for backfilling				6
7			dry	6.5' - 6.8' : Brown fine to coarse sand, fine gravel, loose, medium dense				7
8			dry	6.8' - 7.7' : Dark brown peat, moderate concentration of root fibers, likely peat down to 10' , very soft, chunk of decompost wood @ 7.7 ft				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	High Tide Lane Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-305**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		wet	No pavement, gravel 6" down, water present at the bottom Fine to medium sand, little silt, dark tan				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft to	4.3	moist	5'-5.5': Brown fine to medium sand, little coarse sand, moist/wet, medium dense				6
7	10 ft		moist	5.5'-7.9': Brown fine to medium sand, little coarse sand, moist/wet, medium dense, dark to very dark brown				7
8			Moist	7.9'-8.4': Very stiff brown silt, sampled				8
9			moist	8.4'-8.75': Very stiff brown silt, sampled				9
10			wet	8.4'-9': Very dark brown fine to coarse sand, wet, medium dense ---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	High Tide Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-305**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	No pavement, vacuum down to 5', root; rock obstruction Coarse sand, meduim sand, little silt, few gravel, little cobble, dark tan				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	5	moist	6'-10': Brown- tan oxidized fine to coarse sand, trace fine gravel, trace roots/fibers, moist				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Cedar Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-147**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			Pavement: none on top, 5" down pavement layer that is 3" deep, air knife down to 6 ', cobble at bottom, very cobbly				1
2	to 6 ft		dry	Fine to medium sand and silt with lits of gravel and cobble, medium-dark brown and orange				2
3								3
4								4
5								5
6	5 ft		dry	5' - 6' : Preclear backfill				6
	to		dry	6' - 6.5' : Gravel-fill, some brown medium gravel				
7	10 ft		dry	6.5' - 7.5' : Densly compacted silt, some gravel, some small to medium gravel				7
8			dry	7.5' - 8' : Loose coarse sand, red/tan, large gravel at 8 ft				8
			dry	8' - 8.8' : Medium coarse sand, tan				
9			dry	8.8' - 9.1' : Loose coarse sand, red and orange				9
			damp	9.1' - 9.5' : Damp brown sand, trace silt, compact to medium dense				
10				9.5' - 10' : Loose coarse sand, red/tan ---------- End of Boring at 10' ----------				10
11	10 ft							11
	to							
12	15 ft							12
13								13
14								14
15								15
16	15 ft							16
	to							
17	20 ft							17
18								18
19								19
20								20
21	20 ft							21
	to							
22	25 ft							22
23								23
24								24
25								25
26	25 ft							26
	to							
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Grist Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-125**
Date:	Tuesday, April 6, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 4"-5" , Hit big cobble 8"- 10" down, shifted over 6" Large cobble 3' below surface, Fine sand, little silt, little medium sand, dark tan				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	5' - 6' : Pre-cleared soils				6
7	to 10 ft	4	Moisture	6' - 8.4' : Brown-tan fine to medium sand, little coarse sand, trace fine gravel, moist-wet, dense, sampled 6.5' to 7.5'				7
8								8
9			wet	8.4' - 9': Brown-tan fine to medium sand, trace coarse sand, loose, wet				9
10								10
11	10 ft		wet	10' - 11.2' : Brown-tan fine to medium sand, trace coarse sand, loose, wet				11
12	to 15 ft	3	Moist moist	11.2' - 11.4' : Brown dense silty very fine sand, moist 11.4' - 11.8' : Brown fine sand, mottled, moist, dense				12
13			moist	11.8' - 13.8' : Tan mottled fine to medium sand, medium dense, moist/dry				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Pochet Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-40**		
Date:	Friday, April 9, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15		
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 10" - 11", pre-clear to 6 ft Fine to medium sand with trace silt, some gravel, brown-orange				1
2								2
3								3
4								4
5								5
6	5 ft to	2.3	dry	5'-7.3': Gray-brown fine to medium sand, trace silt, dry, loose				6
7	10 ft							7
8								8
9								9
10								10
11	10 ft to	2.9	dry	10'-12.9': Gray-brown fine to coarse sand, trace silt, dry, loose				11
12	15 ft							12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pochet Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-41**
Date:	Friday, April 9, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 0" - 10" , Pre-clear to 6 ft Fine to medium sand with trace silt and some gravel, small to medium and a few large pieces of gravel noted along side walls of holes				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.1	dry	5' - 7.6' : Brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7			dry	7.6' - 8.1' : Gray fine sand, trace silt, dry, loose				7
8								8
9								9
10								10
11	10 ft to 15 ft	3.3	dry	10' - 11.5' : Gray- brown fine to medium sand, trace gravel, trace silt, dry, loose				11
12			moist	11.5' - 11.8' : Gray very fine sand and silt, trace clay, moist, dense				12
13			dry	11.8' 13.3' : Brown fine to coarse sand, little silt, trace gravel, dry, slightly compact				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pochet Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck
Date:	Friday, April 9, 2021		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620
Date:	Wednesday, April 14, 2021		

Boring Number:	**MH-42**
Sheet:	1 of 1
Surface Elevation (ft-asl):	TBD
Boring Depth (ft):	15
Boring Diameter (in):	2
Screen Depth:	N/A
Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement : 9" - 10" , pre-clear to 6 ft Fine to medium sand with trace silt and some small to medium gravel, brown-orange				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft to	3.2	dry to moist	5' - 6.8' : Brown fine to coarse sand, some silt, dry to moist, firm				6
7	10 ft		moist	6.8' - 8.2' : Brown fine sand and silt, trace clay, moist, dense				7
8								8
9								9
10								10
11	10 ft to	2.8	moist	10' - 11' : Brown fine to coarse sand, little silt, trace gravel, moist, slightly compact				11
12	15 ft		wet	11' - 11.6' : Gray silt and clay, trace very fine sand, wet, dense, medium placticity				12
13			moist	11.6' - 12.8' : Brown fine to coarse sand, little silt, trace gravel, moist, slightly compact				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pochet Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-43**
Date:	Friday, April 9, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 9", pre-clear to 6 ft Fine to medium sand with trace silt, some small gravel, light brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.0	dry	5' - 6' : Light brown fine sand, trace gravel, trace silt, dry, loose				6
7			moist	6' - 6.6' : Brown fine to coarse sand, little silt, trace gravel, moist, dense				7
8			dry	6.6' - 9' : Light brown-orange fine to medium sand, trace silt, dry, loose				8
9								9
10								10
11	10 ft to 15 ft	4.3	dry	10' - 12' : Light brown fine to coarse sand, trace gravel, trace silt, dry, slightly compact				11
12			moist	12' - 13.2' : Gray-brown fine to very fine sand and silt, little clay, moist, firm				12
13			dry	13.2' - 14.3' : Light brown-orange fine to coarse sand, trace gravel, trace silt, dry, loose, slightly compact				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pochet Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck
Date:	Friday, April 9, 2021		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620
Date:	Wednesday, April 14, 2021		

Boring Number:	**MH-44**
Sheet:	1 of 1
Surface Elevation (ft-asl):	TBD
Boring Depth (ft):	15
Boring Diameter (in):	2
Screen Depth:	N/A
Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 7" , pre-clear to 6 ft, large cobbles noted in the hole Fine to medium sand with trace silt, some small gravel, light brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.8	dry	5' - 7.8' : Brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.6	dry	10' - 11': Brown fine to medium sand, trace silt, trace gravel, dry, slightly compact				11
12			dry	11' - 11.6': Light brown fine to coarse sand, trace gravel, trace silt, dry, loose				12
13			dry	11.6' - 13.6' : Brown fine to coarse sand, trace gravel, trace silt, dry, slightly compact, cobble @ 18'				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Larboard Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-132**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 5", encountered a PVC at 2.5 ft, potential fiber optic or cable wire casing in edge of the hole, when drilling, will go down on other edge of the hole about a foot/foot and a half away from burried cable casing, able to clear to 6 ft Fine sand with trace silt, medium sand, trace small gravel, light brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	5' - 6' : pre-clear material				6
7			dry	6' - 7' : Cobble				7
8			dry	7' - 8' : Fine sand with little silt, trace gravel, medium dense				8
9			wet	8' - 10' : Dense fine sand with silt, slightly wet with trace small to medium gravel				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Larboard Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-131**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 6" - 7" , pre-clear to 6 ft Fine sand with trace silt, trace small gravel				1
2								2
3								3
4								4
5								5
6	5 ft to		dry	5' - 6' : pre-clear				6
7	10 ft		dry	6' - 10' : Fine to medium sand with trace silt, large cobble @ 8 ft, loose to medium dense, Orange-tan				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Natural Drive Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-130**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 6" -7", pre-clear to 6 ft Fine sand with trace silt, little medium sand, little small gravel,observed root fragments in hole				1
2	to 6 ft			along sides, light orange-brown				2
3								3
4								4
5								5
6	5 ft to		dry	5' - 6' : Pre-clear soils				6
7	10 ft		dry	6' - 9' : Fine sand with little silt, orange, loose to medium dense, dry				7
8			dry	9' - 10' : Silt with fine gray sand with mottling, medium dense, dry, sampled				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Natural Drive Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-129**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		water	Pavement: 4", Pre-clear to 6 ft Fine sand, top 12 " little siltier material, water @ 5', orange-tan				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	5' - 6' : Pre-clear soils				6
7	to 10 ft		wet	6' - 8' : Fine sand, loose, wet, tan, gravel @ 8', 2-inch cobble				7
8			moist	8' - 10' : Silt with trace fine sand, dense, moist, light brown, sampled				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft							11
12	to 15 ft							12
13								13
14								14
15								15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Natural Drive Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-128**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 4" , Fine to medium sand with trace silt, gravel, light brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	6' - 9' : Fine sand, some silt, light brown, medium dense, dry				6
7								7
8								8
9			dry	9' - 10 ' : Silt with fine sand, medium dense, light brown, sampled				9
10								10
11	10 ft to 15 ft		moist	10' - 13' : Fine to medium sand with few small gravel, loose to medium dense, slightly moist				11
12								12
13			dry	13' -15' : Fine sand, light tan, loose, dry				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Mill Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-307**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 12, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 6" Sand, air knife to 6 ft, hole keeps collapsing, fine sand with silt, medium brown to tan				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.4	damp	5' - 6.9' : Gray-brown very fine to fine sand and silt, dense, damp				6
7			damp	6.9' - 7.8' : Light brown fine to medium sand, some silt, trace gravel, firm, damp				7
8			damp	7.8' - 8.4' : Orange-red very fine to medium sand, little silt, trace gravel				8
9								9
10								10
11	10 ft to 15 ft	4.3	damp	10' - 11' : Brown fine to medium sand, some silt, trace gravel, slightly firm, damp				11
12			wet	11' - 12' : Gray fine to medium sand, little silt, damp to wet, loose				12
13			damp	12' - 14.3' : Light brown fine to medium sand, some silt, trace gravel, damp, firm				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Beach Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-112**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 4" -5" Fine sand, some coarse sand, trace silt, some small gravel, few medium to large gravel,				1
2	to 6 ft			few medium cobble, tan-light brown to dark brown				2
3								3
4								4
5								5
6	5 ft to	4	moist	5' - 8.4' : Gray- orange brown very fine to medium sand and silt, trace gravel, damp to moist, firm				6
7	10 ft		moist	8.4' - 9' : Gray very fine sand and silt, moist, trace clay, firm, slight plastic				7
8								8
9								9
10								10
11	10 ft to	3.7	damp	10' -12' : Brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12	15 ft		damp	12' - 13.7' : Tan fine to medium sand, trace to little silt, damp, loose				12
13								13
14								14
15								15
16	15 ft to	2.6	moist	15'- 17.6' : Tan-orange brown fine to medium sand, trace silt, moist, loose, no water				16
17	20 ft							17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Beach Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-113**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	25
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 9" Fine sand, some coarse sand, trace silt, small to medium to large gravel, large cobble throughout hole, large cobble @ 5 ft, cleared to 6 ft with air knife				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.3	dry	5' - 8.3' : Light brown-orange brown very fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.6	damp	10' - 10.9': Tan-light brown fine to medium sand, trace gravel, trace silt, damp, loose				11
12			damp	10.9' - 13.6' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				12
13								13
14								14
15								15
16	15 ft to 20 ft	4.4	damp	15' - 19.4' : Tan-orange brown fine to medium sand, trace silt, damp, loose				16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft	4.4	damp	20' - 22' : Tan-orange brown fine to medium sand, trace silt, damp, loose				21
22			moist	22' - 24.4' : Tan- orange brown very fine tofine sand, trace silt, moist, loose, no water				22
23								23
24				---------- End of Boring at 25' ----------				24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Beach Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-114**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft			Fine sand, some coarse sand, trace silt, small to medium to large gravel, tan-dark brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	0.8	dry	5' - 5.8' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.3	dry	10' - 13.3' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Beach Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-115**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 7" - 9" , located near gas service, some organic-roots Coarse sand, fine sand, trace silt, small to medium gravel, tan-dark brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.4	moist	5' - 7.4' : Very fine to medium sand, trace silt, light brown-orange brown, moist, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3	moist	10' - 10.8' : Light brown fine to coarse sand, little silt, trace gravel, moist to damp, dense				11
12			damp	10.8' - 12.1' : Light brown fine to medium sand and silt, trace clay, damp, dense, slight plastic				12
13			moist	12.1' - 13' : Light brown fine to coarse sand, little silt, trace gravel, dense, moist				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Beach Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-116**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 9"-10", pre-clear to 6 ft, large cobble fell from side to 5 ft Coarse sand, some fine sand, trace silt, small to medium to large gravel, light brown-tan				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		moist	5' - 6.5' : Brown-light brown fine to coarse sand, some silt, trace gravel, moist, compact				6
7	to 10 ft	2.5	moist	6.5' - 7.5' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, moist, loose				7
8								8
9								9
10								10
11	10 ft		moist	10' - 12.5' : Tan- orange brown- brown fine to coarse sand, trace gravel, trace silt				11
12	to 15 ft	3.8	moist	12.5' - 13.9' : Gray-light brown very fine sand and silt layered with very fine to medium sand, little silt, moist, dense				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Beach Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-117**
Date:	Wednesday, May 1, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 19, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8"-10:, large cobble removed ~ 2.3 ft, pre-clear to 6 ft Coarse sand, some fine sand, some silt, few small to medium to large gravel, tan-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.4	damp	5' - 7.3' : Light brown - orange brown- brown fine to coarse sand, trace gravel, trace silt, damp, loose				6
7			moist	7.8' - 8.4' : Gray very fine sand and silt, layered with light brown-orange brown fine to medium sand, trace silt, moist, compact				7
8								8
9								9
10								10
11	10 ft to 15 ft	4.4	moist	10' - 11' : Light brown fine to medium sand, trace gravel, trace silt, moist, loose				11
12			moist	11' - 11.5' : Brown-dark gray fine to coarse sand, trace gravel, trace silt, moist, loose				12
13			moist	11.5' - 12.6' : Light brown-gray fine to medium sand, trace silt, layered with gray very fine sand and silt, moist, compact				13
14			moist	12.6' - 19.4 : Tan-orange brown fine to medium sand, trace silt, moist, loose				14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Nauset Farms Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-121**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, April 12, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 9" 9" - 12" : hard packed base 12" - 6 ft : fine to coarse tan sand, loose, dry, no evidence of cobble or boulder				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2	dry	5' - 7' : no recovery				6
7			dry	7' : refusal, granite chips				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Nauset Farms Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-120**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 12, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5"-6" Fine medium sand, more fine silt, no utilities, some gravel				1
2								2
3								3
4								4
5								5
6	5 ft to	3.5	dry	5' - 7.5' : Gray fine to mediun sand, trace silt, loose, dry				6
7	10 ft		wet	7.5' -8.5' : Light gray brown fine to medium sand, little gravel, trace silt, loose, wet				7
8								8
9								9
10								10
11	10 ft to	5	wet	10' - 12.5' : Light brown fine to medium sand, little silt, little gravel, wet, loose				11
12	15 ft		wet	12.5' - 13.5' : Gray fine sand, some silt, wet, slightly compact				12
13			wet	13.5' - 15.0' : Light brown fine sand, trace gravel, trace silt, wet, slightly compact				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Nauset Farms Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-119**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, April 12, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 3"-4" Fine sand, tan, no utilities				1
2								2
3								3
4								4
5								5
6	5 ft to	2.8	dry	5' -7' : Light brown-gray fine to medium sand, trace gravel, trace silt, dry, loose				6
7	10 ft		dry	7' - 7.8' : Brown very fine sand and silt, dense				7
8								8
9								9
10								10
11	10 ft to	4	dry	10' - 11.5' : Gray fine to medium sand, little gravel, trace silt, dry, loose				11
12	15 ft		damp	11.5' - 13.5' : Light orange fine to medium sand, trace silt, damp, loose				12
13			damp	13.5'-14' :Dark orange-brown fine to medium to coarse sand, trace silt, damp, slightly compact				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Nauset Farms Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-118**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, April 12, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5"-5.5" Some organic-root material, rock at the bottom of excavation, able to be displaced Medium brown-tan fine sand with some silt				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.3	dry	5' - 5.5' : Tan fine to medium sand, trace silt, dry, loose				6
7				5.5' - 9.3' : Brown fine to medium sand, some silt, trace gravel, damp, firm				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Cole Place Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-124**
Date:	Monday, May 24, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Monday, May 24, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft			Pre-cleared to 6 ft				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.75	dry	5' - 8.6' : Light brown fine to medium sand, trace silt, trace gravel, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3	dry	12' - 13' : Orange loose dry to moist fine to medium sand, few gravel				11
12			Slightly moist	13' - 15' : Slightly moist, dense silt with little clay, gray mottled with orange, sampled, Large cobble at 13.5 ft				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Cole Place Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-123**
Date:	Tuesday, May 25, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Tuesday, May 25, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			No pavement, dirt road, pre-clear to 6 ft Large cobbles noted along hole, Fine loose sand with some silt and gravel				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		wet	5' - 6' : Brown fine to coarse sand and gravel, trace silt, wet				6
7	to 10 ft	3.75	wet	6' - 7': Brown fine to medium sand, trace gravel, trace silt, slightly compact, wet				7
8			wet	7' - 8.25: Gray fine to medium sand, some silt, trace gravel, wet, slightly compact				8
9								9
10								10
11	10 ft		wet	11' - 12.5' : Fine to medium brown sand with little silt, some gravel, medium dense, saturated, water @ 9 ft				11
12	to 15 ft	4	wet	12.5' - 13.7' : Fine sand with silt, dense, saturated				12
13			wet	13.7' - 14.6' : Very dense, wet, silt with clay, little fine sand, sampled				13
14			wet	14.6' - 15' : Brown-gray Fine to medium sand with little silt, dense, saturated				14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Cole Place Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-122**
Date:	Tuesday, May 25, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Tuesday, May 25, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear			No pavement, on dirt road				1
2	0 ft to 6 ft		dry	Fine to medium sand, loose, dry, gravel, few cobble noted				2
3								3
4								4
5								5
6	5 ft		dry	5' - 6': Brown fine to medium sand, trace gravel, trace silt				6
7	to 10 ft	3.5	dry	6'-7' : Tan fine to medium sand, some silt, trace gravel, compact, dry				7
8			dry	7' - 8.5': Tan fine sand and silt, trace gravel, dense to hard				8
9								9
10								10
11	10 ft		dry	11' - 14.4' : Silt with fine sand, tan-gray mottling, dry, medium dense to dense, few small				11
12	to 15 ft	4		angular gravel throughout the interval				12
13								13
14			dry	14.4' - 15' : Fine to medium sand with trace silt, coarse sand, few small gravel, loose to medium dense, dry				14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Lewis Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-314**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5"-6" Organic root material, no utilities, cobble, fine to medium sand, some silt, light brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.5	dry	5'-6': pre-clear backfill				6
7			dry	6'-6.9': Tan-oxidized medium to coarse sand, trace fine gravel, dry, medium dense				7
8			moist	6.9'-7.7': Brown fine sand and silt, some medium sand, little coarse sand, moist/wet @ 7.3'				8
			moist	7.7'-8.1': Brown mottled silt layer, slightly loose				
9			moist	8.1'-8.5': Tan medium to coarse sand, trace fine gravel, dry, medium dense				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Lewis Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-110**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 4"-5" Fine to medium sand, cobble, silt, no utilities				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.7	dry	5'-6.5': Pre-clear backfill				6
7			dry	6.6'-8.7': Tan fine to coarse sand, dry, medium dense, intermittent very fine sand and silt layers, 3"-6" thick				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Lewis Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-111**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 9, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5"-6" Sand, some cobble, fine to medium sand, some silt, cobble, brown-orange color				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.6	dry	5'-5.5': Pre-clear backfill				6
7			dry	5.5'- 7': Tan-light brown medium to coarse sand, trace fine gravel, medium dense, dry				7
8			wet	7'-7.6': Dark brown fine to medium sand, trace coarse sand, wet, medium dense				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Cheney Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-106**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 6" Sand, organic root material, light orange, brown, fine to medium sand and silt				1
2								2
3								3
4								4
5								5
6	5 ft to		dry	6' - 8.5' : Fine sand, trace small gravel, loose- medium dense, dry, Brown to Orange to tan				6
7	10 ft		dry	8.5' - 10' : Fine sand with some coarse sand, little small to large gravel, loose, dry, orange				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Cheney Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-107**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 4"-5"				1
2	to 6 ft			Sand, coble, compacted sand and silt at 6 ft, no utilities, medium brown, some silt, rock or cobble, fine to medium sand				2
3								3
4								4
5								5
6	5 ft to		dry	6' - 9.3' : Silt with trace fine sand, few gravel, dense, dry, light brown-orange				6
7	10 ft		dry	9.3' - 10' : Fine sand with some coarse sand, loose, dry, tan				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Cheney Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck
Date:	Monday, April 5, 2021		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620
Date:	Thursday, April 8, 2021		

Boring Number:	**MH-108**
Sheet:	1 of 1
Surface Elevation (ft-asl):	TBD
Boring Depth (ft):	10
Boring Diameter (in):	2
Screen Depth:	N/A
Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5" Fine to medium sand, some silt and some angular gravel, light orang-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	6' - 7' : Fine sand with trace silt, medium dense to loose, dry, light brown				6
7			dry	7' - 10' : Fine to medium sand, loose, dry, light tan, trace coarse sand				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Cheney Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-109**
Date:	Monday, April 5, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5"-6" Fine to medium sand, no utilities, no gravel, light orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	6' - 10' : Fine to medium sand with little coarse sand, loose, dry, orange to tan				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-93**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8" Sandy soil				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.6	moist	5'-7.3': Brown very fine to fine sand and silt, moist, firm, trace gravel				6
7			moist	7.3'-8.1': Brown fine to coarse sand, trace silt, moist, loose				7
8			moist	8.1'-9.6': Brown very fine to fine sand and silt, trace clay, moist, firm				8
9								9
10								10
11	10 ft to 15 ft	3.3	moist	10'-10.9': Brown-light brown fine to medium sand, trace silt, moist, slightly compact				11
12			damp	10.9'-11.4': Brown very fine to fine sand, some silt, damp, firm				12
13			moist	11.4'-13.3': Tan-light brown-orange brown fine to coarse sand, trace silt, moist, loose				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-94**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 10" Sandy soil				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		damp	5'-8.5': Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				6
7	to 10 ft	3.9	moist	8.5'-8.9' : Gray-orange brown very fine to fine sand and silt, moist, firm				7
8								8
9								9
10								10
11	10 ft		moist	10'-11': Gray-light brown very fine to fine sand and silt, moist, firm				11
12	to 15 ft	3.3	moist	11'-13.3': Tan-orange brown fine to medium sand, trace silt, moist, loose				12
13								13
14								14
15								15
16	15 ft		damo	15'-16.6': Dark orange brown fine to medium sand and silt, damp, firm				16
17	to 20 ft	5	damp	16.6'-20': Tan-orange brown fine to coarse sand, trace silt, damp, loose				17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-95**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 6" Sandy soil				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.3	damp	5' - 7.2' : Light brown-orange brown fine to medium sand, little silt, damp, loose				6
7			damp	7.2' - 8.3' : Orange brown-gray very fine sand and silt, damp, firm				7
8								8
9								9
10								10
11	10 ft to 15 ft	3.7	damp	10' - 13' : Gray-orange brown very fine to fine sand and silt, damp, firm				11
12			moist	13'-13.7' : Orange brown fine to medium sand , trace silt, moist, loose				12
13								13
14								14
15								15
16	15 ft to 20 ft	3	moist	15'-15.5' : Orange brown-brown very fine to medium sand, little silt, moist, firm				16
17			damp	15.5' - 17.2' : Gray-orange brown very fine to fine sand and silt, damp, moist, firm				17
18			moist	17.2' - 18' : Orange brown very fine to medium sand, little silt, moist, firm				18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-96**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 11", Pre-clear to 6 ft Fine sand, some coarse sand, cobble 2 ft down, dry, brown-orange-tan				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.7	damp	5' - 7.2' : Light brown-orange brown very fine to medium sand, little silt, damp, slightly compact				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.1	damp	10' - 13.1' : Light brown fine to medium sand, little silt, damp, loose				11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft	4.2	damp	15' - 17.4' : Light brown-brown fine to medium sand, trace silt, damp, loose				16
17			wet	17.4' - 19.2' : Gray-light brown very fine to medium sand and silt, wet, compact				17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-97**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 9", Pre-clear to 6 ft Fine sand, some coarse sand, few small to medium gravel, orange-brown, dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.2	dry	5' - 8.2' : Tan-orange brown fine to medium sand, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	4.9	damp	10' - 14.9' : Light brown fine sand, trace silt, damp, loose				11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft	3.1	moist	15' -18.1' : Light brown-orange brown fine to medium sand, trace silt, moist, loose				16
17								17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-98**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 9" , Pre-clear to 6 ft Fine sand, few coarse sand, few small gravel, orange to brown to tan, dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.3	dry	5' - 6.3' : Light brown-orange brown fine to coarse sand, trace silt, dry, loose				6
7			damp	6.3' - 6.9' : Light brown very fine to fine sand, some silt, damp, compact				7
8			dry	6.9' - 9.3' : Brown-orange brown fine to medium sand, trace silt, dry, loose				8
9								9
10								10
11	10 ft to 15 ft	3.9	dry	10' - 18.9' : Tan-orange brown very fine to medium sand, trace to little silt, dry, loose				11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft	3.8	dry	15' - 18.8' : Tan-orange brown fine to medium sand, trace silt, dry, loose				16
17								17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Great Oak Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-99**		
Date:	Friday, April 16, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15		
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 11"-12" Fine to medium sand with trace silt, few small gravel, cobble				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	5' -7' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7	to 10 ft	3.3	damp	7' - 7.4' : Light brown fine to medium sand, little silt, damp, slightly compact				7
8			damp	7.4' - 8.3' : Tan-orange brown fine to coarse sand, trace silt, damp, loose				8
9								9
10								10
11	10 ft		damp	10' - 13.7' : Tan-orange brown fine to coarse sand, trace silt, damp, loose				11
12	to 15 ft	3.7						12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-100**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5" Fine to medium sand with trace silt, orange few small cobbles				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.3	dry	5' - 8.3' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	4.1	dry	10' - 14.1' : Tan-orange brown fine to coarse sand, trace silt, dry, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-101**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8" Fine to medium sand with trace silt, little coarse sand, silt, orange-light brown, small gravel, cobble				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.6	dry	5' - 8.6' : Tan-orange brown fine to coarse sand, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.8	dry	10' - 13.8' : Tan-orange brown fine to coarse sand, trace silt, dry, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-311**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8" Fine to medium sand, trace coarse sand with few small gravel, orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.3	dry	5' - 8.3' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.4	dry	10' - 13.9' : Light brown-orange brown fine to medium sand, trace silt, slightly firm, dry				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Great Oak Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-312**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		Dry	Pavement: 6" 6" - 6' : Sandy soil- rock in hole at 5 ft				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.2	moist	5'-7.2': Tan-orange brown fine to coarse sand, trace gravel, trace silt, moist, loose				6
7								7
8			damp	7.2'-8.2': Brown-orange brown very fine to fine sand and silt, trace clay, damp, firm, slightly plastic				8
9								9
10								10
11	10 ft to 15 ft	3.6	moist	10'-13.6': Tan to orange brown fine to coarse sand, trace gravel, trace silt, moist, loose				11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft	4.3	moist	15'-19.3': Tan-orange brown fine to coarse sand, trace gravel, trace silt, moist, loose				16
17								17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pine Ridge Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-103**
Date:	Wednesday, April 28, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 6"				1
2	to 6 ft			6" - 6' : Light brown fine to medium sand, trace gravel, trace silt, dry, loose				2
3								3
4								4
5								5
6	5 ft to		dry	5' -7' : Fine to medium sand				6
7	10 ft		dry	7' - 10' : Fine to silty sand				7
8								8
9								9
10								10
11	10 ft to		dry	10' - 15' : Fine sand with silt				11
12	15 ft			GW @ 11.5'				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pine Ridge Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-102**
Date:	Wednesday, April 28, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 7" 7" - 6' : Light brown fine to medium sand, trace gravel, trace silt, dry, loose				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	5' - 10' : Fine sand				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft		wer	10' - 15' : Wet sand fine to medium GW @ 11.5'				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Oak Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-104**
Date:	Wednesday, April 28, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 6" 6" - 6' : Brown fine to coarse sand, trace gravel, trace silt, cobble @ 2' and deeper				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	6' - 6.5' : Backfill pre-clear				6
7	to 10 ft		dry	6.5'-7.3' : Coarse to medium coarse sand, dry, some fine sand, trace silt, densely packed				7
8			dry	7.3' - 8.3' : Layers of gravel, dark brown coarse sand, gray stone/gravel				8
9			dry	8.3' - 9' : Loose coarse sand, dry some to little small gravel, some fine sand, orange				9
10								10
11	10 ft		dry	10' - 12' : Loose coarse sand, dry, brown				11
12	to 15 ft		dry	12' - 15' : Medium sand, some coarse sand, some fine sand, light brown, loose, dry				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Manito Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-313**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 4", pre-clear to 6 ft Orange fine sand, trace silt, large cobble down the hole				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	6' - 7.2' : Fine medium sand, trace silt, few small gravel, loose, dry, light brown-orange				6
7	to 10 ft		dry	7.2' - 9.3' : Dense silt, mottling (gray, orange), dry, trace fine sand, few small angular gravel				7
8			wet	9.3' - 10' : Fine sand, some silt, wet, medium dense, tan				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft							11
12	to 15 ft							12
13								13
14								14
15								15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Manito Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-90**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			Pavement: 5", pre-clear to 6 ft				1
2	to 6 ft		dry	Fine sand with trace silt, small gravel, orange				2
3								3
4								4
5								5
6	5 ft to		dry	5' - 6' : Preclear backfill				6
7	10 ft		dry dry	6'-7': Fine medium sand, little fine to medium gravel, loose, dry, brown 7'-7.7': Fine sand, little coarse sand, loose, dry, light brown				7
8			dry	7.7-9.1': Dense silt, trace fine sand, gray-orange mottling, few small gravel				8
9			dry	9.1'-10': Fine to medium sand, loose to medium dense, trace silt, large gravel @ 10 ft				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Manito Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-91**
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement : 4" Fine to medium sand with little silt and small gravel, orange				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	5'-6': Preclear backfill				6
7	to 10 ft		dry dry	6'-7.7': Fine to medium sand, brown-orange 7.7'-8.5': Fine sand				7
8			dry	8.5'-9': Fine to medium sand				8
9			dry	9'-10': Fine sand, little medium coarse sand, little gravel, medium gravel, tan, loose, dry				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Manito Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-92**	
Date:	Wednesday, April 7, 2021			*Sheet:*	1 of	1
				Surface Elevation (ft-asl):	TBD	
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10	
Date:	Thursday, April 8, 2021			*Boring Diameter (in):*	2	
				Screen Depth:	N/A	
				Screen Length:	N/A	

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 4", pre-clear to 6 ft Fine sand with trace silt, medium sand, little gravel, orange large cobble @ bottom of hole				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry dry	5'-6': Preclear backfill 6'-7.5' : Silt with fine sand, few small gravel, dense, dry, light brown				6
7			dry	7.5'-8' : Fine sand with trace silt, loose, dry, orange				7
8			moist	8'-10' : Silt with trace fine sand, dense, slightly moist, light brown with some gray-orange				8
9				mottling, large gravel @8.9 ft				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Loomis Lane Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-83**
Date:	Friday, April 9, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 3"-4", pre-clear to 6 ft Some organic (root) material, fine to medium sand, some silt, tan-orange and medium brown				1
2								2
3								3
4								4
5								5
6	5 ft to	2.2	damp	5'-7.2' : Light brown- orange brown very fine to fine sand, some silt, damp, firm				6
7	10 ft		damp	7.'-7.7' : Light brown- orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Loomis Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-84**
Date:	Friday, April 9, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		damp	Pavement: none, dirt road, small stones, pre-clear to 6 ft, hit water @ 4 ft Fine to medium sand, damp, silt, tan-brown				1
2								2
3								3
4								4
5								5
6	5 ft to	2.9	wet	5'-6.3' : Light brown- gray brown fine to coarse sand, little silt, trace gravel, wet, slightly compact				6
7	10 ft		wet	6.3'-7.9' : Dark brown-black silt and peat, little sand, little clay, wet, firm				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Loomis Lane Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-85**		
Date:	Friday, April 9, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10		
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: none, sandy dirt road, hit water @ 4.5 ft, pre-clear to 6 ft Some organic root material, small stone, no cobble, fine to medium sand, silt, slightly damp tan-orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3	wet	5'-6.5' : Dark brown- black fine to coarse sand, little to some silt, organics, wet, slightly compact				6
7			wet	6.5'-8' : Dark brown fine to coarse sand, little silt, wet, loose, trace gravel				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Loomis Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-86**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		damp	Pavement: None, 2 layers bedding 10" - 5' : Light brown fine to medium sand, trace gravel, trace silt, loose, damp				1
2	to 6 ft		wet	5'-6' : Light brown fine to medium sand, trace gravel, trace silt, loose, water @ 5 ft				2
3								3
4								4
5								5
6	5 ft		dry	6'-7' : Fine to medium sand with trace silt, few small gravel, loose, dry, orange				6
7	to 10 ft	4	moist	7'-8' : Fine sandy silt, moist, medium dense				7
8			moist	8' -9.5' : Fine to medium sand with trace silt, moist, medium dense, orange				8
9			moist	9.5'-10' : Silt with fine sand, moist, dense, tan-brown with mottling, sampled, cobble @ 9.8 ft				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Loomis Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-87**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		damp	Pavement: None, 2 layers dense bedding 1'-5' : Light brown fine to coarse sand, trace gravel, trace silt, loose, damp				1
2	to 6 ft		wet	5'-6' : Light brown fine to medium sand, trace gravel, trace silt, loose, water @ 6 ft				2
3								3
4								4
5								5
6	5 ft		dry	5'-6' : pre-clear backfill				6
7	to 10 ft	5	dry	6'-8' : Fine to coarse sand with trace silt with few small gravel, loose, dry				7
8			moist	8'-9' : Fine sand, loose, moist, tan				8
9			moist	9'-10' : Fine to coarse sand, few small gravel, moist, loose, tan				9
10				---------- End of Boring at 10' ----------				10
11	10 ft							11
12	to 15 ft							12
13								13
14								14
15								15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Loomis Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-88**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		ddamp	Pavement: None, 2 layers bedding 1'-5' : Light brown fine to medium sand, trace gravel, trace silt, loose, damp				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3	saturated	6'-10' : Fine to medium sand, loose, orange to tan, wet at top becomes saturated @ ~ 7 ft				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Loomis Lane Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-89**		
Date:	Tuesday, April 13, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10		
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		damp	Pavement: 3" 3"-6' : Light brown fine to coarse sand, trace gravel, trace silt, loose, damp, no water				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4	moist	6'-9.8' : Fine to coarse sand, few small gravel, loose, orange, moist to ~ 8 ft then wet				6
7								7
8								8
9			wet	9.8'-10' : Silt with trace fine sand, dense, wet, light brown, sampled				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Deerwood Lane Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-80**		
Date:	Monday, April 19, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10		
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 6"-7" , pre-clear to 6 ft Some small rocks, fine to medium sand, silt, orange-tan some darker brown				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft to		dry	6'-6.5' : Pre-clear backfill				6
7	10 ft		wet	6.5'-6.7' : Wet silt and gravel, some medium sand, brown				7
			dry	6.7'-7.2' : Sand and silt, fine sand, few small gravel				
8			dry	7.2'-8': Dense silt with mottling, brown-orange				8
			dry	8'-8.5' : Fine to medium sand, brown-tan				
9			dry	8.5'-9.5' : Dense silt with mottling				9
			dry	9.5'-10' : Coarse loose sand, red-tan				
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM 9 Jonathan Bourne Drive Pocasset, Massachusetts (508)-833-6950
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH	
Site Location:	Deerwood Lane Orleans, MA			

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-81**
Date:	Monday, April 19, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 7"-8", pre-clear to 6 ft Some small to medium cobble, fine to medium sand, some silt, small stone, tan-med brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	5'-6.5' : Pre-clear backfill				6
7			dry	6.5'-7.6' : Medium to coarse sand, trace silt, few small to medium gravel				7
8			dry	7.6'-10' : Coarse sand, some medium sand, orange-tan-brown-dark brown				8
9			dry	@ 10' : Coarse sand, some dense silt				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Deerwood Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-82**
Date:	Monday, April 19, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 3"-4", pre-clear to 6 ft Some organic materials, fine to medium sand, some silt, tan-orange and medium brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	5'-7' : Pre-clear backfill				6
7			dry	7'-8': Brown coarse sand, few small gravel, loose				7
8			dry	8'-8.2': Light tan, fine to medium sand, loose				8
9			dry	8.2'-9.6' : Coarse loose sand, multi-colored, orange-tan-brown, few small gravel, little medium gravel				9
10			dry	9.6'-10' : Medium sand, loose, little tan ---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Deerwood Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-318**
Date:	Monday, April 19, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			Drilled in asphalt, side of the road surrounded by utilities and communications Pavement: 5"-6", pre-cleared to 6 ft				1
2	to 6 ft		dry	Some stone and gravel, tan-orange medium to fine sand, some silt				2
3								3
4								4
5								5
6	5 ft		dry	5'-6.5' : Pre-clear backfill				6
	to		dry	6.5'-7.5' : Red coarse sand, some small gravel, loose				
7	10 ft		dry	7.5'-10' : Medium to coarse sand, few small gravel				7
8								8
9								9
10								10
11	10 ft		dry	10'-11.8' : Medium sand				11
	to							
12	15 ft		dry	11.8'-12' : Stratified layers, red, brown, tan, coarse sand				12
13			dry	12.1'-13.8' : Light medium sand, few coarse sand, loosly dense				13
14			dry	13.5'-14.8' : Orange coarse sand, little small gravel, loose				14
			dry	14.8'-15' : Large gravel, some red coarse sand				
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
	to							
17	20 ft							17
18								18
19								19
20								20
21	20 ft							21
	to							
22	25 ft							22
23								23
24								24
25								25
26	25 ft							26
	to							
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Karen Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-152**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5"-6" , pre-clear to 6 ft Fine to medium sand with trace silt, little small gravel, orange				1
2								2
3								3
4								4
5								5
6	5 ft to	3.2	dry	5'-7.7': Light brown fine to coarse sand, trace gravel, trace silt, dry, slightly loose				6
7	10 ft		damp	7.7'-7.9': Gray very fine to fine sand, some silt, compact, damp				7
8			damp	7.9'-8.2' : Gray very fine sand and silt, little clay, dense, damp				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Karen Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-151**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 5" Fine to medium sand with little coarse sand and trace silt, few small gravel, orange				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		damp	5'-6.7': Brown very fine to fine sand and silt, trace clay, damp, compact				6
7	to 10 ft	3.4	dry	6.7'-8.4': Brown fine to coarse sand, trace gravel, trace silt, dry, loose				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft							11
12	to 15 ft							12
13								13
14								14
15								15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Karen Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-150**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5", observed some small to medium cobbles on sidewalls of hole intermittently Densly packed sand, fine sand with little medium to coarse sand, trace silt, few small gravel, orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.7	damp	5'-6.7': Brown very fine to fine sand, some silt, trace clay, damp, compact				6
7			dry	6.7'-8.7': Brown fine to coarse sand, trace gravel, trace silt, dry, loose				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Karen Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-149**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement : 4", pre-clear t 6 ft Fine sand with trace medium to coarse sand, trace silt, few small gravel, orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.1	damp	5'-6.1': Brown very fine to fine sand, some silt, damp, compact				6
7			dry	6.1'-6.4: dark brown- orange silt, loose, dry				7
8			dry	6.4'-8.1' : Orange brown fine to medium sand, little silt, trace gravel, loose, dry				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Karen Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-148**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5"-6", pre-clear to 6 ft Fine to medium sand with little coarse sand and few small to medium gravel, orange				1
2								2
3								3
4								4
5								5
6	5 ft to	1.2	dry	5'-5.8' : Orange brown fine to mediun sand, trace silt, dry, loose				6
7	10 ft		dry	5.8'-6.2' : Brown-gray very fine to fine sand and silt, dry, compact				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM 9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH	Pocasset, Massachusetts
Site Location:	Ministers Prim Orleans, MA			(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-78**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		damp	0-4" : No pavement, layer bedding 4"-6': Brown fine to coarse sand, trace gravel, trace silt, loose to slightly compact, dry to damp				1
2	to 6 ft			deeper, no water				2
3								3
4								4
5								5
6	5 ft		dry	6'-7' : Fine to medium sand with trace coarse sand, few small gravel, loose, dry, brown				6
7	to 10 ft	4	dry	7'-10': Fine to emdium sand with trace silt, loose, dry, dark orange				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Ministers Prim Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-79**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		damp	0'4": No pavement, one-layer bedding 4"-6': Brown fine to coarse sand, trace gravel, trace silt, damp, loose to slightly compact				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft to	4	moist	6'-8': Fine sand with some medium sand, trace silt, loose, moist, brown				6
7	10 ft		moist	8'-8.5' : Fine to coarse sand, loose, moist, orange				7
8			dry	8.5'-9' : Fine to medium sand, trace silt, loose, dry, tan				8
9			wet	9'-10': Fine to coarse sand, wet, loose to medium dense, light brown				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-19**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	30
Date:	Wednesday, April 28, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	Pavement: 5" 2' : Silty sand 2'-6': Sandy soil				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.1	damp	5' - 6.3' : Brown very fine to fine sand, little silt, damp, slightly compact				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30				---------- End of Boring at 30' ----------				30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Main Street Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-20**		
Date:	Wednesday, April 14, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	30		
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			Pavement 10" - 11" , gravel/stone base 4" , precleared to 6'				1
2	to 6 ft	5.0		Few roots in hole, fine sand, little coarse sand, little small gravel, dry, orange-tan				2
3								3
4								4
5								5
6	5 ft		damp	5' - 5.5' : Light brown fine sand, little silt, damp, loose				6
7	to 10 ft	3.3	damp	5.5' - 6.5' : Gray-orange brown very fine to fine sand, some silt, damp, compact				7
8			damp	6.5' - 6.8' : Orange brown fine to coarse sand, some gravel and cobble, slightly compact, damp				8
9			damp	6.8' - 8.3' : Light brown-orange brown fine to coarse sand, trace silt, dampt, loose				9
10								10
11	10 ft		damp	10' -13.7' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12	to 15 ft	3.7						12
13								13
14								14
15								15
16	15 ft		damp	15'- 19.3' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				16
17	to 20 ft	4.3						17
18								18
19								19
20								20
21	20 ft		damp	20' - 23.4' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				21
22	to 25 ft	3.4						22
23								23
24								24
25								25
26	25 ft		damp	25' - 27.3' : Brown fine sand, trace gravel, trace silt, cobbles, damp, loose				26
27	to 30 ft	4.6	damp	27.3' - 29' : Tan fine to coarse sand, trace silt, damp, loose				27
28								28
29								29
30				---------- End of Boring at 30' ----------				30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-21**
Date:	Wednesday, April 14, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	25
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement 11" , gravel/stone base 4", precleared to 6' Coarse sand, some fine sand, trace silt, little small gravel, dry, orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.4	dry	5' - 8.4' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	4.9	dry	10' - 14.9': Brown-light brown-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose.				11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft	2.5	damp	15' - 17.5' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft	4.0	damp	21' - 24' : Tan-brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				21
22								22
23								23
24				---------- End of Boring at 25' ----------				24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-22**
Date:	Wednesday, April 14, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement 9" - 10", gravel/stone base 3", precleared to 6' Coarse sand, some fine sand, trace silt, few small to medium gravel, little large gravel, orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.7	dry	5' - 8.7' : Tan-orange brown-brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	4.9	dry	10' - 14.9' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft	5.0	damp	15' - 20' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				16
17								17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Main Street Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-23**		
Date:	Wednesday, April 14, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20		
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement 9" - 10", gravel/stone base 4", precleared to 6' Medium coarse/fine sand, little silt, few small gravel, orange-brown, dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.2	damp	5' - 8.25' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	4.8	damp	10' - 14.2' : Light brown- orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12			moist	14.2' - 14.8' : Gray-orange brown very fine to fine sand and silt, moist, firm				12
13								13
14								14
15								15
16	15 ft to 20 ft	4.1	damp	15' - 19.1' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				16
17								17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Main Street Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-24**		
Date:	Wednesday, April 14, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15		
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement 12", gravel/stone base, presleared to 6' Fine to coarse sand, few silt, few small to medium to large gravel, orange-brown, dry				1
2								2
3								3
4								4
5								5
6	5 ft to	3.2	dry	5' - 5.9' : Light brown-orange brown very fine to coarse sand, trace gravel, trace silt, dry, loose				6
7	10 ft		moist	5.9' - 7.3' : Brown-orange brown very fine to fine sand, silt, moist, compact				7
8			damp	7.3' - 8.2' : Orange brown fine to coarse sand, trace gravel, damp, loose				8
9								9
10								10
11	10 ft to	3.5	damp	10' - 13.5' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12	15 ft							12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-25**
Date:	Wednesday, April 14, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement 13"-14" , gravel base 4" Few large cobble cleared, fine sand, trace silt, few small to medium gravel, trace silt, dry, orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.0	damp	5' - 8' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose.				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.9	damp	10' - 13.9' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-26**
Date:	Wednesday, April 14, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	Pavement 13", gravel/stone base 3" Fine sand, few coarse sand, trace silt, trace small gravel, orange-tan-brown				1
2								2
3								3
4								4
5								5
6	5 ft to	4.7	moist	5' - 9' : Light brown-orange brown very fine to fine sand and silt, trace gravel, moist, firm				6
7	10 ft		damp	9' - 9.7' : Orange brown fine to coarse sand, trace silt, damp, loose				7
8								8
9								9
10								10
11	10 ft to	3.9	damp	10' - 13.9' : Tan-dark brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12	15 ft							12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-27**
Date:	Wednesday, April 14, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			Pavement 12", gravel/stone base Preclear to 5' with 4"-5" vacuum- cleared to 6' with knife				1
2	to 6 ft	5.0	dry	Coarse sand and fine sand, small to medium gravel (few), trace silt, orange-tan-brown				2
3								3
4								4
5								5
6	5 ft to	5.0	damp	5' - 10' : Light brown-orange brown silt, some very fine sand, trace gravel, damp, firm				6
7	10 ft							7
8								8
9								9
10								10
11	10 ft to	4.6	moist	10' - 11' : Light brown very fine sand and silt, moist, firm				11
12	15 ft		damp	11' - 14' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-28**
Date:	Wednesday, April 14, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement 15" , gravel base 4" Fine sand, few coarse sand, few small to medium gravel, orange-brown				1
2	to 6 ft	5.0						2
3								3
4								4
5								5
6	5 ft		dry	5' - 6.4' : Black- orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7	to 10 ft	3.7	moist	6.4' - 8.7' : Light brown-orange brown very fine to fine sand, some silt, moist, compact				7
8								8
9								9
10								10
11	10 ft		moist	10' -13.6' : Light brown-orange brown very fine to fine sand and silt, moist, firm				11
12	to 15 ft	3.6						12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-29**
Date:	Wednesday, April 14, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	13" - 14" : Pavement Coarse sand, some fine sand, trace silt, few small gravel, trace medium gravel, orange, few cobble in hole, roots				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.0	dry	5' - 5.6' : Orange brown fine to medium sand, trace silt, dry, loose				6
7			Moist	5.6' - 6.5' : Orange brown fine to medium sand, some silt, trace gravel, moist, firm.				7
8			dry	6.6' - 9' : Light brown-orange brown fine to coarse sand, trace silt, dry, loose.				8
9								9
10								10
11	10 ft to 15 ft	3.9	dry	10' - 11.1' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt				11
12			moist	11.1' - 12' : Orange brown very fine to fine sand and silt, trace gravel, moist, firm				12
13			moist	12' - 13.9' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, moist, loose.				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-30**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft	5.0	dry	Pavement : 13" -14" fine sand, few coarse sand, trace silt, few small gravel, brown-tan-orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.2	dry	5' -8' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose.				6
7			damp	8' - 9.2' : Gray-orange brown very fine to fine sand and silt, damp, firm				7
8								8
9								9
10								10
11	10 ft to 15 ft	4.4	dry	10' - 11.6' : Brown-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				11
12			moist	11.6'-12.6' : Orange brown-gray very fine to fine sand and silt, moist, firm				12
13			moist	12.6' - 13.0' : Gray very fine t fine sand, some silt, moist, firm				13
14			moist	13' - 14.4' : Light brown to orange brown very fine to coarse sand, trace silt, moist, loose.				14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-31**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 14" , large gravel/stone cobble base fine sand, few coarse sand, trace silt, few small to medium gravel, tan-brown-orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.8	damp	5' - 6.3' : light brown fine to medium sand, trace silt, damp, loose				6
7			damp	6.3' - 7.8' : Gray-orange brown very fine to fine sand and silt, damp, firm				7
8								8
9								9
10								10
11	10 ft to 15 ft	3.1	damp	10' - 11' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12			damp	11' -13.2' : light brown very fine to fine sand and silt, trace clay, damp, dense, slight plastic				12
13								13
14								14
15								15
16	15 ft to 20 ft	2.1	damp	15' - 16.5' : Light brown very fine to fine sand and silt, trace clay, damp, firm				16
17			damp	16.5' -17.1' : Tan-orange brown very fine to coarse sand, trace silt, damp, loose				17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Main Street Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-32**		
Date:	Monday, April 12, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	25		
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 12" - 13" , Fine sand, few coarse sand, trace silt, small gravel (few), few small cobble, tan-brown-orange				1
2								2
3								3
4								4
5								5
6	5 ft to	3.5	damp	5' - 5.6' : Orange brown fine to coarse sand, little silt, trace gravel, damp, slightly compact				6
7	10 ft		moist	5.6' - 8.5' : Light brown-orange brown very fine to fine sand and silt, trace gravel, trace cobble, moist, firm				7
8								8
9								9
10								10
11	10 ft to	3.5	damp	10' - 13.5' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to	4.0	damp	15' -16' : Light brown fine to coarse sand, trace silt, damp, loose				16
17	20 ft		damp	16' - 16.6' : Brown fine to medium sand, little silt, damp, slightly compact				17
18			damp	16.6' - 19' : Tan-orange brown fine to coarse sand, trace silt, damp, loose				18
19								19
20								20
21	20 ft to	4.6	moist	20' - 23.8' : Tan-brown fine to coarse sand, trace silt, moist, loose				21
22	25 ft		moist	23.8' - 24.6' : Gray- light brown fine to medium sand, some silt, moist, loose				22
23								23
24								24
25				---------- End of Boring at 25' ----------				25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-33**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Wednesday, April 21, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 9" - 13", fog line, concrete ledge at 2', hole toward fog line Fine sand, few coarse sand, trace silt, large cobble, large gravel (few), small to medium gravel (few)				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.9	damp	5' - 7.7' : Light brown-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				6
7			moist	7.7' - 8.9' : Brown-gray very fine to fine sand and silt, moist, firm				7
8								8
9								9
10								10
11	10 ft to 15 ft	3.6	damp	10' - 13.6' : Tan-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft	3.4	damp	15' - 18.4' : Tan- orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				16
17								17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Main Street Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-34**
Date:	Monday, April 12, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Wednesday, April 14, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 10"-11", large gravel base, packed-dense soil @ 5', cleared with air knife to 6' Few medium cobble, dine sand, few coarse sand, trace silt, few small gravel, light brown-tan				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.5	damp	5' - 5.5' : Tan- light brown fine to medium sand, trace gravel, trace silt, damp, loose.				6
7			damp	5.5' - 8.5' : Very fine to find sand and silt, damp, compact				7
8								8
9								9
10								10
11	10 ft to 15 ft	3.7	damp	10' - 13.7' : Tan- light brown-orange brown fine to medium sand, trace silt, damp, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	River Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-315**
Date:	Wednesday, April 28, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	30
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8" 8"-6': Light brown fine to medium sand, trace gravel, trace silt, dry, loose				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	5'-7': pre-clear backfill				6
7			dry	7'-10': Fine to medium sand, tan-orange, trace small gravel, loose				7
8								8
9								9
10								10
11	10 ft to 15 ft		dry	10'-13.2' : Brown fine to medium sand, few small gravel, loose				11
12								12
13								13
14			dry	13.2'-15': Light tan, medium to coarse sand, some to few small gravel, loose, dry				14
15								15
16	15 ft to 20 ft							16
17								17
18			dry	17'-18.1': Coarse to medium sand, brown, some orange, slightly dense				18
19			dry	18.1'-19.4' : Loose coarse sand, trace small gravel, light tan, dry				19
20			dry	19.4' - 20' : Coarse sand, some medium sand, dry, loose				20
21	20 ft to 25 ft		dry	20'-21.9': Brown coarse to medium sand, slightly dense				21
22			dry	21.9'-22.4' : Gray-tan coarse sand, dry, loose				22
23			dry	22.4'-24': Red coarse sand, slightly dense				23
24			dry	24'-25': Coarse to medium sand, tan, dry, loose				24
25								25
26	25 ft to 30 ft		dry	26'-28.4' : Coarse medium sand, brown, slightly dense, trace small gravel, dry				26
27			wet	28.4'-30': Statified orange-gray-tan coarse sand, some medium sand, dry to wet, water @ 29 ft				27
28								28
29								29
30				---------- End of Boring at 30' ----------				30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	River Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-65**
Date:	Wednesday, May 1, 2019			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft			*Missing pre-clear information, pavement and soil interpolated from MH-315 and MH-66 Pavement Estimate: 8-9" Soil Estimate: Fine to medium sand				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	5'-6.5': pre-clear backfill				6
7			dry	6.5'-7.6': Fine sand, tan, light mottling (orange), slightly dense				7
8			dry	7.5'-10': Coarse sand, loose, few small gravel (near 10 ft), dry, light tan with some light orange				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	River Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-66**		
Date:	Tuesday, April 13, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10		
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		moist	Pavement: 10" - 11", pre-clear to 6 ft Fine to medium sand, slightly moist/wet, brown				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft to	5		5'-6': pre-clear backfill				6
7	10 ft		dry	6'-8.5': Fine to medium sand with little coarse sand, loose, dry, dark orange				7
8			dry	8.5'-10': Fine sand with trace silt, medium dense, dry, brown-orange-tan				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	River Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-67**
Date:	Wednesday, April 14, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 9"-10", Pre-clear to 6 ft Medium to fine sand, some coarse sand, trace silt				1
2								2
3								3
4								4
5								5
6	5 ft to	3						6
7	10 ft		dry	7'-10': Fine to coarse sand, small gravel, few orange to tan, loose, dry				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	River Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-68**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	0-11" : Pavement 11"-6': Brown-light brown fine to coarse sand, trace gravel, trace silt, slightly compact, dry				1
2								2
3								3
4								4
5								5
6	5 ft to	4		pre-clear to 6 ft				6
7	10 ft		dry	6'-10': Fine to medium sand with trace coarse sand, loose, dry to 9 ft then becomes slightly moist, brown to tan with some orange				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	River Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-69**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	0"-6": Pavement 6"-6' : Light brown fine to coarse sand, trace silt, slightly compact, loose, dry				1
2								2
3								3
4								4
5								5
6	5 ft to		dry	5'-6': pre-clear backfill				6
7	10 ft		dry	6'-10': Fine to coarse sand, trace silt, few small gravel, loose, dry until 9 ft then becomes slightly moist, tan with some orange				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM 9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH	Pocasset, Massachusetts
Site Location:	River Road Orleans, MA			(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-70**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	0-6" : pavement 6"-6' : Light brown fine to coarse sand, trace gravel, trace silt, loose to slightly compact, dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4	dry	6'-7.5'; Fine to medium sand, loose, dry, light brown-tan with little coarse sand				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	River Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-71**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		Dry	0-8" : Pavement, no bedding 8"-6' : Brown fine to coarse sand, trace gravel, trace silt, dry to slightly damp, no water				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4	dry	6'-10': Fine to coarse sand, loose, dry, tan-orange				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	River Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-72**	
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of	1
				Surface Elevation (ft-asl):	TBD	
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10	
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2	
				Screen Depth:	N/A	
				Screen Length:	N/A	

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			0-11" : Pavement 11"-12" : Base bedding				1
2	to 6 ft		dry	1'-6': Light brown fine to coarse sand, trace rounded gravel, trace silt, loose to slightly compact, dry to dam				2
3								3
4								4
5								5
6	5 ft		dry	6'-10': Fine to medium sand with little coarse sand, loose, dry, tan to orange				6
7	to 10 ft	4						7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft							11
12	to 15 ft							12
13								13
14								14
15								15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Linden Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-75**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		damp	0-4" : Pavement 4"-6': Brown fine to coarse sand, trace gravel, trace silt, dry, slightly damp, slightly compact				1
2								2
3								3
4								4
5								5
6	5 ft to	4	dry	6'-9.5': Fine to medium sand with trace coarse sand, few small gravel, orange, loose, dry				6
7	10 ft		moist	9.5'-10': Fine sand, loose, medium dense, slightly moist, tan				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Linden Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-317**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	0-6" : Pavement 6"-6': Light brown fine to coarse sand, trace to no gravel, trace ilt, slightly compact to loose, dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4	dry	6'-8': Fine to medium sand with trace silt, trace coarse sand, loose, dry, tan to light tan				6
7			dry	8'-8.5': Fine sand with little silt, medium dense, dry, small rock at 8 ft				7
8			dry	8.5'-10': Silt with trace fine sand, dense, dry, few fine to medium sand, tan and some orange sampled				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Packet Landing Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-76**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	0-5" : Pavement 5"-6': Light brown fine to coarse sand, trace to no gravel, trace silt, slightly compact to loose,dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4	dry	6'-7.5': Fine to coarse sand, few small gravel, loose, dry, brown to orange				6
7			moist	7.5'-8': Fine sand with trace silt, moist, loose to medium dense, orange				7
8			dry	8'-9.8': Fine to medium sand with little coarse sand, loose, dry, orange				8
9			moist	9.8'-10': : Fine to medium sand with little coarse sand, few small gravel, loose, moist, orange				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Packet Landing Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-77**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	0-5" : Pavement 5"-6': Light brown fine to coarse sand, trace gravel, trace silt, slightly compact to loose,dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4	dry	6'-7': Fine to medium sand with trace silt, few small gravel, loose, dry, light brown				6
7			dry	7'-8': Fine to coarse sand, few small gravel, loose, dry, tan-orange				7
8			dry	8'-8.5': Fine sand with trace silt, medium sand, few small gravel, loose, dry, tan-orange				8
9			moist	8.5'-9.5': Silt with some fine to medium sand, dense, moist, few small gravel, tan, sampled				9
10			moist	9.5'-10': Fine sand with trace silt, loose, medium dense, moist, orange-tan ---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Packet Landing Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-316**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	0-5" : Pavement 5"-6': Light brown fine to coarse sand, trace to no gravel, trace silt, slightly cmpact to loose, dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3	dry	7'-9': Fine to coarse sand, gets gradually coarser as core goes deeper, dry, loose, tan-orange few small gravel				6
7								7
8								8
9			dry	9'-10': Rock @ 9 ft, fine sand with silt, tan, loose, dry				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Lucys Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-73**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	0-3" : Pavement, no bedding 3"-6': Brown fine to coarse sand, trace gravel, trace silt, loose to slightly compact, dry, no water				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4	dry	6'-7.5': Fine to medium sand with few little coarse sand and few small gravel, loose, dry, tan to orange				6
7			dry	7.5'-10': Fine sand with little silt, medium dense, dry, light tan to tan				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Lucys Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-74**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 15, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		damp	0-4": No pavement, no bedding, packed sand 4"-6': Brown fine to coarse sand, trace gravel, trace silt,, loose to slightly compact, dry to damp with depth, no water				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	5	dry	6'-9': Fine to medium sand with little coarse sand, few small gravel, loose, dry				6
7			moist	9'-10': Fine sand with trace silt, medium dense, slightly moist, tan with some orange				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	School Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-16**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	No pavement Top soil: 4", sandy soil to 6 ft				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3	moist	5'-8' : Tan-orange brown fine to medium sand, trace silt, moist, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.8	damp	10'-13.8': Tan-orange brown fine to medium sand, trace silt, damp, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	School Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-17**		
Date:	Thursday, April 15, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	30		
Date:	Wednesday, April 28, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	No pavement Top soil: 4", up to 6 ft sandy soil				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.6	damp	5'-7.6' : Tan-orange brown fine to medium sand, trace to little silt, damp, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.5	damp	10'-10.4' : Tan-orane brown fine to medium sand, trace silt, damp, loose				11
12			damp	10.4'-11.8' : Tan-orange brown very fine to fine sand and silt, damp, firm				12
13			damp	11.8'-13.5' : Tan-orange brown fine to coarse sand, trace silt, damp, loose				13
14								14
15								15
16	15 ft to 20 ft	3.7	damp	15'-16.3' : Tan-light brown very fine to fine sand, trace silt, damp, loose				16
17			moist	16.3'-18.7' : Gray-orange brown very fine sand and silt, little clay, moist, dense, slightly compact, plastic				17
18								18
19								19
20								20
21	20 ft to 25 ft	2.8	wet	20'-27.8' : Gray-orange brown very fine to fine sand and silt, trace clay, wet, dense				21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30				---------- End of Boring at 30' ----------				30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	School Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck
Date:	Thursday, April 15, 2021		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620
Date:	Wednesday, April 28, 2021		

Boring Number:	**MH-18**
Sheet:	1 of 1
Surface Elevation (ft-asl):	TBD
Boring Depth (ft):	35
Boring Diameter (in):	2
Screen Depth:	N/A
Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description	Depth
1	Pre-Clear 0 ft to 6 ft		dry	No pavement Top soil: 8", Sand to 6 ft	1
2					2
3					3
4					4
5					5
6	5 ft to 10 ft	2.1	damp	5'-7.1' : Light brown fine to coarse sand, trace gravel, trace silt, damp, loose, cobble @ 7 ft	6
7					7
8					8
9					9
10					10
11	10 ft to 15 ft		damp	10'-11.4' : Orange brown-brown fine to coarse sand, trace gravel, trace silt, damp, loose, cobble @ 11.9'	11
12			damp	11.4'-13.3' : Light brown- orange brown fine to coarse sand, trace silt, damp, loose	12
13					13
14					14
15					15
16	15 ft to 20 ft	4.3	damp	15'-16.9' : Brown- orange brown fine to coarse sand, trace gravel, trace silt, damp, loose	16
17			damp	16.9'-19.5' : Tan-orange brown fine to coarse sand, trace silt, damp, loose	17
18					18
19					19
20					20
21	20 ft to 25 ft	2.0	damp	20'-22' : Tan - orange brown fine to medium sand, trace silt, damp, loose	21
22					22
23					23
24					24
25					25
26	20 ft to 25 ft	3.2	wet	25'-28.2' :Light brown-orange brown fine to coarse sand, trace silt, moist to wet, water @ 31', loose	21
27					22
28					23
29					24
30					25
31	25 ft to 30 ft	3.7	wet	32'-33.7' : Light brown-orange brown fine to coarse sand, trace silt, wet, loose	26
32					27
33					28
34					29
35				---------- End of Boring at 35' ----------	30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	School Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-322**
Date:	Thursday, April 15, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	No pavement top soil: 4", Sandy silt and some stones to 6 ft				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft to	3.6	Moist	Brown fine to very fine sand, some silt, firm, moist				6
7	10 ft		moist	6.2'-8.6': Orange brown-brown very fine to fine sand, lttle silt, moist, compact				7
8								8
9								9
10								10
11	10 ft to	4.2	moist	10'-14.2: Brown-orange brown-gray very fine to fine sand, some silt, moist, compact				11
12	15 ft							12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Uncle Vick's Way Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-60**		
Date:	Tuesday, April 13, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15		
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 3"-4", pre-clear to 6 ft Fine sand with little medium sand and trace silt, orange				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	5'-5.8': Tan-light brown fine to medium sand, trace gravel, trace silt, dry, loose				6
7	to 10 ft	1.9	dry	5.8'-6.2': Orange-brown very fine to fine sand, some silt, trace gravel, dry, moist, compact				7
8			dry	6.2'-6.9':Tan-light orange brown fine to medium sand,trace gravel, trace silt, dry to damp, loose				8
9								9
10								10
11	10 ft		damp	10'-11.1': Tan-light brown fine to medium sand, trace silt, damp, to moist, loose				11
12	to 15 ft	2.5	wet	11.1'-12.5': Tan-light orange brown fine to coarse sand, trace silt, wet, loose, water @ 11.1 ft				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Uncle Vick's Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-61**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 3"-4", pre-clear to 6 ft Fine sand with little medium sand and trace silt, orange-tan				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.2	dry	5'-7.2': Tan-brown fine to medium sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.9	dry	Light brown-tan fine to medium sand, trace silt, dry, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Uncle Vick's Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-62**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 3"-5", pre-clear to 6 ft Fine sand with little medium to coarse sand, few small gravel, orange				1
2								2
3								3
4								4
5								5
6	5 ft to		dry	5'-7.9': Light brown fine to medium sand, trace gravel, trace silt, dry, loose				6
7	10 ft							7
8								8
9								9
10								10
11	10 ft to	4	dry	10'-13.5': Tan-orange brown fine to medium sand, trace gravel, trace silt, dry, loose				11
12	15 ft		dry	13.5'-14.9': Tan-orange brown fine to medium sand, little silt, dry, slightly compact				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Uncle Vick's Way Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-63**
Date:	Tuesday, April 13, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 16, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5", pre-clear to 6 ft Some root material noted along hole sidewalls, fine to medium sand with trace silt, orange-light brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	1.9	dry	5'-5.9': Brown fine to medium sand, trace silt, dry, loose				6
7			dry	5.9'-6.9': Orange brown fine to medium sand, trace silt, dry, loose				7
8								8
9								9
10								10
11	10 ft to 15 ft	3.7	dry	10'-13.7': Light brown-tan fine to medium sand, trace silt, dry, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Monument Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-13**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: none, pre-clear to 6 ft Fine to medium sand, dirt, dark orange-dark brown, slightly moist, some silt				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.1	damp	5'-8.1' : Light brown - orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	2.7	damp	10' - 12.7' : Light brown - orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Monument Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-14**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: none, off side of the road in dirt, pre-clear to 6 ft Some organic material, fine to medium sand, dark brown-dark orange, lots of dirt, slightly moist, some silt				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.1	damp	5'-7.1': Light brown fine to medium sand, trace silt, damp, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	2.9	damp	10' - 12.1' : Tan- light brown fine to medium sand, trace silt, damp, loose				11
12			damp	12.1' - 12.9' : Light brown very fine to fine sand and silt, damp, firm				12
13								13
14								14
15								15
16	15 ft to 20 ft	3.5	damp	15' - 17.8' : Light brown - orange brown very fine to fine sand and silt, trace clay, damp, firm				16
17			damp	17.8' - 18.5' : Gray-orange brown very fine to medium sand, some to little silt, damp, compact				17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Monument Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-15**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		moist	Pavement: 10"-11", pre-clear to 6 ft Fine to medium sand, some silt, dark orange-dark brown, slightly moist, some small stones				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		damp	5'-6.5': Gray-orange brown very fine to fine sand, some silt, damp, compact				6
7	to 10 ft	3.2	dry	6.5'-7.4': Light brown-orange brown fine to medium sand, trace silt, dry, loose				7
8			damp	7.4'-8.2': Gray-orange brown very fine sand, some silt, damp, compact				8
9								9
10								10
11	10 ft		dry	10'-12.3': Tan-orange brown fine to coarse sand, little silt, dry, loose, slightly compact				11
12	to 15 ft	2.3						12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Monument Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-56**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: none, off side of the road in dirt, pre-clear to 6 ft Some organic root material, small to medium stones, fine to medium sand, some silt, moist dark brown-medium orange				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.8	damp	5'-6.3': Light brown-brown fine to coarse sand, little silt, damp, loose				6
7			damp	6.3'-7.8': Light brown-orange brown very fine to fine sand, some silt, damp, slightly compact to compact				7
8								8
9								9
10								10
11	10 ft to 15 ft	3	dry	10'-13': Light brown-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Monument Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-57**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: 7"-9" , pre-clear to 6 ft Fine to medium sand, some silt, slightly moist, orange-brown, some small socks, small to medium cobble				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.5	damp	5'-7.5': Tan-orange brown very fine to medium sand, little silt, damp, slightly compact				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.4	damp	10'-11.7': Tan-orange brown very fien to fine sand, little silt, damp, slightly compact				11
12			damp	Light brown-orange brown very fine sand, some silt, damp, slightly compact				12
13			damp	12.4'-13.4': Tan-orange brown fine to medium sand, trace silt, damp, loose				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Monument Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-58**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: none, off side of the road in dirt, pre-clear to 6 ft Some organic root material, fine to medium sand, some silt, dirt, orange-brown, moist				1
2				dark brown-medium orange				2
3								3
4								4
5								5
6	5 ft to 10 ft	3.2	damp	5' - 7.5' : Tan- orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				6
7			damp	7.5' - 8.2' : Gray very fine to fine sand, some silt, damp, compact				7
8								8
9								9
10								10
11	10 ft to 15 ft	3.5	damp	10' - 13.5' : Gray - orange brown very fine to medium sand, some silt, damp, compact				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Monument Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-59**		
Date:	Monday, April 26, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10		
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: non, off side of the road in dirt, pre-clear to 6 ft, water @ 5 ft Organic root material (a lot), dirt, medium sand, dark brown, moist from water table				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.2	wet	5'-5.9': Brown very fine sand and silt, trace clay, wet, dense				6
7			moist	5.9'-6.5': Brown very fine to fine sand, some silt, moist, firm				7
8			damp	6.5'-8.2': Orange brown fine to coarse sand, little silt, damp, loose				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Monument Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-321**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: none, off side of the road in dirt, pre-clear to 6 ft Small cobble, fine to medium sand, some silt, dirt, orange/dark brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.9	damp	5' -7.9' : Gray- orange brown very fine to fine sand, little to some silt, damp, slightly compact				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	2.4	damp	10'-10.4' : Brown- orange brown very fine sand and silt, damp, compact				11
12			damp	10.4'-12.4' : Tan-orange brown very fine to fine sand, trace to little silt, damp, slightly compact				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Gesner Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-303**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 6"-7", pre-clear to 6 ft Fine to medium sand, fairly silty, some organic root material, orange-light to medium brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	1.6	damp	5' - 6.6' : Tan-orange brown fine sand, damp, loose				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Gesner Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-304**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 4"-5" , pre-clear to 6 ft Some organic root material, fine to medium sand, some silt, orange-light brown-tan, some stones				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.6	damp	5' -7.6' : Light brown - orange brown fine to medium sand, trace silt, damp, loose				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-4**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 7"-8", pre-clear to 6 ft Fine sand with little medium sand, brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.3	damp	5'-7': Light brown-tan very fine to medium sand, little silt, trace gravel, damp, slightly compact				6
7			damp	7'-8.3': Orange brown-red brown very fine to medium sand, some silt, damp, compact				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-5**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 7"-8: , Pre-clear to 6 ft Fine to medium sand, orange-light tan, few medium cobbles removed from the hole				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.5	damp	5'-5.9': Tan-light brown fine to medium sand, trace silt, damp, loose				6
7			damp	5.9'-8.5': Tan-orange brown very fine to fine sand, some silt, damp, compact to firm in depth				7
8								8
9								9
10								10
11	10 ft to 15 ft	3	damp	10'-11' : Orange brown-light brown very fine sand, some silt, damp, compact				11
12			damp	11'-13': Tan-light brown very fine to medium sand, little silt, damp, loose, slightly compact, firm by depth				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-6**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 10"-11", pre-clear to 6 ft Fine to medium sand, trace silt, few gravel/cobble, orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.3	damp	5'-8.7': Light brown-orange brown fine to medium sand, trace silt, damp, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	4.2	damp	10'-14.2': Light brown-orange brown fine to medium sand, trace silr, dmp, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-7**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8"-9" , pre-clear to 6 ft Fine to medium sand, brown-orange with trace silt, few small gravel, roots visible down the hole, few small cobbles removed from hole				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.3	damp	5'-7.3': Tan-orange brown fine to coarse sand, trace to little gravel, trace silt, damp, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	3.8	damp	10'-11.6': Tan-orange brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12								12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Pond Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-8**		
Date:	Friday, April 16, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15		
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 6"-7" , pre-clear to 6 ft Fine to medium sand, medium cobbles, small gravel, trace silt				1
2								2
3								3
4								4
5								5
6	5 ft to	3.7	damp	5'-6': Light brown- orange brown fine to medium sand, trace silt, damp to dry				6
7	10 ft		damp	6'-8.1': Gray-orange brown very fine sand and silt, damp, firm				7
8			damp	8.1'-8.9': Tan fine to medium sand, trace silt, damp, loose				8
9								9
10								10
11	10 ft to	3.1	damp	10'-13.1': Tan-orange brown fine to medium sand, trace silt, damp, loose				11
12	15 ft		=]					12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-9**
Date:	Monday, April 19, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			Pavement: 9"-10", pre-clear to 6 ft Hit additional pavement 2 ft down (4"-5" thick)				1
2	to 6 ft		Moist	Fine to medium sand, silt, some small cobble/gravel, brown-orange, slightly moist				2
3								3
4								4
5								5
6	5 ft		damp	5'-6.8': Gray-red brown very fine to fine sand and silt, damp, firm				6
7	to 10 ft	3	damp	6.8'-8': Tan-orange brown fine to medium sand, trace silt, damp, loose				7
8								8
9								9
10								10
11	10 ft		damp	10'-12.6': Tan- red brown fine to coarse sand, trace gravel, trace silt, damp, loose				11
12	to 15 ft	4.4	damp	12.6'-12.8': Gravel, gray, damp, loose				12
13			moist	12.8'-14.4': Gray- orange brown silt, some very fine sand, trace clay, moist, firm				13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-10**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 6", pre-clear to 6 ft Hit additional pavement 2 ft down (4"-5" thick), used jackhammer to break it up by extending the size of the hole Fine to medium sand, silt, some small cobble, some gravel, orange-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.9	dry	5'-6': Light brown fine to coarse sand, little silt, trace gravel, loose, dry				6
7			dry	6'-7': Brown very fine to fine sand, some silt, dry, compact				7
8			dry	7'-8.9': Gray-light brown very fine to fine sand, some silt, dry, compact				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-11**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft			Pavement: 8", pre-clear to 6 ft Hit additional pavement 2 ft down (4"-5" thick), used jackhammer to break it up by extending the size of the hole				1
2	to 6 ft		dry	Fine to medium sand, silt, some small cobble, some gravel, orange-brown				2
3								3
4								4
5								5
6	5 ft to	2.3	dry	5'-7.3': Light brown fine to medium sand, trace gravel, trace silt, dry, loose				6
7	10 ft							7
8								8
9								9
10								10
11	10 ft to	3.7	dry	10'-13.7': Tan-orange brown fine to medium sand, trace gravel, trace silt, dry, loose				11
12	15 ft							12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Pond Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-12**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	20
Date:	Thursday, April 22, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8", pre-clear to 6 ft Fine to medium sand, some silt, some small cobble, some gravel, orange-light to medium brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.6	dry	5'-7.6': Light brown-orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10								10
11	10 ft to 15 ft	2.4	damp	10'-11.6': Light brown-orange brown fine to coarse sand, trace silt, damp, loose				11
12			moist	11.6'-12.4': Gray very fine to fine sand and silt, moist, compact				12
13								13
14								14
15								15
16	15 ft to 20 ft	2	damp	151'-15.3': Orange brown fine to coarse sand, little silt, trace gravel, damp, slightly compact				16
17			moist	15.3'-17': Gray-orange brown very fine to fine sand and silt, moist, compact				17
18								18
19								19
20				---------- End of Boring at 20' ----------				20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Pond Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-319**
Date:	Friday, April 16, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	15
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 12" , pre-clear to 6 ft Fine to medium sand light tan-orange, few small to medium gravel, few small cobble removed from the hole				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.6	damp	5'-5.9': Orange brown fine sand, little silt, damp, loose				6
7			damp	5.9'-6.3': Light brown very fine to fine sand, little silt, damp, loose				7
8			moist	6.3'-8.6': Light brown-orange brown, silt, some ery fine sand, trace clay, moist, firm with depth				8
9								9
10								10
11	10 ft to 15 ft	3.2	moist	10'-12.3': Light brown-orange brown, silt, some very fine sand, trace gravel, moist, firm				11
12			damp	12.3'-13.2': Tan-orange brown fine to medium sand, trace silt, damp, loose				12
13								13
14								14
15				---------- End of Boring at 15' ----------				15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Lake Farm Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-55**
Date:	Monday, April 19, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 4"-5", pre-clear to 6 ft Some organic root material, fine to medium sand and silt, orange-light brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	5'-5.5': Pre-clear backfill				6
			dry	5.5'-6.2': Dark brown fine sand, some silt				
7			dry	6.2'-7': Light brown fine to medium to coarse sand				7
8			dry	7'-7.8': Light orange, light sand				8
			wet	7.8'-8.2': wet, fine to coarse sand				
9			wet	8.2'-9': Dark brown, wet coarse to medium sand, wet				9
			wet	9'-10': Dark brown, coarse sand, some gravel, large gravel at 9 ft				
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	Lake Farm Lane Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-54**		
Date:	Monday, April 19, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10		
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 5", pre-clear to 6 ft Fine to medium sand and silt, mostly fine sand, light brown-orange				1
2								2
3								3
4								4
5								5
6	5 ft to		dry	5'-6.5': pre-clear material				6
7	10 ft		dry	6.5'-7.5': Brown fine sand, few coarse sand, little silt				7
8			dry	7.5'-9.9': Light fine sand, slughtly dense, dry				8
9			dry	9.9'-10': Few small to medium gravel				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Lake Farm Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-53**
Date:	Monday, April 19, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 4"-5", pre-clear to 6 ft Fine to medium sand and silt, light to medium brown, and orange, small stone				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	6.5'-8.1': Brown sand, coarse to medium, few small gravel				6
7			dry	8.1'-9.5': Light brown, coarse to medium sand, lightly packed, dry				7
8								8
9			wet	9.5'-10': Brown coarse sand, loose, wet (large gravel at 9.5 ft)				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Lake Farm Lane Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-52**
Date:	Monday, April 19, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Thursday, April 29, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft		dry	Pavement: 5", pre-clear to 6 ft Fine to medium sand and silt, orange-light to medium brown, some small stone				1
2	to 6 ft							2
3								3
4								4
5								5
6	5 ft		dry	6'-7': Coarse sand				6
7	to 10 ft		dry	7'-10': Medium sand				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft							11
12	to 15 ft							12
13								13
14								14
15								15
16	15 ft							16
17	to 20 ft							17
18								18
19								19
20								20
21	20 ft							21
22	to 25 ft							22
23								23
24								24
25								25
26	25 ft							26
27	to 30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	South Orleans Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-51**
Date:	Monday, May 24, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, May 24, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: none, hole in grass, pre-clear to 6 ft Fine to medium sand with some coarse, little silt, brown-orange, loose, dry				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	6'-9': Loose, dry, fine to medium sand, light tan, trace small angular gravel				6
7								7
8								8
9			dry	9'-10': Fine sand with some medium sand, loose to slightly dense, dry, trace small gravel, medium cobble at 9.5 ft				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	South Orleans Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-50**
Date:	Monday, May 24, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, May 24, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: none, off side of the road in dirt/grass, pre-clear to 6 ft Fine to medium sand, lots of silt, light tan-dark brown, some small stone				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		wet	Fine to medium sand with some coarser sand throughout, loose, slightly wet, few small angular gravel throughout, orange, trace silt				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	South Orleans Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-49**
Date:	Monday, May 24, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, May 24, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: none, off side of the road in dirt, pre-clear to 6 ft, had to shift boring 2' right Fine to medium sand, some silt, slightly moist, tan-brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		moist	5'-7': Medium sand, moist, some gravel, tan				6
7			moist	7'-8': Light sand and silt, loose				7
8			moist	8'-9.5': orange sand, moist				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	South Orleans Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-48**
Date:	Monday, May 24, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, May 24, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: none, off side of road in dirt/grass, pre-clear to 6 ft, small to medium stones Fine to medium sand, some silt, tan-dark brown, slightly moist				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		moist	6'-9': Sand all the way down, slightly moist at bottom, all tan, darker towards end				6
7								7
8								8
9			moist	9'-10': Silt based and fine to medium sand				9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24				---------- End of Boring at 25' ----------				24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM	9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH		Pocasset, Massachusetts
Site Location:	South Orleans Road Orleans, MA				(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-3**		
Date:	Monday, May 24, 2021			*Sheet:*	1	of	1
				Surface Elevation (ft-asl):	TBD		
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10		
Date:	Monday, May 24, 2021			*Boring Diameter (in):*	2		
				Screen Depth:	N/A		
				Screen Length:	N/A		

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: none, location in grass along roadway Few large cobbles noted along hole edges, brown, loose, dry, fine to medium sand with silt				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft		dry	6'-10': Fine sand with little medium with trace silt, brown to orange, loose, dry to moist				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-162**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: 7"-9" , pre-clear to 6 ft Fine to medium sand, some silt, orange-brown, slightly moist, some small stones/gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.5	dry	5' - 8' : Light brown fine to coarse sand, little silt, dry, loose				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-161**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: 8" , pre-clear to 6 ft Fine to medium sand, some silt, orange-brown, slightly moist, some small stones/gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.2	dry	5' -7.2' : Light brown - orange brown fine to medium sand, trace silt, dry, loose				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-160**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: 8"-9", pre-clear to 6 ft Fine to medium sand, some silt, orange-brown, slightly moist, some small stones/gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.6	dry	5' - 7.6' : Light brown - orange brown fine to medium sand, trace silt, dry, loose				6
7			damp	6.4' - 6.9' : Light brown- orange brown very fine sand and silt, trace clay, damp, firm				7
8			damp	6.9' -7.6' : Tan fine to medium sand, trace silt, damp, loose				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-159**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: 8"-9", pre-clear to 6 ft Fine to medium sand, some silt, orange-brown, slightly moist, some small stones/gravel				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.2	dry	5 ' -9.2' : Light brown - orange brown fine to coarse sand, trace gravel, trace silt, dry, loose				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-158**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: 8"-9", pre-clear to 6 ft Fine to medium sand, some silt, orange-brown, slightly moist, some small stones/gravel				1
2								2
3								3
4								4
5								5
6	5 ft to	3.7	dry	5' - 7.2' : Orange brown- light brown fine to medium sand, trace silt, trace gravel, dry, loose				6
7	10 ft		dry	7.2' - 8.7' : Tan- light brown very fine to fine sand, little silt, dry, loose				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-157**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: 7"-8", Pre-clear to 6 ft Fine to medium sand, some silt, orange-brown, slightly moist, some small stones				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.1	dry	5'-8.1': Light brown - orange brown fine to coarse sand, little silt, trace gravel, dry, loose				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue	AECOM 9 Jonathan Bourne Drive
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH	Pocasset, Massachusetts
Site Location:	Finlay Road Orleans, MA			(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-156**
Date:	Monday, April 26, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Tuesday, April 27, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		moist	Pavement: 8"-9", pre-clear to 6 ft, airknife to 5.5', lots of cobble (small to medium), big at bottom Fine to medium sand, some silt, orange-brown, slightly moist				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.6	dry	5'-7.6': Light brown- orange brown very fine to fine sand, little silt, trace gravel, dry, slightly compact				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-155**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, April 26, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 8", pre-clear to 6 ft, 2" pavement observed at 1.25 ft Fine sand with cobbles				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	4.5	damp	5'-9.5': Gray- light brown-orange brown very fine to fine sand and silt, damp, compact, 2" layer fine to medium sand @ 7.3'				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24				qa				24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-154**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, April 26, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		wet	Pavement: 10" 14"-6': Fine sand, wet at bottom				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3.5	wet	5'-8.5': Light brown - orange brown fine to medium sand, trace silt, wet, loose				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

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Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-153**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, April 26, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		wet	Pavement : 7", Fine sand, some gravel, wet at 5 ft				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	5	wet	5'-6.5': Fine to medium to coarse sand, little silt, wet, compact, water at 4 ft				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

AECOM
9 Jonathan Bourne Drive
Pocasset, Massachusetts
(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-1**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Monday, April 26, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		wet	Pavement: 7" Fine sand, water at 6 ft				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	3	moist	5'-6.1': Light brown-orange brown fine to coarse sand, little silt, moist, slightly compact				6
7			moist	6.1'-6.6': Dark brown-black fine to coarse sand, some silt,moist, compact				7
8			wet	6.6'-8': Orange brown very fine to fine sand and silt, little gravel, trace cobbles, firm, wet				8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

AECOM
9 Jonathan Bourne Drive
Pocasset, Massachusetts
(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-2**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 6", pre-clear to 6 ft Fine to medium sand, some silt, few small stones, orange/brown				1
2								2
3								3
4								4
5								5
6	5 ft to		damp	5'-5.4': Orange brown fine to medium sand, trace silt, damp, loose				6
7	10 ft		damp	5.4'-8.8': Gray-orange brown very fine sand and silt, damp, compact				7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to							11
12	15 ft							12
13								13
14								14
15								15
16	15 ft to							16
17	20 ft							17
18								18
19								19
20								20
21	20 ft to							21
22	25 ft							22
23								23
24								24
25								25
26	25 ft to							26
27	30 ft							27
28								28
29								29
30								30

Project Number:	60652634	*Project Manager:*	Reggie Donoghue
Client:	Town of Orleans, MA	*Field Tech(s):*	TL/CH/BB/MO/AH
Site Location:	Finlay Road Orleans, MA		

AECOM
9 Jonathan Bourne Drive
Pocasset, Massachusetts
(508)-833-6950

Pre-Clear Contractor:	Geologic	*Equipment:*	Vac-Truck	***Boring Number:***	**MH-320**
Date:	Tuesday, April 20, 2021			*Sheet:*	1 of 1
				Surface Elevation (ft-asl):	TBD
Drill Contractor:	Geologic	*Equipment:*	Geoprobe 6620	*Boring Depth (ft):*	10
Date:	Friday, April 23, 2021			*Boring Diameter (in):*	2
				Screen Depth:	N/A
				Screen Length:	N/A

Depth	Sample Interval	Rec (ft)	Moisture Level	Field Identification / Description				Depth
1	Pre-Clear 0 ft to 6 ft		dry	Pavement: 6", pre-clear to 6 ft 14" to bottom: concrete mix, Fine to medium sand with silt, slightly damp, orange-medium to dark brown				1
2								2
3								3
4								4
5								5
6	5 ft to 10 ft	2.5	damp	5'-7.5' : Tan-orange brown very fine to medium sand, trace silt, damp, loose				6
7								7
8								8
9								9
10				---------- End of Boring at 10' ----------				10
11	10 ft to 15 ft							11
12								12
13								13
14								14
15								15
16	15 ft to 20 ft							16
17								17
18								18
19								19
20								20
21	20 ft to 25 ft							21
22								22
23								23
24								24
25								25
26	25 ft to 30 ft							26
27								27
28								28
29								29
30								30

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B400

Sheet 1 of 2

Date(s) Drilled	**September 27, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**30.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Cold Asphalt Patch**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 6 inches of ASPHALT 0.5	*Vacuumed to 6 feet.*
							Orange to brown, Poorly graded SAND (SP), fine to coarse grained, some fine to coarse grained gravel, trace non-plastic fines, trace cobbles, moist	
5								
		GP1			35		Light brown, Poorly graded SAND (SP), fine to coarse grained, moist	
10							Similar to GP1, moist	
		GP2			44			
15							Light brown to orange, Poorly graded SAND (SP), fine to coarse grained, few fine grained gravel, trace fines, moist	
		GP3			44			
20							GP4, Top 32": Light brown to orange, Poorly graded SAND (SP), fine to coarse grained, trace fine grained gravel, trace fines, moist	
		GP4			44		GP4, Bot. 12": Light brown, Poorly graded SAND (SP), fine to medium grained, trace fines, moist	
25							25.0	
		GP5			32		Light brown, Well-graded SAND (SW), fine to coarse grained, trace fine grained gravel, trace fines, moist	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:01 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B400

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
		GP5			32			
30							30.0 Boring Terminated at 30 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:01 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B401

Sheet 1 of 2

Date(s) Drilled	**September 26, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**30.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Bagged Sand**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**24 feet**		

Depth, feet	SAMPLES Type	Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								0.0 Dark brown, Poorly graded SAND (SP), fine to coarse grained, trace fine to coarse grained gravel, roots and cobbles, trace fines, moist (TOPSOIL) 0.3	*Vacuumed to 6 feet.*
								Brown, Silty SAND (SM), fine to coarse grained, little non-plastic fines, trace fine grained gravel, moist	
5									
		GP1			26			Orange, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	
10								Similar to GP1, orange to brown in color, moist	
		GP2			43				
15								GP3, Top 36": Orange to brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	
		GP3			46			GP3, Bot. 7": Light brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	
20								GP4, Top 36": Light brown, Poorly graded SAND (SP), fine to medium grained, trace fines, moist	
		GP4			48			GP4, Bot. 12": Light brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, wet	
25		GP5			35			Light brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, wet	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:06 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B401

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
	GP	5			35			
30							30.0 Boring Terminated at 30 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:07 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B402

Sheet 1 of 2

Date(s) Drilled	**September 27, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**35.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**29.4 feet**		

Depth, feet	SAMPLES Type	Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								0.0 Orange to brown, Poorly graded SAND (SP), fine to coarse grained, few fine grained gravel, trace fines, moist 1.0	*Vacuumed to 6 feet.*
5	GP	GP1			39			GP1, Top 27": Orange to brown, Poorly graded SAND (SP), fine to coarse grained, trace fine grained gravel, trace fines, moist GP1, Bot. 12": Light brown to orange, Poorly graded SAND (SP), fine to medium grained, trace fines, moist	
10	GP	GP2			45			Light brown, Poorly graded SAND (SP), fine grained, trace fines, moist	
15	GP	GP3			51			GP3, Top 29": Light brown to orange, Poorly graded SAND (SP), fine to medium grained, trace fines, moist 17.6 GP3, Bot. 22": Light brown, Silty SAND (SM), fine to medium grained, little non-plastic fines, moist	
20	GP	GP4			60			20.0 Light brown, Poorly graded SAND (SP), fine to medium grained, trace non-plastic fines, moist	*Pushed 3.25" casing to 25 feet.*
25	GP	GP5			36			GP5, Top 29": Light brown, Poorly graded SAND (SP), fine grained, trace fines, moist	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:13 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B402

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
	GP5				36		GP5, Bot. 7": Light brown to orange, SILT with Sand (ML), non-plastic, little fine grained sand, wet	
27.5								
30	GP6				48		GP6, Top 35": Light brown, Poorly graded SAND (SP), fine grained, trace fines, wet	
33.0							GP6, Bot. 13": Light brown, Lean CLAY (CL), low plasticity, few fine grained sand, wet	
35							Boring Terminated at 35 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:13 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B403

Sheet 1 of 2

Date(s) Drilled	**September 24, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**35.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**24.8 feet**		

Depth, feet	SAMPLES Type	Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								0.0 Dark Brown, Poorly graded SAND (SP), fine to coarse grained, few non-plastic fines, trace fine to coarse grained gravel, trace roots, moist	*Vacuumed to 6 feet.*
								3.0 Light brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	
5								6.0 Orange to brown, Silty SAND (SM), fine to medium grained, little non-plastic fines, trace fine grained gravel, moist	
	GP	1			48				
10								GP2, Top 7": Dark brown, Silty SAND (SM), fine to coarse grained, little non-plastic fines, trace fine grained gravel, moist GP2, Mid. 19": Light brown to orange, Silty SAND (SM), fine to medium grained, little non-plastic fines, moist	
	GP	2			41			13.5 GP2, Bot. 15": Light brown, Poorly graded SAND (SP), fine grained, trace fines, moist	
15								GP3, Top 23": Light brown, Poorly graded SAND (SP), fine grained, trace fines, moist	
	GP	3			47			GP3, Bot. 24": Light brown, Poorly graded SAND (SP), medium grained, trace fines, moist	
20								Light brown, Poorly graded SAND (SP), fine to medium grained, trace non-plastic fines, moist	
	GP	4			50				
25									
	GP	5			39			GP5, Top 29": Light brown, Poorly graded SAND (SP), fine grained, trace fines, moist	

AECOM

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:18 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B403

Depth, feet	SAMPLES Type	Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
		GP5			39			GP5, Bot. 7": Light brown to orange, SILT with Sand (ML), non-plastic, little fine grained sand, wet	
30		GP6			0			GP6, Top 35": Light brown, Poorly graded SAND (SP), fine grained, trace fines, wet GP6, Bot. 13": Light brown, Lean CLAY (CL), low plasticity, few fine grained sand, wet	*Was able to gather some sample from jammed inner liner as drilling tried to recover it.*
35								35.0 Boring Terminated at 35 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:18 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B404

Sheet 1 of 2

Date(s) Drilled	**September 29, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**30.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Sand**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**17 feet**		

Depth, feet	SAMPLES Type	Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 Orange to brown, Poorly graded SAND (SP), fine to coarse grained, few non-plastic fines, few fine grained gravel, moist	*Vacuumed to 6 feet.*
5								
		GP1			41		Light brown, Poorly graded SAND (SP), fine to medium grained, trace fines, moist	
10		GP2			60		GP2, Top 38": Similar to GP1, moist	*Pushed 3.25" casing to 20 feet.*
							13.0 GP2, Bot. 27": Grey, Silty SAND (SM), fine grained, some non-plastic fines, moist	
15		GP3			60		15.0 GP3- Top 12": Light brown, Poorly graded SAND (SP), fine to medium grained, trace fine grained gravel, trace fines, moist 16.0 GP3, Bot. 48": Light brown, Silty SAND (SM), fine grained, seams of coarse grained sand, some non-plastic fines, wet	
20		GP4			42		Light brown, Silty SAND (SM), fine grained, some non-plastic fines, wet	
25		GP5			37		Light brown, Silty SAND (SM), fine grained, few coarse grained sand seams, some non-plastic fines, wet	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:24 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B404

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
	GP	5			37			
30							30.0 Boring Terminated at 30 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:24 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B405

Sheet 1 of 1

Date(s) Drilled	**September 26, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**15.0´ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 Dark brown, Poorly graded SAND (SP), trace roots, trace gravel, trace fines, moist (TOPSOIL) 0.2	*Vacuumed to 6 feet.*
							Orange to brown, Poorly graded SAND (SP), trace gravel, trace fines, moist	
5							Light brown, Poorly graded SAND (SP), fine to medium grained, trace fines, moist	
		GP1			33			
10							GP2, Top 34": Light brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	
		GP2			40		GP2, Bot. 6": Light brown, Poorly graded SAND (SP), fine to medium grained, trace non-plastic fines, moist	
15							15.0 Boring Terminated at 15 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:30 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B406

Sheet 1 of 1

Date(s) Drilled	**September 29, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**9 feet**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								Dark brown, Poorly graded SAND (SP), trace roots, trace fines, moist (TOPSOIL) 0.0	*Vacuumed to 6 feet.*
								2.0	
5								GP1, Top 27": Light brown, Poorly graded SAND (SP), fine grained, trace fines, moist	
		GP1			48			GP1, Bot. 21": Brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, wet	
10								10.0 Boring Terminated at 10 ft bgs	

AECOM

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:33 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B407

Sheet 1 of 1

Date(s) Drilled	**September 28, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**20.0´ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 4 inches of ASPHALT 0.3 Dark brown, Poorly graded SAND (SP), fine to coarse grained, trace non-plastic fines, trace gravel, moist (FILL) 2.0 Orange to brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	*Vacuumed to 6 feet.*
5							6.0 Orange to brown, Well-graded SAND (SW), fine to coarse grained, few gravel, trace fines, moist	
		GP1			35			
10							10.0 GP2, Top 37": Orange to brown, Poorly graded SAND (SP), fine to coarse grained, few gravel, trace fines, moist	
		GP2			42		13.0 GP2. Bot. 5": Light brown, Silty SAND (SM), little non-plastic fines, moist	
15							15.0 GP3, Top 12": Light brown, Poorly graded SAND (SP), fine to coarse grained, few fine grained gravel, trace fines, moist	
		GP3			48		GP3, Bot. 36": Light brown to grey, Poorly graded SAND (SP), fine to medium grained, trace fines, moist	
20							20.0 Boring Terminated at 20 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:36 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B408

Sheet 1 of 1

Date(s) Drilled	**September 29, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								TOPSOIL 0.0	*Vacuumed to 6 feet.*
								2.0 Orange to brown, Poorly graded SAND (SP), fine to coarse grained, little gravel, few non-plastic fines, moist	
5									
		GP1			46			Orange to brown, Poorly graded SAND with Silt (SP-SM), fine to coarse grained, little gravel, few non-plastic fines, moist	
10								10.0 Boring Terminated at 10 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:39 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B409

Sheet 1 of 1

Date(s) Drilled	**September 29, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								0.0 TOPSOIL 1.0	*Vacuumed to 6 feet.*
								Orange to light brown, Poorly graded SAND (SP), fine to coarse grained, little fine gravel, trace non-plastic fines, moist	
5									
		GP1			44			GP1, Top 20": Orange to brown, Poorly graded SAND (SP), fine to coarse grained, little gravel, trace fines, moist GP1, Bot. 24": Light brown, Poorly graded SAND (SP), fine grained, trace fines, moist	
10								10.0 Boring Terminated at 10 ft bgs	

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B410

Sheet 1 of 1

Date(s) Drilled	**September 28, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**15.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Cold Asphalt Patch**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 4 inches of ASPHALT 0.3 Orange to brown, Silty SAND (SM), fine to medium grained, some non-plastic fines, little gravel, moist	*Vacuumed to 6 feet.*
5							6.0 GP1, Top 21": Grey to brown, SILT with Sand (ML), non-plastic, little fine grained sand, moist 7.8	
	GP1				48		GP1, Bot. 27": Light brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist 10.0	
10							GP2, Top 48": Grey to brown, SILT with Sand (ML), non-plastic, little fine grained sand, moist	
	GP2				60		14.0 GP2, Bot. 12": Light brown, Poorly graded SAND (SP), fine to medium grained, trace fines, moist 15.0	
15							Boring Terminated at 15 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:44 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B411

Sheet 1 of 1

Date(s) Drilled	**September 28, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Cold Asphalt Patch**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 6 inches of ASPHALT 0.5 Orange to brown, Silty SAND (SM), fine to coarse grained, little non-plastic fines, little gravel, trace cobbles, moist	*Vacuumed to 6 feet.*
5							6.0 Light brown to orange, Poorly graded SAND with Silt (SP-SM), fine to coarse grained, few non-plastic fines, few fine to coarse grained gravel, moist	
		GP1			48			
10							10.0 Boring Terminated at 10 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:47 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B412

Sheet 1 of 1

Date(s) Drilled	**September 28, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe 6620DT**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Cold Asphalt Patch**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**9 feet**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								0.0 8 inches of ASPHALT 0.7	*Vacuumed to 6 feet.*
								Orange to brown, Silty SAND (SM), moist	
5								6.0	
		GP1			38			GP1, Top 18": Orange to brown, Poorly graded SAND (SP), fine to medium grained, trace fines, moist GP1, Bot. 20": Light brown, Poorly graded SAND (SP), fine to medium, trace fines, wet	
10								10.0 Boring Terminated at 10 ft bgs	

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B413

Sheet 1 of 1

Date(s) Drilled	**September 30, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 TOPSOIL 0.3 Orange to brown, Poorly graded SAND with Silt (SP-SM), fine to coarse grained, few non-plastic fines, few gravel, moist	*Vacuumed to 6 feet.*
5							6.0 GP1, Top 21": Orange to brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist 7.8	
	GP	GP1			38		GP1, Mid. 6": Light brown to grey, Silty SAND (SM), fine grained, little non-plastic fines, trace gravel, moist 8.3 GP1, Bot. 10": Light brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	
10							10.0 Boring Terminated at 10 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:53 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B414

Sheet 1 of 1

Date(s) Drilled	**September 30, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**11.0′ bgs**
Drill Rig Type	**Geoprobe**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Cold Asphalt Patch**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 8 inches of ASPHALT 0.7 Orange to brown, Poorly graded SAND with Silt (SP-SM), fine to medium grained, few non-plastic fines, moist 1.7 2 inches of ASPHALT 1.8 Orange to brown, Silty SAND (SM), fine to medium grained, little non-plastic fines, moist	*Vacuumed to 6 feet.*
5							GP1, Top 12": Orange to brown, Silty SAND (SM), fine to medium grained, little non-plastic fines, moist 7.0 GP1, Bot. 48": Light brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	
	GP1				60			
10							11.0 Boring Terminated at 11 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:56 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B415

Sheet 1 of 1

Date(s) Drilled	**September 30, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Cold Asphalt Patch**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 12 inches of ASPHALT 1.0	*Vacuumed to 6 feet.*
							Orange to brown, Silty SAND (SM), little non-plastic fines, trace gravel, moist (FILL) 4.0	
5							Light brown, Poorly graded SAND with Silt (SP-SM), fine to medium grained, few non-plastic fines, moist	
		GP1			32		Orange to brown, Poorly graded SAND (SP), fine to medium grained, trace fines, moist	
10							10.0 Boring Terminated at 10 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:00:58 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B416

Sheet 1 of 1

Date(s) Drilled	**September 30, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								0.0 TOPSOIL 0.5	*Vacuumed to 6 feet.*
								Light brown, Silty SAND (SM), fine to coarse grained, little non-plastic fines, little fine to coarse gravel, trace cobbles, moist	
5									
		GP1			48			GP1, Top 36": Orange to brown, Silty SAND with Gravel (SM), fine grained, some non-plastic fines, little gravel, moist	
								9.0 GP1, Bot. 12": Light brown, Poorly graded SAND (SP), fine to coarse grained, trace gravel, trace fines, moist	
10								10.0 Boring Terminated at 10 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:01:01 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B417

Sheet 1 of 1

Date(s) Drilled	**September 30, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0´ bgs**
Drill Rig Type	**Geoprobe**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings & Cold Asphalt Patch**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 8 inches of ASPHALT 0.7	*Vacuumed to 6 feet.*
							Brown, Poorly graded SAND (SP), fine to medium grained, trace non-plastic fines, few fine grained gravel, trace cobbles, moist 2.7	
							Orange to brown, SILT with Sand (ML), non-plastic, little fine grained sand, trace gravel, moist	
5								
	GP1				48		GP1, Top 36": Brown, SILT with Sand (ML), non-plastic, little fine grained sand, moist 9.0	
							GP1, Bot. 12": Light brown to orange, Poorly graded SAND with Silt (SP-SM), fine to medium grained, few non-plastic fines, few gravel, moist 10.0	
10							Boring Terminated at 10 ft bgs	

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Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B418

Sheet 1 of 1

Date(s) Drilled	**September 26, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							0.0 Poorly graded SAND (SP), fine to coarse grained, little crushed stone, moist (FILL) 1.5	*Vacuumed to 6 feet.*
							Orange to brown, Poorly graded SAND (SP), fine to coarse grained, trace fines, moist	
5								
		GP1			35		Light brown, Poorly graded SAND (SP), fine to medium grained, trace fines, moist	
10							10.0 Boring Terminated at 10 ft bgs	

AECOM

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:01:07 PM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B419

Sheet 1 of 1

Date(s) Drilled	**September 26, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in		Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0								0.0	*Vacuumed to 4 feet.*
								Light brown, Silty SAND (SM), fine grained, some non-plastic fines, moist	
5								Light brown, Silty SAND (SM), fine grained, some non-plastic fines, few gravel, moist	
		GP1							
10								10.0 Boring Terminated at 10 ft bgs	

Report: GEO_CR_WITH_N_VALUE; File C:\USERS\BIVIAN.REYES\DESKTOP\ORLEANS MEETING HOUSE POND.GPJ; 10/25/2022 3:01:10 PM

AECOM

Project: Meetinghouse Pond
Project Location: Orleans, MA
Project Number: 60652634

Log of Geoprobe B420

Sheet 1 of 1

Date(s) Drilled	**September 28, 2022**	Logged By	**E.daSilva**	Checked By	**B. Reyes**
Drilling Method	**Probe**	Drill Bit Size/Type	**N/A**	Total Depth of Borehole	**10.0′ bgs**
Drill Rig Type	**Geoprobe**	Drilling Contractor	**Geologic**	Surface Elevation	
Borehole Backfill	**Soil Cuttings**	Sampling Method(s)	**1 3/4" Direct Push**	Hammer Data	**N/A**
		Groundwater Level(s)	**Not encountered**		

Depth, feet	SAMPLES Type	SAMPLES Number	SPT Blows/6 in.	SPT N-Value (Uncorrected)	Recovery, in	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER DETAILS
0							Light brown, Sandy SILT (ML), non-plastic, little sand, little gravel, moist (0.0)	*Vacuumed to 3 feet.*
5	GP1				55		GP1, Top 43": Light brown, Sandy SILT (ML), non-plastic fines, little fine grained sand, few gravel, moist (9.0)	
10							Light brown, Poorly graded SAND (SP), medium grained, trace fines, moist (10.0)	
							Boring Terminated at 10 ft bgs	

AECOM

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SECTION 01311

CONSTRUCTION PROGRESS SCHEDULES

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PART 1 - GENERAL

1.01 - SCOPE

A. The work covered by this section of the specifications includes furnishing all labor, equipment, tools, and materials, and in performing all operations in connection with developing and updating construction progress schedules.

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

1.02 - MEASUREMENT AND PAYMENT

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

B. No payment shall be made for any work on this project unless these requirements have been met.

1.03 - DEFINITIONS

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

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

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

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

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

C. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

D. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise accepted by Engineer.

E. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

F. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

G. Event: The starting or ending point of an activity.

H. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

I. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.04 - SUBMITTALS

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

B. Construction Progress Schedules includes administrative and procedural requirements for documenting the progress of construction during performance of the Work and shall include at least the following:

1. Startup construction schedule. Within 15 days after execution of the Agreement, submit preliminary schedule indicating planned operations during first 60 days. Include cost of activities expected to be completed before submission and acceptance of the complete schedule.

2. Contractor's construction schedule. Initial schedule, of size required to display entire schedule for entire construction period.

3. Monthly construction schedule updating reports. Submit with Applications for Payment.

4. Daily construction reports. Submit weekly.

5. Material location reports.

6. Site condition reports. Submit at time of discovery of differing conditions

7. Special reports. Submit at time of unusual event

1.05 – PRODUCT HANDLING – Not Used

1.06 – DESIGN CRITERIA – Not Used

1.07 - QUALITY ASSURANCE

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

1.08 - COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.01 - CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 working days, unless specifically allowed by Engineer.

2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, acceptance, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in DIVISION 1 - GENERAL REQUIREMENTS, SECTION 01300, SUBMITTALS in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.

4. Startup and Testing Time: Include no fewer than 45 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.

6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

a. Limitations of continued occupancies.

b. Uninterruptible services.

c. Partial occupancy before Substantial Completion.

d. Use of premises restrictions.

e. Seasonal variations.

2. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.

b. Completion of mechanical installation.

c. Completion of electrical installation.

d. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.

2. Unanswered Requests for Information.

3. Rejected or unreturned submittals.

4. Notations on returned submittals.

5. Pending modifications affecting the Work and Contract Time.

F. Recovery Schedule: When periodic update indicates the Work is 10 or more working days behind the current accepted schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, as well as the date by which recovery will be accomplished.

G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.02 - STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within 15 days of date of execution.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.03 - CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.04 - REPORTS

A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.05 - SPECIAL REPORTS

A. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable. Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Weekly Look Ahead Schedule – The Contractor shall prepare and submit a Weekly Look Ahead Schedule for all crews on the Thursday prior to the next week. Failure to comply with this requirement will result in no payment for work performed.

PART 3 - EXECUTION

3.01 - CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.

3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of accepted schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

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SECTION 01400

QUALITY ASSURANCE

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes preparation and implementation of the Quality Assurance Program.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Within 20 days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner, for review and comment, a draft of the Contractor's CQC program.
2. Prior to commencement of the work but not later than 60 days after the Notice to Proceed, the Contractor shall submit to the Owner for review the following:
    a. The CQC program.
    b. An inspection and test index identifying all required inspections and tests to be performed under the Contract Documents and the CQC program.
    c. Those implementing procedures required for quality control of Work scheduled to be performed within 180 days after receipt of the Notice to Proceed together with a schedule of Contractor procedures for the balance of Work activities.
    d. A list of all quality records that are to be developed and turned over to the Owner as a result of implementing the quality control program and procedures.

3. The Contractor shall submit any revisions or changes to the CQC program or implementing procedures previously submitted to and reviewed by the Owner.
4. Resumes of the QC Manager and Resident inspection personnel shall be submitted and reviewed prior to their commencement of work.
5. Prior to Subcontractors' and suppliers' commencement of work for which their own quality control (SQC) program will be implemented, the Contractor shall review, approve and submit to the Owner for review the SQC program and the resumes of the SQC Manager and Resident inspection personnel to be used.
6. During performance of Contract Work, the Contractor shall submit the following to the Owner for information and as a condition of payment:
    a. Monthly quality control reports as specified herein.
    b. Copies of inspection and test results.
    c. Manufacturer representative reports (in duplicate) within 10 days of each field visit as specified herein including final reports which certify that equipment or systems have been satisfactorily installed and are functioning correctly. If the duration of field visits are greater than one week, the Contractor shall submit weekly reports.

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA – Not Used

1.07 - REFERENCED STANDARDS

A. The Contractor shall indicate any instance where specified reference standards conflict with Contract Documents and request clarification from Owner before proceeding.

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

1.08 - QUALITY CONTROL AND CONTROL OF WORK

A. The Contractor shall control the quality of Work including work of its Subcontractors and suppliers. The Contractor shall develop and maintain a quality control program which complies with the requirements of this Section. The Contractor Quality Control (CQC) program shall explain the Contractor's approach to on-site quality control, off-site quality control, the CQC organization, documentation of quality control activities, and provide all other information necessary to demonstrate to the Owner that the Contractor and its Subcontractors and suppliers will provide quality control services that comply with the Contract Documents. The CQC program shall identify the Contractor's individuals responsible for the execution of the program and identify those Subcontractors/suppliers working to the CQC program and those working to their own Subcontractor/Supplier Quality Control (SQC) program. The Quality Control programs shall apply to the control of quality throughout all areas of contract performance including the procurement, identification, stocking, and issue of material; the entire process of construction; and the installation and testing of equipment.

B. Overall administration of the CQC program shall be vested in an element of the Contractor's organization, hereinafter referred to as the QC Organization, under a QC Manager who has clear access to senior level offsite home office management and to Subcontractors' officers responsible for the execution of the SQC Program. The QC Manager shall manage and administer the CQC program. The QC Manager shall be assigned full time to the Project for the duration of the Contract, shall be on-site at all times and shall have no other duties in the company. The Contractor shall perform the work covered by this Section with a QC Manager having five (5) years of experience, all in the last ten (10) years, in quality control management of resident inspection personnel performing quality control inspection on construction Projects, and with a staff of resident inspection personnel each having three (3) years of experience, all in the last ten (10) years, in quality control inspection on construction Projects. The staff of resident inspection personnel shall inspect the Work in process for completeness and acceptance including multi shift Work and multi operations occurring concurrently. The size and composition of the resident inspection staff may vary as the job progresses but at all times it shall be compatible with the level of effort and capability required by the Contract and construction schedule.

C. The QC Organization shall consistently maintain quality requirements and shall be independent from that portion of the Contractor's organization responsible for production.

D. Written quality control inspection and test procedures shall be used for all operations. These procedures shall contain instructions for performing the required inspection or test, contain the accept/reject criteria for each inspection or test activity (i.e., applicable drawing, specification section, industry code or standard), shall establish the frequency for performing the inspection or test, and shall provide for recording the results of inspections and tests on checklists. These procedures shall be available at all locations where inspections and tests are to be performed. Payment will not be processed until these procedures are submitted to and reviewed by the Owner.

E. The Contractor's procurement documents shall require subcontractors and supplies to implement their own (SQC) program or require them to implement the CQC Program. Copies of the Contractor's procurement documents shall be provided to the Owner in accordance with the requirements specified herein. The Contractor shall comply fully with manufacturers' instructions, including completing each step-in sequence. Should manufacturers' instructions conflict with Contract Documents, the Contractor shall request clarification from the Owner before proceeding.

F. Work to be done away from the construction site is subject to inspection by the Owner during its fabrication, manufacture, testing, or before shipment. The Contractor shall give notice to the Owner of the place and time where such fabrication, manufacture, testing, or shipping is to be done. Such notice shall be in writing and delivered to the Owner in accordance with SECTION 01680, PHYSICAL CHECKOUT, SHOP, FIELD AND FUNCTIONAL TESTING so that the necessary arrangements for inspections and witnessing of shop tests can be made. The Owner has the right but not the responsibility to perform inspection or to witness tests. The Owner's right to perform inspection or to witness tests does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents.

G. The Owner has the right to perform inspections, witness tests, or otherwise monitor or assess the Work and activities. The Owner's right to perform inspections, witness tests, or monitor or assess the Work and activities does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents nor does it imply completion of the work.

H. Procedures shall be established for controlling the identification, inspection status, handling, and storage of raw and fabricated material. These controls shall be maintained from the time of receipt of the material until delivery to the Owner, in order to protect the material from damage, deterioration, loss or substitution.
The Contractor shall maintain control over construction and installation processes to assure compliance with specified requirements. In-process and final inspection and testing of construction shall be performed in accordance with written implementing quality control inspection and test procedures to assure that contract requirements have been met. The results of in-process and final inspections shall be recorded on inspection checklists developed by the Contractor and reviewed by the Owner.

I. The CQC and SQC programs are subject to periodic audit by the Owner to assure compliance with the Contract Documents. However, audit by the Owner does not relieve the Contractor of the requirements for the CQC and SQC programs.

J. Monthly quality control reports shall be submitted as specified herein and shall address: status of the Contractor quality control program including procedure development, status of Subcontractor/supplier quality control programs and procedures, number of inspections and tests performed during the month, unsatisfactory and nonconforming items identified as well as those that remain open or were closed during the month, and any other quality problems experienced.

1.09 - QUALITY ASSURANCE/CONTROL OF SUBCONTRACTORS/SUPPLIERS

A. The Contractor shall be responsible for controlling the quality of Work performed by its Subcontractors and suppliers. Unless Subcontractors and suppliers implement their own quality control (SQC) program, approved by the Contractor and reviewed by the Owner, the Contractor shall instruct the Subcontractor or supplier to implement the CQC program on all Work performed and the Contractor shall perform the Quality Control inspections of the Subcontractor's or supplier's Work and activities at their facilities. The CQC program shall list all Subcontractors and suppliers and identify which quality program, CQC or SQC, they are to implement.

1.10 - OWNER FURNISHED TESTING AND INSPECTION SERVICES

A. The Contractor shall furnish a construction schedule and a minimum of 48-hour notice of readiness for testing and inspection of the work. The Owner shall determine the exact time and location of field sampling and testing, and may require such additional sampling and testing as necessary to determine that materials and equipment conform with data previously furnished by Contractor and with the Contract Documents.

B. The Contractor shall schedule the work to permit adequate time for testing and re-testing should test results not conform to the contract documents. Lack of testing or inspection which is attributable to insufficient notice by the Contractor or failure of the Contractor to cooperate, will be cause for rejection of the work.

C. The Contractor shall deliver materials in sufficient quantities to the Owner testing agency as may be required. Laboratory testing shall be performed within a reasonable time, consistent with the specified standards.

D. The Contractor shall furnish material samples and cooperate in the field sampling and testing activities. The Contractor shall furnish personnel, facilities and access to assist in the sampling and testing activities.

1.11 - CONTRACTOR'S ON-SITE QUALITY CONTROL TESTING AND INSPECTION

A. The Contractor shall perform inspections, tests, and other services required by the Contract Documents, the CQC programs, and in accordance with all applicable laws, codes, rules, and regulations and document the results on checklists as specified herein.

B. The Contractor shall provide 48 hour notice to the Owner so that the Owner may witness Contractor’s on-site inspections and tests. The Owner's witnessing of inspections and tests does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents.

C. The Contractor shall develop an inspection and test index identifying all required inspections and tests as indicated in the Contract Documents and the CQC program. This index shall be submitted to the Owner for review and be included as part of the CQC program. The Contractor shall provide the original inspection and test results upon completion to the Owner witnessing the inspection or test.

1.12 - OWNER QUALITY CONTROL ACTION ITEMS

A. The Contractor shall promptly undertake appropriate action, at no additional cost to the Owner, to respond and correct any unsatisfactory, nonconforming, or otherwise deficient conditions reported to the Contractor by the Owner. These conditions may be identified as a result of Owner inspections, audits or surveillances.

1.13 - MANUFACTURERS' FIELD INSTALLATION SERVICES AND REPORTS

A. When specified in the Contract Documents, the Contractor shall require material or product suppliers and manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, (test, adjust, and balance of equipment) and to provide instructions for installation.

B. The Contractor shall report to the Owner in writing any observations and site decisions or instructions given by the manufacturer’s representatives to the Contractor that are supplemental or contrary to manufacturers' written instructions.

C. The Contractor shall submit manufacturer representative reports (in duplicate) within 10 days of each field visit, to the Owner for review. If the durations of field visits are greater than one week, the Contractor shall submit weekly reports. Final report shall certify that the equipment or systems have been satisfactorily installed and are functioning correctly.

PART 2 - PRODUCTS AND SERVICES – Not Used

PART 3 - EXECUTION

3.01 - GENERAL

A. Inspections and tests shall be made by the Contractor and the appropriate documentation produced as each element of Work is executed.

3.02 - CONTRACT CLOSEOUT

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

END OF TEXT

SEE ATTACHMENT A – ELEMENTS OF A QUALITY CONTROL PROGRAM

ATTACHMENT A - ELEMENTS OF A QUALITY CONTROL PROGRAM

A-1 - INTRODUCTION

A. The Quality Control Program is the basic quality document for the construction of a Project, and it identifies quality program commitments. The Quality Control Program assigns responsibilities, authority levels, and interface requirements for activities, which affect quality. Activities which affect quality are those activities which affect the features and characteristics important to the equality of an item, such as soil compaction, concrete curing, etc. The Quality Control Program serves as the basis for Quality Control Procedures, which contain the administrative and implementation requirements for quality control activities.

B. A Quality Control Program must address the following program topics/elements as they relate to the equipment, material or service being furnished:

1. Organization
2. Quality Assurance Program
3. Design Control
4. Control of Procurement Documents
5. Instruction and Procedures
6. Control of Documents
7. Control of Material, Equipment, and Services
8. Survey/Field Coordination
9. Control of Special Processes
10. Inspection and Tests
11. Unsatisfactory/Nonconformance Control
12. Quality Control Records
13. Surveillance and Audits
14. Attachments:
    a. Inspection Report
    b. Nonconformance Report
    c. List of Procedures
    d. List of Subcontractors and Suppliers and applicable QC program
    e. List of inspections and tests
    f. List of QA Records

A-2 - ORGANIZATION

A. This section the QC program must:

1. Specify that the responsibility for the program is retained and exercised by the Contractor.
2. Describe how responsibility is exercised for the overall program including oversight, and how the Contractor evaluates the performance of work by the delegated organization.
3. Describe lines of communication between the contractor/suppliers to assure quality control program direction.

4. Contain organization charts clearly identifying all on-site and off-site organizations which function under the cognizance of the quality control program (such as design, engineering, procurement construction, subcontractors, suppliers, etc.), lines of responsibility and a description of the size of the quality control organization including the inspection staff.
5. Describe the delegation of contract work and the quality control responsibility for the quality control program and which:
    a. Is at the same or higher organizational level as the highest line manager responsible for contract activities affecting quality.
    b. Has communications with other senior management positions.
    c. Has responsibility for approval of QC Manual(s).
    d. Has no other duties or responsibilities.
    e. Has access to senior level management to identify quality problems; initiate, recommend or provide solutions to problems; and verify implementation of solutions.
6. Require that verification of conformance to established requirements is accomplished by individuals or groups within the QC organization who do not have direct responsibility for performance of the work being verified and are independent from that portion of the contractor's organization responsible for production.
7. Assure that QC personnel are sufficiently free from direct pressures due to cost/schedule, and have the responsibility delineated in writing to stop unsatisfactory work and control further processing, delivery, or installation of nonconforming material.
8. Document and make mandatory the corporate level policies regarding the implementation of the QC program.

A-3 - QUALITY CONTROL PROGRAM

A. This element of the program must:
1. Describe the scope of the QC program applicability.
2. Establish provisions to assure that quality-affecting procedures required to implement the QC program are consistent with QC program commitments and corporate policy and are properly documented, controlled, and made mandatory through signature of the responsible official.
3. Provide for the submittal of quality affecting procedures to the Authority for review with documented agreement of acceptance prior to initiation of activities affected by the program and procedure.
4. Address how management regularly assesses the scope, status, adequacy and compliance of the QC program to the contract requirements.
5. Establish requirements for training such that:
    a. Personnel performing quality-affecting activities are instructed as to the purpose, scope and implementation of the quality control program and procedures.
    b. Personnel verifying activities affecting quality are trained and qualified in the principals, techniques, and requirements of the activity being performed.
    c. Documentation of training and qualification including the subject, content of the training, attendees, and date of attendance is maintained.

A-4 - CONTRACTOR DESIGN CONTROL

A. This element of the program must:

1. Describe the scope of design control, if any, including Contractor's design activities associated with the preparation and review of design documents including the correct translation from the contract documents.

2. Define the organizational responsibilities for preparing, reviewing, approving and verifying design documents.

3. Establish internal and external design interface controls, procedures, and lines of communication among participating design organizations and across technical disciplines.

A-5 - PROCUREMENT DOCUMENT CONTROL

A. This element of the program must:

1. Require that procurement documents are reviewed to determine that quality requirements are correctly stated, inspective and controllable; and there are adequate acceptance and rejection criteria.

2. Require that procurement documents, to the extent necessary, require suppliers and subcontractors to provide an acceptable quality control program.

3. Assure that procurement documents identify applicable technical, administrative and reporting requirements; drawings, specifications; codes and industrial standards; test and inspection requirements; and special process instructions that must be complied with by suppliers.

4. Require procurement documents to indicate that the work is subject to inspection by the Contractor and others on behalf of the Authority during its fabrication, manufacture, testing, or before shipment.

A-6 - INSTRUCTION AND PROCEDURES

A. This element of the program must:

1. Describe organizational responsibilities for assuring that activities affecting quality are prescribed by documented instructions and procedures and that the activities are accomplished through implementation of these documents.

2. Require that instructions and procedures be developed that include quantitative (such as dimensions, tolerances, and operating limits) and qualitative (such as workmanship samples) acceptance criteria for determining that important activities have been satisfactorily accomplished.

3. List, as an attachment, all quality administrative and quality-affecting procedures developed or to be developed to implement the program.

A-7 - DOCUMENT CONTROL

A. This element of the program must:

1. Describe the scope of the document control program and identify the types of documents to be controlled. Controlled documents shall include:

a. Design documents (e.g., calculations, drawings, specifications, analyses).

b. Instructions and procedures for such activities as fabrication, construction, modification, installation, test and inspections.

c. As-built documents.

d. Quality control manuals and quality-affecting procedures.

2. Establish procedures for:

    a. Assurance that changes to documents are reviewed and approved by the same organizations that performed the initial review and approval.

    b. Assurance that the documents are available at the location where the activity will be performed and obsolete documents are removed.

A-8 - CONTROL OF MATERIAL, EQUIPMENT AND SERVICES:

A. This element of the program must:

1. Describe the organizational responsibilities for the procurement of material, equipment and services including the interface between the design, procurement and QC organizations.

2. Describe requirements for verification of subcontractors' and suppliers' activities during fabrication, inspection, testing and shipment of materials, equipment and components by the QC organization in accordance with written procedures to assure conformance to the procurement document.

3. List, as an attachment, all subcontractors and suppliers to be utilized on the project and indicate whose QC program will be implemented on the work.

4. Require receiving inspection by the QC organization to assure:

    a. Material, equipment and components are identified and conform to the procurement document requirements.

    b. That the supplier furnished the documentation required by the Contract and procurement documents and that the documentation identifies the purchased item and the specific procurement requirements (e.g., codes, standards, and specifications) met the item.

5. Describe the measures for the control and identification of materials, equipment, parts, and components to preclude the use of incorrect or defective items. When Contract Documents require to be traceable in order to show locations, heat numbers, chemical analysis, physical properties or other inspection/test results for materials used, the Program must:

    a. Establish procedures to assure that identification is maintained either on the material item or on records traceable to the material/item.

    b. Require that correct identification of material items is verified and documented prior to release for fabrication, assembly, shipment and installation.

    c. Require identification to be traceable to the appropriate drawings; specifications; purchase/manufacturing/inspection documents; and physical/chemical test reports.

6. Describe the control of the handling and storage of material, equipment, and components to assure that they are protected from damage, deterioration, loss or substitution and installed in accordance with the design drawings.

A-9 - SURVEY/FIELD COORDINATION

A. This element of the Program must:

1. Describe the organizational responsibilities for the control of survey accuracy and integrity.

2. Establish a procedure for surveying which addresses:

    a. Verification of the continuing accuracy and integrity of both horizontal and vertical surveys.

    b. Establish control traverse, baseline and benchmarks.

    c. Performance of survey checks of detailed layout of the work and accuracy of preparations for field installations as work progresses.

    d. Verify dimensional location and tolerances of completed work.

3. Require preparation of as-built plans.

A-10 - CONTROL OF SPECIAL PROCESSES

A. This element of the Program must:

1. Contain a listing of those processes that are controlled as special processes.
2. Describe the organizational responsibilities including those of the QC organization for qualification of the special process, equipment, and personnel, in accordance with the applicable codes, standards, QC procedures and specifications.
3. Establish requirements for performance of the special process using qualified procedures, equipment and personnel, including documentation of the results.
4. Establish requirements for retention of qualification records of procedures, equipment and personnel associated with special processes.

A-11 - INSPECTION AND TESTS

A. This element of the Program must:

1. Describe the scope of the inspection and test program and the organizational responsibilities for performing inspection and tests.
2. Require that individuals performing inspections and tests be independent of those who performed or directly supervised the activity being inspected.
3. Establish and document the qualification requirements for inspectors, including Non-Destructive Testing (NDT) personnel, and test personnel.
4. Establish procedures for calibration (technique and frequency), maintenance, and control of measuring and test equipment (instruments, tools, gages, fixtures, etc.) used in acceptance measurement, inspection and testing. The Program/Procedures must:
    a. Require the identification and be able to trace Measuring and Test equipment to the calibration test data.
    b. Specify intervals of calibration based on the required accuracy, purpose, usage or other conditions affecting the measurement.
    c. Require calibration against standards that have a higher degree of accuracy then the Equipment being calibrated to assure that the Equipment being calibrated will be within required tolerance.
    d. Require reference and calibration standards to be traceable to nationally recognized Standards.
5. Require preparation of inspection and test procedures, instructions, or checklists which require:
    a. Identification of characteristics and activities to be inspected or tested.
    b. Describe the method for performing tests or inspections.
    c. Acceptance and rejection criteria.
    d. Prerequisites such as calibrated measuring and test equipment and instrumentation.
    e. Method of recording or documenting inspection and test results and data.
6. Determine acceptability of inspection results or test data and results.

A-12 - UNSATISFACTORY/NONCONFORMANCE CONTROL

A. This element of the Program must:

1. Establish procedures for identification, documentation, segregation, review, disposition and notification to affected organizations of unsatisfactory and nonconforming materials, parts, components, and services, if disposition is other than to scrap.

2. Require re-inspection of items reworked, repaired or replaced to determine compliance with contract documents or approved engineering dispositions.

3. Require nonconformances or unsatisfactory conditions to be corrected or resolved prior to the initiation of pre-operational tests on the item.

A-13 - QUALITY CONTROL RECORDS

A. This element of the Program must:

1. Describe the scope of the QC Records including a list of the record types, which will be generated as a result of implementing the program. QC records include results of reviews, assessments, inspections, tests, audits and surveillances; material analysis; monitoring of work performance; qualification of personnel, procedures and equipment; and other documentation such as drawings, specifications, procurement documents, calibrations procedures and reports, nonconformance reports and corrective action reports.

2. Identify the organizational responsibilities for the implementation and retention activities related to QC records including turnover to the Authority.

A-14 - SURVEILLANCE AND AUDITS

A. This element of the Program must:

1. Require an audit of the QC program on an annual basis by personnel having no direct responsibilities for the area being audited.

2. Establish requirements and procedures describing the audit and surveillance programs which includes:

a. Performance of audits and surveillances to pre-established written procedures or checklists by trained personnel having no direct responsibilities in the areas being evaluated.

b. Analysis of data.

c. Issuance of reports to appropriate management for action, review and assessment.

d. Tracking of deficient areas until satisfactory resolution.

e. Re-audit of deficient areas to verify correction and closure.

A-15 – SUBMITTALS

A. Submit the following:

1. Inspection Report

2. Nonconformance Report

3. List of Procedures

4. List of Subcontractors and Suppliers and applicable QC program

5. List of QA Records

END OF ATTACHMENT

SECTION 01500

TEMPORARY FACILITIES

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PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes the furnishing of all labor, tools, equipment and materials, performing all operations necessary to provide temporary facilities as specified herein and as directed by the Engineer.

B. The materials covered by this specification are intended to be standard materials of proven ability as manufactured by reputable concerns. Materials shall be designed and constructed in accordance with the best practice of the industry and shall be installed in accordance with the manufacturer's recommendations. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS – Not Used

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

1.06 - DESIGN CRITERIA

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

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

PART 2 - PRODUCTS

2.01 - TEMPORARY BUILDINGS

A. Furnish temporary offices, storage and fabrication facilities as required and obtain all necessary applicable permits and/or approvals required for their use. Such buildings shall be located as required and as to not interfere with the work of the project and shall be completely removed at the completion of the work.

B. Engineer's Field Office

1. Provide at the start of the work and for the duration of the project, unless otherwise directed, a field office for the use of the Engineer. The office shall be of approximately 500 square feet divided into three rooms plus a lavatory with hot and cold running water and a closet. Legally dispose of sanitary wastes. The office and rooms shall be constructed in a manner, and of materials, satisfactory to the Engineer. Office shall be weathertight with a minimum of six windows and two exterior doors. The office shall be adequately lighted for detailed working conditions, heated and air conditioned during the appropriate seasons (each room to be individually controlled). Thoroughly clean and mop the trailer on a weekly basis and shall restock all paper products such as but not limited to cups, towels, toilet paper, office copy paper, printer paper and plastic liners for waste baskets.

   a. The rooms shall be designated Room "A", Room "B" and Room “C” and of the approximate sizes: Room "A" - 100 square feet, Room "B" - 300 square feet and Room “C” – 100 square feet. Separate entrances shall be provided to each Room.

   b. Furniture, furnishings and equipment subject to approval of the Engineer, shall be provided in the designated rooms as follows:

      (1) Room "A"

      1 - Executive desk

      2 - Executive chairs

      1 - Bookcase (6' high x 3' wide)

      1 - 4 drawer steel files (locking, legal size)

      1 - Waste basket

      1 - Cordless telephone (with hands free speaker and speed dialing)

      1 - Telephone answering machine with recorder

      1 - Dell All-In-One Printer 962 or equal.

      (2) Room "B"

      3 - Tables (2'-6 x 6'-0)

      1 - Plan table (3’-0” x 4’-0”)

      1 - Plan rack (mobile stand and handling clamps by rack manufacture)

      2 - 4 drawer steel files (locking, legal size)

      12 - Folding metal chairs

      1 - Water Cooler/Heater with up to ten 5-gallon supply containers furnished per month for the duration of the contract

      1 - 18 cubic foot refrigerator

      1 - Small microwave oven

      1 – Black and White and Color copy machine, self-feeding, with 8-1/2" x 11" and 11" x 17" printing capability, enlargement/reduction capability and scanning capability; provide cartridges, toner, paper, etc., for the project duration

      1 – Wi-Fi service (commercial grade with wireless router)

      1 - Push broom and dust pan

      1 - First aid kit

      1 - Fire extinguisher

      1 - Waste basket

1 - Canon Power Shot ELPH 180 - digital camera or equal

(3) Room "C"

1 - Executive desk

2 - Executive chairs

1 - Bookcase (6' high x 3' wide)

1 - 4 drawer steel files (locking, legal size)

1 - Waste basket

1 - Cordless telephone (with hands free speaker and speed dialing)

3. The Engineer's Field Office shall be located at the work site where it will not interfere with the construction work. Space shall be provided with crushed stone base for at least three vehicles adjacent to the office for the exclusive use of the Engineer and visitors. Remove snow, mud, and control dust in the parking area adjacent to the office.

2.02 - TEMPORARY OPERATIONS

A. General

1. The Contractor shall conduct operations in such a manner and sequence that shall neither result in a disruption of the amenities, nor interfere with the functional organization and workings of existing infrastructure.

2. The Contractor is required to provide all temporary facilities required to maintain the operation of the existing infrastructure.

3. The Contractor shall prepare a carefully planned and detailed construction schedule showing the proposed sequences of operation and the methods to be used for maintaining continued operations of existing infrastructure. No payment will be made until the carefully planned and detailed construction schedule has been developed by the Contractor and approved by the Owner and the Engineer. The following provides the minimum requirements to be addressed by the Contractor while preparing the construction schedule. It should be noted that the following is not intended to be all inclusive.

B. In order to maintain continuous operations during construction (if applicable), the Contractor is required to furnish, install, maintain and remove all necessary temporary by-pass systems. The Contractor shall fully maintain the temporary by-pass systems at all times. The temporary by-pass systems shall include, but is not limited to, piping, valves, flow control devices, electrical connections, and power supply, if necessary. The temporary by-pass equipment shall remain in operation and be fully maintained by the Contractor until the applicable equipment or system has been approved by the Engineer and approved by the Owner.

PART 3 - EXECUTION

3.01 - TELEPHONE SERVICES

A. Provide separate temporary telephone services in the field offices for use by the Contractor, subcontractors and the Engineer up to the time of final acceptance of the project.

B. The Engineer's Field Office shall be provided with one telephone line.

3.02 - WATER

A. Make connections to the nearest municipal water supply and use this supply for construction purposes. Any portions, which are to become a part of the permanent system, shall conform to the applicable sections of these specifications.

B. Furnish, maintain and subsequently provide the water meters and backflow preventers at each location. Furnish all extensions required. Provide drinking water, satisfactorily cooled.

3.03 - ELECTRICITY

A. Arrange for, furnish and maintain all expenses for all electricity required for proper lighting, the use of power tools, for temporary heat for construction operations and for field offices up to the time of final acceptance of the project.

B. Furnish all wiring, fixtures, lamps and other accessories required for his or his subcontractors' work, and for proper lighting, the use of power tools and for temporary heat for construction operations up to the time of final acceptance. Power shall be obtained directly from power company lines or from portable, gasoline driven generator sets.

3.04 - SANITARY CONVENIENCES

A. Provide sanitary conveniences for the duration of the project for the use of all persons employed on the project, including all other contractors and subcontractors.

B. Sanitary conveniences shall be properly screened from public observation, provided in sufficient numbers, and in such manner and at such points as shall be approved by the Engineer and/or Owner. The contents shall be removed and legally disposed of at a frequency acceptable to the public health agency having jurisdiction or as required.

3.05 - PROJECT SIGNS

A. Contractor shall provide Project Sign(s) in accordance with SECTION 00902, PROJECT SIGN.

3.06 - BARRICADES AND GUARD LIGHTS

A. Barricades, signs, fences and similar safety and warning devices shall be provided as required, in order to insure the protection of employees and others concerned with their duties and presence on the premises at the project site.

B. Provide and maintain guard lights at all barricades, obstructions in plant ways, and at all trenches and pits adjacent to traveled ways.

3.07 - TEMPORARY HEAT

A. During the months of October through April, provide heat, fuel and services necessary to protect all of the work and materials against injury from dampness and cold and to maintain temperature above 55 degrees F in all enclosed portions of the project. Provide temporary heating devices, electrical power, adequate and proper fuel, fire enclosures, and the like, as required for the work of all trades, and shall have watchmen constantly in attendance when fires are burning. Only Underwriters' Laboratory approved equipment shall be used. Open salamanders will not be allowed.

B. The permanent heating system may be used for temporary heat prior to the occupancy of the buildings by the Owner, or as otherwise approved by the Engineer, however, the use of permanent equipment for temporary heat purposes shall not affect the guarantee period stated elsewhere in these specifications. Operate and maintain the heating system (including fuel) and the equipment used for temporary heat until final completion of the project, and repair and replace all items damaged during temporary use. Clean all of the permanent heating equipment if it is used for temporary heat before turning the system over to the Owner.

3.08 - TEMPORARY CLOSURES

A. Temporary doors and closures for all openings shall be furnished and installed to keep out inclement weather and intruders until the permanent units are installed. Any loss or damage caused by failure to comply with the above provisions shall be replaced and/or repaired at no additional cost to the Owner.

3.09 - SCAFFOLDING

A. Furnish, erect, maintain in a safe condition and remove all scaffolding required for the execution of the work not specified as being furnished under other sections herein.

B. Neither the Engineer nor the Owner will act as an arbitrator on questions of whether the Contractor or any of his subcontractors shall furnish or remove scaffolding required for any portion of the work.

3.10 - SHELTER AND PROTECTION OF MATERIALS

A. Provide adequate storage facilities for all materials required for the work. The facilities shall be enclosed, heated and provided with moisture control, as required to provide adequate protection and shall be satisfactory to the Engineer.

3.11 - BRACING, SHORING AND SHEETING

A. Provide all bracing, shoring and sheeting as required for safety and for the proper execution of work. Unless otherwise ordered by the Engineer, all bracing, shoring, and sheeting shall be removed when work is completed.

END OF SECTION

SECTION 01570

TRAFFIC MANAGEMENT AND MAINTENANCE

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PART 1 - GENERAL

1.01 - SCOPE

A. The work under this section includes furnishing all engineering, materials, labor, and equipment required for traffic management and maintenance on state highways and/or municipal roadways within the limits of construction under this contract.

B. All practices and traffic control devices shall conform to the relevant provisions of the Manual on Uniform Traffic Control Devices, latest edition and State of Massachusetts Department of Transportation (hereinafter called State) Standard Specifications for Road and Bridge Construction.

C. Develop a traffic management plan to be reviewed and approved by the Owner, state, local, and/or jurisdictional agencies as appropriate. The traffic management plan shall meet with standard practices of the above references, requirements of this specification, and special requirements required by the project.

D. Furnish adequate notice to police and fire departments, public transportation authorities, and school departments/districts of the proposed traffic maintenance plan including, but not limited to, detours, lane closures, and alternate routes.

E. Furnish, erect and maintain traffic control devices, as required by the traffic maintenance plan. Provide traffic control devices including lights, markings, barricades, warning signs, and all other safety precautions necessary to protect streets, sidewalks, access to adjoining property, and the traveling public within the area of the construction. Reference is made to the drawings for general guidelines for typical traffic control devices and their placements. These are intended as a guide only, and do not necessarily include all possible warning devices, control devices, or police details, which may be required by the project.

F. Remove, replace and/or reposition all traffic control devices, as necessary.

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

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the Work described in this section shall be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT and as follows:

1. Any traffic control devices provided under this section which are lost, stolen, destroyed or deemed unacceptable while in use on the project, shall be immediately replaced at no additional cost to the Owner.

2. Uniformed Police Officers shall be paid for in accordance with SECTION 01025, MEASUREMENT AND PAYMENT.

3. Payment for work under this Item shall include, but not be limited to, supplying drums, signs, Type III barricades, arrow boards, message boards, removing and replacing damaged traffic control devices, moving and removing drums during non-work hours, providing steel plates as required, and moving traffic control devices to provide uninterrupted abutter access.

4. No payment shall be made for any work on this project until a Traffic Management Plan has been developed, submitted and approved by the Owner and/or Engineer.

B. The Contractor is responsible to obtain and provide a surety bond in the amount of $250,000 to cover the work located within the MassDOT Roadway identified as South Orleans Road (Route 28).

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

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

1. Traffic Management Plan.

2. Written Approval of the Traffic Management Plan from the Owner's Safety Officer/Municipalities' Safety Officer.

1.05 - SPECIAL REQUIREMENTS

A. Notify the Owner, state, local, and/or jurisdictional agencies well in advance of commencing construction. Arrange all detours, partial road closures, and alternate traffic patterns. Inform emergency departments on the daily status of project roadways.

B. Arrange for the services of uniformed police officers, as required to protect and facilitate the flow of vehicular and pedestrian traffic through the construction work zone.

C. During winter months, remove snow and prevent ice conditions within active construction work zones, and assist local or state agencies in clearing roads used as detour routes to facilitate uninterrupted movement of traffic.

D. No Work shall be started on the Project until a detailed Project Schedule and Engineered Traffic Management Plan has been submitted to and approved by the Engineer and MassDOT. In addition, during the construction of the Project update the Project Schedule weekly and inform the Engineer, Owner, MassDOT for work in the State Highway Layout, and all other applicable utilities or other entities affected by the Work in writing of changes to the approved Project Schedule.

PART 2 - PRODUCTS

2.01 - SAFETY CONTROLS AND SIGNING FOR CONSTRUCTION OPERATIONS

A. All signs, barricades and drums shall have reflective sheeting, in accordance with the Manual on Uniform Traffic Control Devices, latest edition and State of Massachusetts Department of Transportation Standard Specifications for Road and Bridge Construction.

B. The Contractor shall use sandbags or provide other suitable means to weigh down Portable Breakaway Barricades to minimize the disturbance of barricades by vandals.

C. Furnish, erect and maintain throughout the construction period warning and directional signs.

D. All traffic control devices not conforming in type, composition, and size to the standards specified herein shall not be used under this contract.

E. Each day, remove or cover all erected signs not consistent with the use of the roadway.

2.02 - FLAGS FOR ADVANCE WARNING SIGNS

A. Standard orange or red-orange flags (16 inch by 16-inch minimum) shall be mounted on all advance work area signs. Flags shall not interfere with a clear view of the sign face.

2.03 - TEMPORARY PRECAST CONCRETE BARRIER

A. Temporary Precast Concrete Barriers shall conform the State Standard Specifications.

B. Furnish, set up, move, maintain, and remove Temporary Precast Concrete Barriers, when positive traffic barriers are needed for traffic control and safety in construction zones.

C. Each run or bay of Temporary Precast Concrete Barrier units shall be installed and fastened together to form a continuous chain, in accordance with the requirements of the state or local agencies having jurisdiction.

2.04 - PORTABLE BREAKAWAY BARRICADE TYPE III

A. Portable Breakaway Barricades shall be a 4-foot unit and conform to the latest edition of the State Construction Standards, as shown on the drawings and any additional requirements of this specification.

B. Reflectorized sheeting shall conform to the State Standard Specifications. Alternating 6-inch-wide stripes shall be orange and white and shall slope downward at 45 degrees toward the end by which traffic is to pass. Pipe shall be Polyvinyl Chloride (PVC) pressure rated SDR 26 conforming to ASTM D2241. Fittings may be PVC conforming to ASTM D2665 or Acrylonitrile Butadiene Styrene (ABS) conforming to ASTM D2661 (Drainage Waste and Vent).

C. Furnish, set up, move, maintain (in good and serviceable condition), and remove Portable Breakaway Barricades as required by the performance of this work or as may be required by jurisdictional authorities, at no additional cost to the Owner.

2.05 - PORTABLE BARRIER FENCE

A. Construction of Portable Barrier Fences shall be as shown on the drawings. Include the necessary signs, reflectors, and all incidental equipment in order to provide the portable barrier fence, complete in place.

2.06 - REFLECTORIZED DRUMS

A. Reflectorized drums shall conform to the State Standard Specification and shall be as shown on the drawings. Other drum-type products providing equivalent target value and stability, and accepted by the State, may be used.

B. Drums shall be used in the protection of driveways, utility structures, and pedestrian control and safety throughout the construction period.

C. Warning lights shall conform to the State Standard Specifications. Drums shall be maintained in a satisfactory manner including the removal of dirt or road film that may cause a reduction in reflective efficiency.

D. The Contractor shall furnish, set up, move, maintain (in good and serviceable condition), and remove reflectorized drums with or without warning lights as required by the performance of his work or as directed by jurisdictional authorities, at no additional cost to the Owner.

2.07 - ADVANCED WARNING ARROW PANELS

A. Advance Warning Arrow Panels shall consist of a black background panel meeting the requirements of the State Standard Specifications. Each Special Lighting Unit shall automatically provide for a minimum of 50 percent dimming from their rated lamp voltage at night. The flashing rate of the lamps shall not be less than 25 nor more than 40 flashes per minute. The arrow panels shall have the capability of the following mode selections: (1) left or right flashing or sequential arrows; and (2) double flashing arrows.

B. Minimum height should be seven feet above the roadway to the bottom of the panel.

2.08 - PORTABLE CHANGEABLE MESSAGE SIGNS

A. The Contractor shall provide portable changeable message signs to provide advance warning to motorists prior to entering the construction area. The portable changeable message signs shall be available for immediate use throughout the duration of the project and be positioned in accordance with the Temporary Traffic Control Plan and/or at the direction of the Engineer. If the unit is found to be defective in any way it shall be replaced immediately at the Contractor's expense.

B. The portable changeable message signs display shall be full matrix LED signs utilizing 18-inch high characters on a display of 3 rows of characters with a minimum of 8 characters per line. The variable message signs shall have an encryption feature that provides data security.

C. Portable changeable message signs shall be Sunray 480 as manufactured by National Sign Incorporated, or equal.

2.09 - TEMPORARY PAVEMENT MARKINGS AND RAISED PAVEMENT MARKERS

A. Paints, tapes, and glass beads used for temporary pavement markings shall conform to the State Standard Specifications. The colors of the marking materials shall be white, yellow or black.

B. Raised pavement markers shall conform to the State Standard Specifications.

2.10 - PEDESTRIAN BARRICADE

A. Pedestrian Barricade shall be ADA Compliant, no trip hazard for pedestrians that meets or exceeds ADA Guidelines and Manual on Uniform Traffic Control Devices Standards.

B. Pedestrian Barricade shall be:

1. Approximately 38-inches high, 43-inches long and 16-inch wide.
2. Modular system can be shaped to any layout.
3. Stable in windy conditions.
4. Quick and easy to install without the use of supporting devices such as sandbags or water barrels.
5. Orange with retroreflective sheeting.
6. Anti-tamper linking system difficult for unauthorized personnel to dismantle when linked.

C. Pedestrian Barricade shall be Plasticade, Des Plaines, IL or approved equal.

D. Contractor shall provide 100 sections of Pedestrian Barricade to be used during construction.

PART 3 - EXECUTION

3.01 - PERFORMANCE

A. Furnish, erect and maintain suitable barriers, barricades, signs, markings, drums and all other traffic control devices necessary to protect all roadways, which are partially obstructed or closed to vehicular or pedestrian traffic, as a result of this project.

B. The Owner reserves the right to suspend work, if inadequate traffic control devices are provided to control and protect both vehicular and pedestrian traffic.

C. Completely backfill all trenches at the end of each workday and/or when work is suspended for indefinite periods. In addition, install temporary trench patch each and every Friday or the last day of the work week, whichever comes first.

D. All damage to the work, pedestrians and/or public/private property due to failure to place or maintain adequate warning or directional signs or other traffic control devices shall be corrected and/or replaced at no additional cost to the Owner.

E. Furnish, supply, maintain and remove temporary white and/or yellow reflectorized and/or black non-reflectorized pavement markings, as required by the performance of his work or as directed by jurisdictional authorities, at no additional cost to the Owner. For the purpose of this specification, temporary markings shall mean markings with an effective marking period of 90-days.

F. Remove existing pavement markings as required by the performance of his work or as directed by jurisdictional authorities, at no additional cost to the Owner. Pavement marking removal methods shall not cause damage to the pavement or cause significant change in its texture. Any damage to the pavement or surfacing caused by pavement marking removal shall be satisfactorily repaired, at no additional cost to the Owner.

G. Provide all necessary temporary pavement markings, and/or temporary raised pavement markers following the completion of each week's operation, change in detour routing or prior to opening the roadway to traffic. Make all necessary arrangements for this work, as required. Continually replace the temporary pavement markings until the final pavement markings have been provided on the final pavement.

H. Transport and relocate any or all signs, barriers, barricades, or other safety devices as specified herein, as required or directed during the project. No additional payment will be provided for relocating and removing traffic control devices.

3.02 - TRAFFIC MANAGEMENT PLAN

A. The hours of operation shall be limited as required by permitting agencies and/or as required by the municipality.

B. $L = S \times W$ for speeds of 45 mph or more and/or $L = W \times S / 60$ for speeds of 40 or less where:

1. L = minimum length of taper
2. S = numerical value of posted speed limit prior to work or 85th percentile speed
3. W = width of offset

C. The maximum spacing between channelizing devices in a taper should be approximately equal in feet to the speed limit.

D. The maximum spacing between channelizing devices should be approximately equal in feet to two times the speed limit.

E. Channelizing devices are to be extended to a point where they are visible to approaching traffic.

F. Warning lights (steady burn Type C) should be used to mark channelizing devices at night as needed.

G. Pavement markings no longer applicable which could create confusion shall be removed. Temporary pavement markings shall be used as necessary and shall be in place prior to work completed each night.

H. Signs and sign supports shall meet criteria in NCHRP 350. No signs shall be attached to drums or cones. All signs shall be attached to independent supports.

I. Exact location of signs shall be approved by the engineer. Distances may be adjusted slightly to meet with field conditions.

J. All traffic control signs shall be completely covered or removed at the end of each work day or when otherwise not in effect.

K. Advisory speed at site to be determined by the municipality prior to the start of construction.

L. As required by the local safety officer, police details shall be used to direct traffic around a work area if traffic must be temporarily stopped or rerouted to allow for movement of work vehicles or other equipment.

M. As required by the local safety officer, in low volume traffic roadways, if the entire work area is visible from one station, a single police officer may be used. A single officer shall be stationed on the shoulder opposite the obstruction or work place or in a position where good visibility and traffic control can be maintained at all times.

N. As required by the local safety officer, in areas of heavy traffic volume or critical work areas, 2 or more police officers shall be used. Where 2 or more police officers are required, all police officers must be in communication with each other and should be clearly visible to the traffic which is being controlled.

O. Flood lights should be provided to mark police detail stations at night as needed.

P. Operation of traffic signal controls at intersections should be coordinated with local authorities.

Q. The contractor shall square off full width of roadway (10:1 slope) at the end of each work day, where applicable.

R. At the end of the work day the contractor shall ensure that safe access/egress of all driveways, entrances and exits are maintained during night time and on weekends.

S. If detour plans which use local roadways are required, they must be approved by engineer in writing prior to commencing work.

3.03 - PORTABLE CHANGEABLE MESSAGE SIGNS

A. Portable changeable message signs shall be positioned in accordance with the traffic control plan and/or at the direction of the Engineer. The portable changeable message signs shall be visible from a minimum distance of 900 feet with a viewing angle of no less than 30 degrees. The Contractor shall take appropriate measures as needed within the roadway layout to provide the required minimum sight distance. The Contractor shall be responsible for the maintenance of each device and appurtenance.

B. The Contractor shall be responsible for all maintenance associated with all portable changeable message signs. This includes, but is not limited to knockdowns, power outages, equipment malfunctions, temporary modifications to support the traffic control plan during construction and any other incidents within the project limits.

3.04 - PEDESTRIAN BARRICADE

A. Pedestrian barricades shall be installed to protect pedestrians at locations within the Project areas.

B. Pedestrian barricades shall be unassembled and reassembled, as necessary, throughout the duration of construction.

C. The Pedestrian Barricades shall remain the property of the OWNER upon completion of the Project. Following construction activities, the Contractor shall clean the Pedestrian Barricade and replace sections damaged during construction.

3.05 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 01600

CONTROL OF MATERIALS

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PART 1 - GENERAL

1.01 - SCOPE

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products including:

1. Definitions.
2. Submittals.
3. Spare parts.
4. Quality assurance.
5. Delivery, storage and handling.
6. Warranty.
7. Products.
8. Substitution and “Or Equal” items.
9. Reuse of existing material.
10. Owner Furnished Products.
11. Manufacturer’s instructions.
12. Special tools.
13. Lubrication.
14. Nameplates.
15. Loads and seismic forces.
16. General material and equipment requirements.
17. Materials and Equipment.
18. Field Quality Control; Installation, and Instructional.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

C. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and accepted through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Engineer’s Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of acceptance or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

1.05 - PRODUCT HANDLING

A. Comply with the requirements of SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Contractor shall arrange deliveries of materials and equipment in accordance with construction Progress Schedule, coordinate to avoid conflict with Work and conditions at Project site.

C. Provide equipment and personnel to handle materials and equipment by methods recommended by manufacturer to prevent soiling or damage to materials or equipment, or their packaging.

D. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

E. Owner assumes no responsibility for damage or loss due to storage of materials and equipment.

F. Interior Storage:

1. Store with seals and labels intact and legible.
2. Store materials and equipment subject to damage by elements in weathertight enclosures.
3. Maintain temperature and humidity within ranges required by manufacturer’s instructions.

G. Exterior Storage:

1. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment subject to deterioration with impervious sheet coverings. Provide ventilation to avoid condensation.

2. Store loose granular materials in well drained area on solid surfaces to prevent mixing with foreign matter.

3. Store materials such as pipe, reinforcing steel, structural steel, and equipment on pallets or racks, off ground.

H. Inspection and Maintenance:

1. Arrange storage to provide easy access for inspection, maintenance, and inventory.

2. Make periodic inspections of stored materials and equipment to ensure materials and equipment maintained under specified conditions are free from damage or deterioration, and coverings are in-place and in condition to provide required protection.

3. Perform maintenance on stored material and equipment in accordance with manufacturer's written instructions and in presence of Owner or Engineer.

a. Notify Engineer 24 hrs before performance of maintenance.

b. Submit report of completed maintenance and condition of coverings to Engineer with each Application for Payment.

c. Failure to perform maintenance, to notify Engineer of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.

I. Contractor shall assume responsibility for protection of completed construction and repair and restore damage to completed Work equal to original condition.

J. Wheeling of loads over finished floors, with or without plank protection, is not permitted in anything except rubber tired wheelbarrows, buggies, trucks or dollies. This applies to finished floors and exposed concrete floors, as well as those covered with composition tile or other applied surfacing.

K. Where structural concrete is also finished surface, avoid marking or damaging surface.

1.06 - DESIGN CRITERIA – Not Used

1.07 - QUALITY ASSURANCE

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.08 - REFERENCED STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. B1.1: Unified Inch Screw Threads (UN and UNR Thread Form)

B. American Society for Testing and Materials International (ASTM):

1. A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. A325/A325M: Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

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

1.09 - SPARE PARTS

A. Provide spare parts for Products as specified in the individual technical Specification sections.

B. Pack spare parts to protect them during storage. Tag spare parts and containers to clearly identify them in accordance with Contractor's parts numbering system as reviewed by Engineer. All parts shall be cross-referenced to their applicable the Specification section.

1.10 - WARRANTY

A. Warranties specified in other Specification sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.

3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in SECTION 01700, CONTRACT CLOSEOUT

1.11 - PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

C. Furnish interchangeable components from same manufacturer for components being replaced.

1.12 - ACCEPTANCE OF MATERIALS

A. Unless otherwise specified, only new materials and equipment shall be incorporated in the Work. All materials and equipment furnished by Contractor shall be subject to the inspection and acceptance of Engineer. No material shall be delivered to the Project site without prior acceptance of the Engineer.

B. As specified in SECTION 01300, SUBMITTALS, Contractor shall submit to Engineer, data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable the Engineer to identify the particular product and to form an opinion as to its conformity to the specifications.

C. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by Contractor. If the Engineer requires, either prior to beginning or during the progress of the Work, Contractor shall submit additional samples or materials for such special tests as may be necessary to demonstrate that they conform to the Specifications. Such samples shall be furnished, stored, packed, and shipped at Contractor's expense. Except as otherwise noted, Owner will make arrangements for and pay for the tests.

D. Any delay of acceptance resulting from Contractor's failure to submit samples or data promptly shall not be used as a basis of a claim against Owner or Engineer.

E. In order to demonstrate the proficiency of workmen or to facilitate the choice among several textures, types, finishes, and surfaces, Contractor shall provide such samples of workmanship or finish as may be required.

F. The materials and equipment used on the Work shall correspond to the accepted samples or other data.

1.13 - REUSE OF EXISTING MATERIAL

A. Except as specifically indicated or specified, do not use materials and equipment removed from existing structure(s) in new Work.

B. For material and equipment specifically indicated or specified to be reused in Work:

1. Use special care in removal, handling, storage, and reinstallation to ensure proper function in completed Work.

2. Contractor shall arrange and pay for transportation, storage, and handling of products which require off-site storage, restoration or renovation.

3. Off-site storage areas and buildings shall conform to requirements of this Specification section.

1.14 - OWNER-FURNISHED PRODUCTS – Not Used

1.15 - MANUFACTURER'S INSTRUCTIONS

A. Installation of equipment and materials shall comply with manufacturer's instructions. Obtain and distribute printed copies of such instructions to parties involved in installation, including two (2) copies to Engineer.

1. Maintain one (1) set of complete instructions at the Project site during installation and until completion of Work.

B. Handle, store, install, connect, clean, condition, and adjust materials and equipment in accordance with manufacturer's written instructions and in conformance with the Specifications.

1. If Project site conditions or specified requirements conflict with manufacturer's instructions, consult Engineer for further instructions. Do not proceed with Work without written instructions.

1.16 - SPECIAL TOOLS

A. For each type of equipment furnished, Contractor shall provide a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be high-grade, smooth, forged, alloy, tool steel. Grease guns shall be lever type.

B. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.

C. Pack items to protect them during storage. Tag items and containers to clearly identify them in accordance with Contractor's part system, as reviewed by Engineer. Cross reference all items to their applicable Specification section.

D. Special tools shall be delivered at the same time as the equipment to which they pertain. Contractor shall properly store and safeguard such special tools until completion of the Work, at which time they shall be delivered to Owner.

E. Contractor shall furnish and erect one (1) or more steel wall cases with flat key locks and clips or hooks to hold each tool in arrangement.

1.17 - LUBRICATION

A. Where lubrication is required for proper operation of equipment, incorporate necessary and proper provisions in equipment in accordance with manufacturer's requirements. Where possible, lubrication shall be automated and positive.

B. Where oil is used, reservoir shall be of sufficient capacity to supply unit for 24 hr period.

C. Provide adequate and, as far as practicable, automatic means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for routing greasing using grease nipples and Type 316 stainless steel or copper tubing extensions where required. Secure nipples and tubing to the equipment at appropriate locations. Indicate on the working drawings submitted, the types of lubricants to be used. Use grease nipples of a consistent type, Alemite button head type or equivalent. Provide grease gun(s) of the appropriate size(s) and pressure(s).

D. Provide a one (1) year supply of all lubricants necessary for the routine, daily operation of the equipment. All lubricants to be readily available to the Owner. Provide a complete schedule of all the lubricant including the manufacturer name, type, name and local address and phone number of where each lubricant can be purchased for each piece of equipment.

1.18 - NAMEPLATES

A. With the exceptions mentioned below, each piece of equipment shall be provided with a nameplate of non-corrodible metal, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information.

B. This requirement shall not apply to standard, manually operated hydrants or to gate, globe, check and plug valves.

1.19 - LOADS AND SEISMIC FORCES

A. Provide anchorage and supports for products, including equipment, assemblies, and pipe, designed to resist the following loads and seismic forces.

1. Horizontal forces: 100 percent of dead and live loads acting in any direction in the horizontal plane applied to the center of gravity of the load.

2. Vertical forces: 50 percent of the dead and live load, acting either upward or downward applied at the center of gravity of the load.

3. Cantilevered anchorages/supports: 100 percent of the dead and live loads acting in any direction applied at the center of gravity of the load.

B. Seismic force determination: Maximum dead and live loads conditions while operating.

C. Products, including equipment and assemblies, in normal submerged condition operation: analysis of seismic forces in both submerged/dry condition.

D. Above ground tanks, their supports and anchorages: Design fabricate and install to comply with the seismic requirements of applicable codes.

E. Analysis of loads and seismic force: Performed by a registered structural professional Engineer in the Commonwealth of Massachusetts with experience in this type of work.

F. Furnish copies of all analyses with the submittals for equipment, assemblies, and pipe.

1.20 - GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

A. The requirements of this Paragraph shall constitute the standards for the material and equipment specified herein. Should these requirements conflict with the Supplier’s recommendations or in any way be less stringent than the Supplier’s requirements, they shall be superseded by the Supplier’s requirements.

B. Bolts, Anchor Rods and Nuts:

1. All necessary bolts, anchor rods, nuts, washers, plates and bolt sleeves shall be furnished by the contractor in accordance herewith. Anchor rods shall have suitable washers and hexagonal nuts.

2. All anchor rods, nuts, washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated or specified.

3. Unless otherwise specified, stud, tap, and machine bolts, and nuts shall conform to the requirements of ASTM Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A325. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to ANSI Standard B1.1 for Unified Inch Screw Threads (UN and UNR Thread Form).

4. Bolts, anchor rods, nuts, and washers, specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformity with the ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123, or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153, as is appropriate.

5. Bolts, anchor rods, nuts, and washers specified to be stainless steel shall be Type 316 stainless steel.

6. Anchor rods shall be set accurately. They shall be carefully held in suitable templates of acceptable design. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least 4 in. by 4 in. by 3/8 in. or shall have square heads and washers and set in the concrete forms with suitable pipe sleeves, or both. If anchor are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be done by Contractor and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the drilling and caulking.

C. Grease Fittings:

1. Provide extension fittings and tubing on all grease fittings that are installed in an inaccessible location. The extension is to be located so that equipment can be lubricated from the operating level without the use of ladders, staging or shutting down the equipment. Tubing: 316 stainless steel.

D. Concrete Inserts For Hangers:

1. Concrete inserts for hangers shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts for hangers shall be of a type which will permit adjustment of the hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized by the hot-dip process in conformity with the ASTM Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Designation A123, or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153, as is appropriate.

E. Equipment Foundations, Installation and Grouting:

1. Contractor shall furnish the necessary materials and construct suitable concrete foundations for all equipment installed by him, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.

2. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.

3. In setting pumps, motors, and other items of equipment customarily grouted, Contractor shall make an allowance of at least 1-inch for grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable non-metallic, non-shrink grout.

4. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

5. Where such procedure is impracticable, the method of placing grout shall be as accepted byEngineer. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an accepted manner and given a burlap-rubbed finish.

F. Equipment Drive Guards:

1. All equipment driven by open shafts, belts, chains, or gears shall be provided with acceptable all-metal guards enclosing the drive mechanism. Guards shall be constructed of galvanized sheet steel (12 gage minimum) or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment. Guards shall conform in all respects to all applicable safety codes and regulations.

2. Provide pivoting access covers for shaft speed measurements.

G. Sleeves:

1. Unless otherwise indicated on the Drawings, or specified, form openings for the passage of pipes, conduits, and circular ducts through floors and walls using sleeves of standard weight, galvanized-steel pipe. Provide sleeves of ample diameter to pass the pipe and its insulation, if any, and to permit expansion as may occur. Provide sleeves that are flush at the walls and at the bottom of slabs and project 4-inches above the finish floor surface. Threaded nipples shall not be used as sleeves.

2. Sleeves in exterior walls below ground or in walls that have liquids on one or both sides, shall have a 2-inch annular fin of 1/8-inch plated welded with a continuous weld completely around the sleeve at mid-length. Galvanize sleeves after the fins are attached.

3. Sleeves shall be set accurately before the concrete is placed or shall be built in accurately as the masonry is being built.

H. Protection Against Electrolysis:

1. Where dissimilar metals are used in conjuction with each other, provide insulation between adjoining surfaces to eliminate direct contact and any resultant electrolysis. Provide bituminous insulation, heavy bituminous coatings, nonmettalic separators or washers, impregnated felt, or other means to provide insulation.

PART 2 - PRODUCTS AND SERVICES

2.01 - MATERIALS AND EQUIPMENT

A. Material and Equipment Incorporated into Work:

1. Conform to applicable specifications and standards.

2. Comply with size, make, type, and quality specified or as accepted by Submittal.

B. Manufactured and Fabricated Materials and Equipment:

1. Design, fabricate, and assemble in accordance with engineering and shop practices standard with industry.

2. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.

3. Two (2) or more items of same kind shall be identical, by same manufacturer.

4. Material and equipment shall be suitable for service conditions.

5. Equipment capabilities, sizes, and dimensions shown or specified shall be adhered to, unless variations are specifically accepted, in writing.

6. Equipment shall be adapted to best economy in power consumption and maintenance. Parts and components shall be proportioned for stresses occurring during continuous or intermittent operation, and for additional stresses occurring during fabrication or installation.

7. Design so working parts are readily accessible for inspection and repair, easily duplicated, and replaced.

8. Design structural members of equipment for anticipated shock and vibratory loads.

9. Design machinery such that working parts are readily accessible for inspection and repair, and that each part is suitable for the service required.

C. Do not use material or equipment for purpose other than for which it is designed or specified.

PART 3 - EXECUTION

3.01 – FIELD QUALITY CONTROL; INSTALLATION, AND INSTRUCTIONAL SERVICES

A. General

1. Provide on-site services of Supplier's representatives for equipment provided by Contractor during construction, installation, equipment startup, and training of Owner's personnel for equipment or plant operation as specifically required in Specification sections for equipment or systems.
2. Include and pay costs for Supplier's services.
3. Work day is defined as 8 hr period during Owner's or Contractor's typical calendar day. Work day for purposes of this section does not include travel to or from the Project Site.
4. Specification sections include minimum mandays to provide basis for bidding. If additional time is required to perform services Contractor shall include that time in the Contract Price.

B. Installation Services

1. Where installation services are called for in the Specifications, provide competent and experienced technical representatives of manufacturers of material or equipment and systems to resolve assembly or installation procedures attributable to, or associated with, equipment furnished.
2. After equipment is installed, representatives shall perform initial equipment and system adjustment and calibration to conform to the Specifications and manufacturer's requirements and instructions.
3. Provide "Certificate of Installation Services" stating proper adjustments have been made to equipment or system and equipment or system is ready for startup and system demonstration.

C. Training

1. Do not start training until Installation Services have been completed.
2. Where training is called for in the Specifications, provide competent and experienced technical representative of Supplier to provide detailed instructions to Owner's personnel for operation of equipment. Training services shall include operation and maintenance of instrumentation and equipment in classroom and on-site. Training shall include electrical, mechanical, and safety aspects of equipment.
3. Submit documentation identifying name of specific representative, factory authorization, and background of named individual(s) to conduct training. Submit information 30 days before scheduled training period for review and acceptance by Engineer.
4. Coordinate training periods with Engineer, Owner and Supplier's representatives.
    a. No training shall be conducted unless instructor has been accepted by Engineer.
    b. Notify Engineer at least 48 hrs before training sessions are to begin so Engineer can make arrangements with Owner's operating personnel.
    c. Reschedule canceled training sessions 48 hrs in advance.
    d. Failure of Supplier's or manufacturer's representative to appear for scheduled training, failure to notify Engineer 24 hrs in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to Owner for time lost by Owner's personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hr for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late, up to 1 hr, after 1 hr training will be rescheduled.
    e. Failure of Supplier's or manufacturer's representative to appear for scheduled training, failure to notify Engineer 24 hrs in advance of need to cancel scheduled training or failure to arrive within 30 min of start of scheduled training shall result in reimbursement to Owner for expenses and time incurred by Engineer in traveling and time spent on-site. Minimum time billed shall be 8 hrs.

5. Similar types of equipment differing in model, size or manufacturer shall require equal service time as stated in specific Specification section.
6. O&M data shall constitute basis of instruction. Review data contents with personnel in full detail to explain aspects of operations and maintenance.
7. Instructional Services shall be completed before start of performance testing required in SECTION 01650, FACILITY START-UP AND TESTING REQUIREMENTS.
8. Provide “Certificate of Instructional Services”, cosigned by Owner and Supplier’s representative, verifying training has been accomplished to satisfaction of each party.

3.02 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 01610

DELIVERY, STORAGE AND HANDLING

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PART 1 - GENERAL

1.01 - SCOPE

A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified with the related item.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS – Not Used

1.05 - PRODUCT HANDLING

A. Transportation and Delivery

1. Transport and handle items in accordance with manufacturer's printed instructions.
2. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer.
3. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.
4. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.
5. All items delivered to the site shall be unloaded by the Contractor and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic. The Owner shall not offload any materials or equipment at the site.
6. Provide equipment and personnel to unload all items delivered to the site.
7. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e. Owner, other Contractors), perform inspection in the presence of the Engineer. Notify Engineer verbally, and in writing, of any problems.

B. Storage and Protection

1. Store and protect products and equipment in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the Engineer by him. Instructions shall be carefully followed and a written record of this kept by the Contractor for each product and pieces of equipment.
2. Arrange storage of products and equipment to permit access for inspection. Periodically inspect to make sure products and equipment are undamaged and are maintained under specified conditions.
3. Provide protective maintenance during storage consisting of manually exercising equipment, inspecting mechanical surfaces for signs or corrosion or other damage, lubricating, applying any coatings as recommended by the equipment manufacturer necessary for its protection and all other precautions to assure proper protection of all equipment stored and for compliance with manufacturers' requirements related to warranties.
4. Store loose granular materials on solid flat surface in a well-drained area. Prevent mixing with foreign matter.
5. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulation of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in manner to reduce breakage, cracking and spalling to a minimum.

6. All mechanical and electrical equipment and instruments shall be covered with canvas and stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it shall be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer and to prevent condensation on the equipment being stored.

    a. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.

    b. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding".

    c. Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

    d. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

    e. For electrical equipment (including switchgear, switchboards, motor control centers, and variable frequency drives) installed in areas where temperature and humidity are not controlled for, provide temporary heaters in accordance with manufacturer’s recommendations to prevent condensation prior to energization of equipment.

    f. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

1.06 - DESIGN CRITERIA – Not Used

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

END OF SECTION

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SECTION 01650

FACILITY START-UP AND TESTING REQUIREMENTS

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PART 1 - GENERAL

1.01 - SCOPE

A. The Contractor shall be responsible for furnishing of all labor, equipment, appliances and materials and performing all operations in connection with the facility testing and inspection and startup and performance testing prior to final acceptance of all process systems, including the coordination of all performance tests and the furnishing of operating instructions for all equipment.

B. Start-up and Testing Requirements for individual equipment systems shall be as indicated for all equipment as specified in individual sections in DIVISIONS 11, EQUIPMENT, 15, MECHANICAL and 16, ELECTRICAL.

C. HVAC systems shall be tested and balanced in accordance with DIVISION 15, MECHANICAL. Fire Protection Systems shall be commissioned in accordance with DIVISIONS 10, SPECIALTIES and 15, MECHANICAL.

D. Electrical and Fire Alarm tests shall be performed as specified in DIVISION 16, ELECTRICAL.

E. The Instrumentation and Control System tests shall be performed as specified in DIVISION 13, SPECIAL CONSTRUCTION.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

10. Shop Testing is defined as testing that is done by the manufacturer either at the place of manufacture, the place of assembly, or at another location where the required testing apparatus is located, for the purpose of proving that the equipment meets the requirements of the pertinent technical specification(s).

11. Physical Checkout, Inspection and Certification is defined as the process of physically inspecting products after they have been installed in the work, and then certifying that the products have been properly and completely installed, and are ready for field and/or start-up.

12. Field Testing or Functional Testing is defined as testing that is performed by the Contractor with supplier assistance on products they have been installed in the work and after the performance of physical checkout, for the purpose of proving that the tested products meet the requirements of the pertinent technical specifications.

13. Start-up is defined as the initial operation of a sufficiently completed facility and/or plant process by the Owner, utilizing wastewater and related substances (sludge, wastewater, scum), or other media which the facility has been designed to process.

14. Full System Testing is defined as testing performed on a "system" normally comprised of two or more pieces of equipment, after the equipment has been installed in the work, and after physical checkout and field testing has been completed, for the purpose of providing that the system meets requirements as specified and as indicated.

15. Performance Testing is defined as testing performed to verify performance of the individual components under actual and simulated operating conditions. The tests shall indicate compliance with the performance requirements in the individual specification sections.

1.04 - SUBMITTALS

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

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

1. Submit data and certificates in accordance with SECTION 01300, SUBMITTALS and as specified herein.

2. Submit detailed specific start-up plans for each significant mechanical or process system.

1.05 - RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and DIVISION 1, GENERAL REQUIREMENTS, Specification Sections, apply to this section.

1.06 - SHOP TESTING

A. When required by the technical specifications, perform shop testing prior to delivery of the equipment or material. Provide thirty days written notice indicating the time and place of testing. Submit the following for approval thirty days prior to this notice.

1. Description of the Test - Specifically outlining how tests will conform to the requirements in the technical specifications.

2. Testing Devices That Will be used In the Tests - Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel Used to Perform the Tests - Resumes, qualifications, and experience shall be submitted. As a minimum, personnel shall have three years' experience with the manufacturer and operation of the equipment to be tested and will have participated in 5 similar tests during this period of experience.

4. Schedule for Testing - Schedule shall include frequency of measurements, personnel present and contingency plans for equipment and/or test failure.

5. Test Forms - Submit all forms used to record and report on shop test data, for approval, prior to the test. Forms shall include description of test, equipment used, personnel present, equipment tag ID numbers, and measurements made. Forms shall conform to the Engineer's format for heading and check off sections. Forms shall have a place for signature by the chief testing person, and an officer of the company that the tests performed are true, accurate, have me the required criteria, and that the equipment will operate as indicated and as specified.

B. Shop test procedures will be reviewed and returned by the Engineer. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Engineer will require a resubmission of the shop test procedure and proposed test date. The Contractor will be notified, in writing by the Engineer, if a formal resubmission is required with the transmittal of the review comments.

C. Submit the following within one week after completion of the tests for approval:

1. Completed test forms, for each device tested, on forms as approved prior to the test.

2. Completed certification, the content of which was approved prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

1.07 - FIELD/FUNCTIONAL TESTING OF EQUIPMENT

A. When required by the technical specifications, perform field or functional testing on installed equipment. If none are required by the technical specifications, complete field / functional testing as detailed below. Field / functional testing shall be in addition to and not in lieu of, any shop testing either required or otherwise performed. Perform testing as a part of the overall testing process defined herein. However, the following specific instructions shall also apply. Provide thirty days written notice indicating the date and time for testing one piece of equipment, or a series of equipment pieces. Submit with this notice the following for approval by the Engineer:

1. Description of the Tests - specifically outlining how the test will conform to the requirements in the technical specifications.
2. Testing Devices That Will Be Used in the Tests - Description shall state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.
3. Personnel Used to Perform the Tests - Submit resumes, qualifications, and experience. As a minimum, personnel must have three years' experience with the manufacturer and operation of the equipment to be tested and will have participated in five similar tests during this period of experience.
4. Schedule of Testing - Schedule shall include frequency of measurements, personnel present and contingency plans for equipment and/or test failure.
5. Test Forms - Review and comment on all forms provided by the Engineer for recording reporting on the field test data, prior to the test.
6. Material and Equipment Required for the Test - This material and equipment shall be supplied by the Contractor or his/her subcontractors at no additional cost to the Owner.
7. Water and Power Requirements - Water and power requirements shall be identified in the plan by the Contractor and will be supplied by the Contractor for field testing purposes only. The Contractor shall provide all temporary piping and wiring required for field testing; and equipment and labor for the reuse of the test water.
8. Disposal of Waste – The Contractor is responsible for the proper disposal of all wastes generated from the testing at no additional cost to the Owner.

B. Field test procedures will be reviewed and returned by the Engineer. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Engineer will require a resubmission of the field test procedure and proposed test date. The Contractor will be notified, in writing, by the Engineer if a formal resubmission is required with the transmittal of the review comments.

C. Submit within one week after completion of the tests, the following to the Engineer for approval.

1. Completed test forms for each device tested on forms provided prior to the tests.
2. Completed certification documentation, the content of which was approved prior to the tests.
3. A written summary of testing, reporting on the results and summarizing the entire procedure.
4. A schedule for retesting, if necessary. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

D. Minimum field test requirements include

1. Calibrate equipment as required. For pumps, use water as a calibration liquid.
2. Test equipment and systems through a normal start, normal stop, and all emergency shutdown sequences.
3. Complete a four-hour running test. For variable speed units, the test shall include running for three complete cycles of one-hour duration at the maximum and minimum speeds for one half of each of those cycles. Operate each system through its normal automatic sequence of operation. During the four-hour test, observe and record all level indications, flow indicators, and pressure indicators.

4. If the equipment utilizes a local programmable logic controller (PLC), verify that the PLC is capable of operating and controlling the system as specified in the individual specification sections. Also verify all communications with distributed control system (DCS) are as specified.

5. For equipment not supplied with a PLC, verify that the instrumentation and control system is capable of operating and controlling the system.

6. Check safety devices, and interlocks for satisfactory operation. Check instrumentation and control systems for conformance with the Specifications.

7. Check for system leaks and proper valve operation.

8. Demonstrate to the Owner's Representative that all temporary jumpers and/or bypass have been removed and that all of the components are operating under their own controls as designated.

9. Coordinate start-up activities with the Owner's representative and with the Engineer prior to commencing system start-up.

E. Motor Testing

1. Visually inspect the motor for any physical damage.

2. Before energizing any machine, visually inspect for serviceability. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.

3. Test run all motors before placing into regular service. A check on the motor for rotation, speed, current and temperature rise shall be made and the results recorded. Maintain the proper color codes for phase identifications. A motor phase rotation meter should be used prior to connection at motor to prevent later swaps of phase wires.

F. Engine Generator Test

1. Visual and Mechanical Inspection.

   a. Compare equipment nameplate data with drawings and specifications.

   b. Inspect physical and mechanical condition.

   c. Inspect correct anchorage and grouting.

2. Electrical and Mechanical Tests.

   a. Perform an insulation-resistance test on generator winding with respect to ground in accordance with ANSI/IEEE Standard 43. Calculate polarization index.

   b. Test protective relay per applicable NETA standards.

   c. Perform phase-rotation test to determine compatibility with load requirements.

   d. Functionally test engine shutdown for low oil pressure, over temperature overspeed, and other features as applicable.

   e. Conduct performance test in accordance with ANSI/NFPA Standard 110, (Installation Acceptance).

   f. Verify correct function of governor and regulator.

   g. Test circuit breakers per applicable NETA standards.

   h. Perform load bank testing for a minimum of 1 hour.

1.08 - INSPECTION AND CERTIFICATION OF EQUIPMENT

A. Upon completion of installation of all permanent equipment and related shop and field testing, the manufacturer's technical service representative shall inspect and, as necessary, adjust and/or calibrate the equipment. The inspection shall consider the completeness and integrity of the installation, the alignment and clearances of the equipment parts with respect to each other, and the sufficiency of any required sealing, lubricants or packing.

B. The technical service representative shall submit the results of the inspection including certification that the equipment was properly installed and is operating as specified and as installed. The report should verify that the equipment is ready for sustained operation and free from defects that would render the guarantee null and void.

1.09 - GENERAL REQUIREMENTS FOR START-UP

A. Fourteen (14) days' notice of scheduled start-up of individual equipment items or mechanical systems, dates shall be given to the Engineer. The following representatives, as appropriate, shall be present simultaneously for the start-up.

1. General Contractor
2. Electrical Subcontractor
3. Equipment Manufacturer's Technical Service Representative
4. Instrumentation and Control Equipment Representative
5. System Integrator
6. Owner and Owner's Representative

B. The following must be completed prior to start-up and testing:

1. Controls and alarm systems shall be tested to show it is capable of transmitting and annunciating all specified control points to the plant-wide SCADA system.
2. All safety equipment shall be installed and operating properly.
3. Initial training of facility personnel by manufacturer's technical service representatives shall be completed.
4. All spare parts, tools, lubricants shall be delivered to the Owner.
5. Installation drawings delivered to the Owner.

C. The Contractor shall, upon orders by the Engineer, startup, adjust and place in satisfactory operation all plant equipment constructed under this contract. At the discretion of the Engineer, individual startups may be required for various phases of the work or individual systems. The Engineer may order the start-ups prior to the completion of non-essential items of work.

D. As soon as practical after the initial start-up, the Contractor shall arrange for the manufacturer's representatives to perform all field tests and complete all additional training.

1.10 - GENERAL REQUIREMENTS FOR SYSTEM AND PERFORMANCE TESTING

A. Full System Tests: Full System tests on all items and systems shall be made at the wastewater treatment facility after all equipment has been installed for a given unit process and a final testing and inspection and all startup activities have been satisfactorily conducted by the Contractor, and the Contractor is satisfied that the equipment is operating as specified. The successful performance of all systems, equipment and components for each unit process shall be demonstrated to the satisfaction of the Engineer by completing a full system demonstration test. Unless especially required in technical specifications, the demonstration test will consist of operating the system, for an uninterrupted seven (7) day period for 24 hours per day or as otherwise specified. Failure of equipment to operate as specified will require the test to be reperformed for the full period. At no time during the startup of the facilities shall any equipment or system be operated under a more severe condition than the maximum design condition for which the equipment is rated.

B. Performance Tests and Performance Criteria: Specific performance testing criteria are listed for specific equipment and systems in the Divisions 11 through 16 specifications. Compliance with these performance test requirements shall be demonstrated during the full system testing or otherwise demonstrated prior to substantial completion.

C. In the event of a failure to demonstrate satisfactory facility performance on the first or any subsequent attempt, it shall be the responsibility of the Contractor to make all the necessary and required changes, replacements, and tests to make the units meet the specified operating and efficiency requirements.

D. If equipment is unable to operate, initial calibration and/or additional adjustments are required, or representatives are absent, the start-up or tests shall be canceled at that time and full rescheduling will be required. Damages shall be assessed to the Contractor for Owner's, Owner's Representative, and Manufacturer's Representative time and expenses wasted on scheduling, coordinating and attending the failed performance test.

E. The Contractor shall be fully responsible for the operation and maintenance of the new equipment and systems until the full system and performance tests have been completed and substantial completion and facility acceptance has been issued.

F. Once the complete facility system is fully tested, operational, calibrated and capable of performing, the Owner shall take occupancy of the equipment and the warranty period shall begin. It should be noted that the final performance test is meant to check complete performance of the equipment and is not a time for contractors' or manufacturers' representatives to begin major calibrating, testing, and adjusting of their equipment to insure it works or performs as required.

G. Substantial completion and facility acceptance will not be issued until the full system tests are completed successfully for all unit processes.

1.11 - ROLES AND RESPONSIBILITIES DURING START-UP AND TESTING

A. The Contractor shall not operate any of the existing facilities at any time. This shall include the starting and stopping of equipment or opening and closing of valves. Whenever the Contractor believe their work will affect or be impacted by the existing facilities operation, they shall so notify the Engineer in writing three (3) working days prior to the intended start of the work. This notification shall clearly detail the work to be completed, the method by which the existing facilities operation may be impacted, and the assistance requested of the Owner.

B. Contractor's Responsibilities: The Contractor shall be responsible for furnishing and installing all of the several kinds and types of equipment required in the treatment facilities, and for testing each individual piece of equipment, all combinations of equipment as they may operate one in conjunction with another, and the complete system, such that each component and the total unit may operate in an acceptable fashion to the Engineer, the Owner, and to any other municipal, State or Federal authorities within whose jurisdiction the operation of the facility may be a concern, at no additional costs to the Owner:

1. Develop specific start-up plans and schedule.

2. Provide specific start-up material and operating supplies until substantial completion. Supplies include lubricants, chemicals, gases, specialized fluids, electric power, water and all other required appurtenances.

3. Provide all specified third-party testing and laboratory costs at no additional costs to the Owner.

4. Provide manufacturer's representative to provide guidance during performance testing.

5. Provide to the Engineer a list of 24 hour, "on call" representative supervisory persons who will monitor the start-up and performance testing.

6. Provide the necessary craft or labor assistance, in the event of an emergency equipment failure requiring immediate attention, (emergency is defined as a failure of function which precludes the further operation of a critical segment of; or the whole of the work) with a response time of not less than four hours from the time of notification. The time of notification is defined as the time of contact between the Engineer's representative and the Contractor's representative.

7. Correct all failures or equipment problems identified during start-up when notified by the Engineer. Resolve and correct all equipment or system failures during the performance testing.

8. Provide manufacturer's representatives and operating supplies for retesting of systems that fail to pass the initial performance tests due to deficiencies in products or workmanship at no additional cost to the Owner.

9. Provide training as specified.

10. Prior to starting the start-up and testing, the Contractor shall provide and field calibrate certified flow meters (by using volumetric calibration), flow recorders, all electrical meters, and electrical recorders. The Contractor shall provide a test procedure, wiring diagram of field test recorders and instrumentation, and a field calibration report on the installed meter.

11. Review procedures for performance testing.

12. Attend meetings related to the review of start-up plan(s).

13. Clarify submittals, testing requirements, schedules, or other items related to the start-up of the equipment and facilities specified and indicated in the Contract Documents.

C. The Owner's Responsibilities:

1. Assist in the start-up testing activities. The Owner will endeavor to be cooperative with the Contractor when required. However, it is emphasized that the existing facilities operations and treatment take precedence and only requests that do not adversely affect the flow or treatment will be considered. Additionally, any assistance given to the Contractor must be completed when the Owner's schedule and manpower permit. There may be instances when the Owner cannot provide assistance at the time of the Contractor's request and this shall not be the basis for a claim by the Contractor.

2. Provide staff to operate and maintain equipment, systems, and facilities requiring start-up.

1.12 - TREATMENT EQUIPMENT USAGE

A. Any partial or full usage of the proposed equipment by the Owner, and/or his employees or agents, prior to acceptance shall be the responsibility of the Contractor.

1.13 - OPERATIONAL EXPENSES

A. During the construction stage and start-up period, before the facilities are turned over to the Owner, the Contractor shall bear all expenditures and operational expenses of all systems included in the project, including electrical power, chemicals, maintenance, and fuel.

B. The Contractor shall be responsible for the proper handling, sampling, and lab testing and analysis from the testing and start-up of facility processes.

1.14 - GUARANTEE

A. The Contractor shall guarantee the materials and equipment furnished and the performance thereof to be in accordance with the requirements of the Contract Documents and agrees upon written notice to make promptly and without charge, all necessary changes, corrections, and replacements (including installation of replacement parts) required to make good all defects developing in the material or equipment, under ordinary use and proper care, within a period of twelve months after final acceptance or substantial completion of the treatment facilities.

PART 2 - PRODUCTS

2.01 - TEST EQUIPMENT

A. The Contractor shall provide all test equipment, including kWh demand meters and recorders, instruments, analyzers, handling equipment, etc., required to sample and test the various systems. All test equipment must have been tested and calibrated within 6 months of their use on this contract.

PART 3 - EXECUTION – Not Used

END OF SECTION

SECTION 01680

PHYSICAL CHECKOUT; SHOP, FIELD AND FUNCTIONAL TESTING

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PART 1 - GENERAL

1.01 - SCOPE

A. The physical inspection and testing requirements in this Section are in addition to those requirements defined in the individual technical specification sections. This testing shall be performed during Contract Closeout.

B. Provide the following checkout and testing activities:

1. Physical checkout and inspection of equipment and materials to verify conformance of the installed equipment and materials as indicated and as specified.

2. Shop Testing of equipment as specified in the sections of Division 2 through 16 and as specified herein.

3. Field Testing of equipment as specified in the sections of Divisions 2 through 16 and as specified herein.

4. Functional Testing of equipment as specified in the sections of Divisions 2 through 16 and as specified herein.

5. Provide a Checkout Plan covering the entire checkout and testing process as specified herein.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. Shop Testing: Is defined as testing that is done by the Supplier or Manufacturer, either at the place of manufacture, the place of assembly, or at another location where the required testing apparatus is located, for the purpose of proving that the equipment supplied under the Contract meets the requirements of the pertinent technical specification(s).
11. Field Testing: Is defined as testing that is performed by the Contractor, on equipment supplied under the Contract after its been installed in the Work, and after the performance of physical checkout, for the purpose of proving that the tested equipment meets the requirements of the pertinent technical specifications.
12. Physical Checkout: Is defined as the process of physically inspecting equipment after it has been installed in the Work to determine if the equipment has been properly and completely installed and is ready for Field and/or Functional Testing.
13. Functional Testing: Is defined as testing performed on a "system" normally comprised of two or more pieces of equipment, after the equipment has been installed in the Work, and after Physical Checkout and Field Testing has been completed, for the purpose of proving that the system meets requirements as specified and as indicated.
14. Supplier's Representative: Sometimes referred to in the technical specifications as a Factory-Trained Service Representative, is defined as a person, or persons provided by the Supplier, who is qualified by having the training and experience, to provide technical and/or process related advice, and/or assistance, relating to the installation or utilization of the Products provided by that same Supplier, for installation and utilization in the Work.
15. The Testing and Checkout Coordinator: Is defined as the person provided by the Contractor to coordinate and oversee the total spectrum of testing and inspection activities required by the Contract Documents. The Testing and Checkout Coordinator shall have been in responsible charge of two similar Projects in the last four years.

1.04 - SUBMITTALS

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

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA – Not Used

1.07 - ROLES AND RESPONSIBILITIES

A. Provide all outside services, materials, labor, supplies, test equipment and other items necessary to perform the testing specified herein. In addition, arrange for and provide the participation or assistance of survey crews, quality control technicians, Supplier's representative(s), and required governmental agency representatives.

B. Provide the services of the Supplier’s representative(s) for the following activities:

1. Assistance during installation.
2. Shop Testing
3. Field Testing
4. Functional Testing

C. The Supplier's representatives activities required by this Section are in addition to the requirements for vendor training and other services specified elsewhere in the Contract Documents. Timing for the performance of these services are to be defined in the Contractors Checkout Plan, specified herein.

D. The Owner will review and comment on the Contractor’s deliverables, participate in the physical inspection activities, witness the shop and field testing, and witness functional testing. The Owner’s right to perform inspections, witness tests or monitor or assess the Work and activities does not relieve the Contractor of its obligation to comply with the requirements of the Contract Documents nor does it imply completion of the Work.

1.08 - CHECKOUT PLAN

A. Submit a Checkout Plan based upon the requirements defined herein to the Owner. Six copies of the Checkout Plan (preliminary) shall be submitted for review 90 days prior to the proposed date of the first test. The plan shall define:

1. The performance of physical inspections, shop, field and functional tests including:
    a. A chronological schedule of all testing and inspection activities.
    b. A checklist of all inspection and testing activities broken down by location, discipline, system, and device or item.
    c. All blank forms proposed by the Contractor for verification or recording of the shop testing.
    d. An index which cross references the forms to their intended application(s).
    e. A list of all shop tests, and supplier certifications, including those required by the applicable technical specifications. Provisions shall also be included for retesting, in the event it is required.
2. Participants in the testing.
3. Special test equipment.
4. Sources of the test media (water, power, air.)
5. The proposed method of delivery of the media to the equipment to be tested.
6. Temporary or interim connections for the sequencing of multiple units.
   Ultimate disposal of the test media.

B. The plan shall be reviewed by the Owner, modified or revised as necessary by the Contractor, then re-reviewed by the Owner. The Contractor shall continue to update the checkout plan, working in conjunction with the Owner prior to the start of the scheduled equipment checkout and functional testing activities as specified herein. Each specific element of the plan must receive review or comment by the Owner two weeks prior to the actual commencement of testing as defined herein.

C. The Contractor shall designate, in the checkout plan, a Testing and Checkout Coordinator, to coordinate and manage the activities defined in the checkout plan.

1.09 - SHOP AND FIELD TESTING REQUIREMENTS

A. In the event no reference to procedures are made, or no procedures for shop and field testing are contained in a technical specification for the following test parameters, the following shall be the checkout requirements. Should these requirements conflict with the Supplier's recommendations or in any way be less stringent than the Supplier's requirements, they shall be superseded by the Supplier's requirements for checkout testing.

B. Hydrostatic Testing:

1. AWWA C600 standards latest edition are the standards for all hydrostatic testing.

2. Visually inspect all welds prior to testing, for cracks, undercut on surface greater than 1/32-in. deep, lack of fusion on surface, reinforcement greater than Table 127.4.2 located in ANSI B31.1 Power Piping, and incomplete penetration (when accessible). Repair or rework as directed by the Owner, at no additional cost to the Owner.

3. At no time during hydrostatic testing shall any part of the piping system be subjected to a stress greater than 90 percent of its yield strength at test temperature.

4. After 10 minutes of full hydrostatic test pressures, make an examination for leakage of all joints, connections, and all regions of high stress, such as around openings and thickness transition sections.

5. Unless otherwise specified, the minimum required hydrostatic test pressure shall be 1.5 times the design pressure as specified and as indicated.

6. Pressure holding time shall be 10 minutes plus the time required to inspect for leakage.

7. Maximum pressure shall not exceed the maximum rated pressure for any component in the system being tested.

1.10 - WITNESSING OF TESTS

A. Provide 30 days written notice to the Owner so that the Owner, may witness the Contractor's Shop, Field, and Functional tests. The Owner may witness the performance of any or all tests, at their option.

1.11 - SHOP TESTING

A. When required by the technical specifications, perform shop testing prior to delivery of the equipment or material. Provide thirty (30) days written notice indicating the time and place of testing. Submit the following for review thirty days prior to this notice:

1. Description of the test: Specifically outlining how tests will conform to the requirements in the technical specifications.

2. Testing devices that will be used in the tests: Description must state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel used to perform the tests: Resumes, qualifications, and experience shall be submitted. Personnel shall have three (3) years' experience with the manufacture and operation of the equipment to be tested and will have participated in 5 similar tests during this period of experience.

4. Schedule for testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or test failure.

5. Test forms: Submit all forms used to record and report on Shop Test data, for review, prior to the test. Forms shall include description of test, equipment used, personnel present, equipment tag ID numbers, and measurements made. Forms shall have a place for signature by the chief testing person, and an officer of the company that the tests performed are true, accurate, have met the required criteria, and that the equipment will operate as indicated and specified.

B. Shop test procedures will be reviewed and returned by the Owner within 30 days of receipt. Incorporate comments on the procedures, equipment, or personnel prior to testing. Comments by the Owner will require a resubmission of the shop test procedure and proposed test date.

C. Submit the following within one week after completion of the tests for review:

1. Complete test forms, for each device tested, on forms as reviewed prior to the test.

2. Completed certification, the content of which was reviewed prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if more testing is required. Perform any retesting required to fulfill the technical specification test requirements at no additional cost to the Owner. Additional travel required by the Owner to witness retesting shall be provided by the Contractor, at no additional cost to the Owner. Reimbursement for travel expenses required for retesting will be applied as a debit against the Contractor's subsequent Application for Payment.

1.12 - FIELD TESTING OF EQUIPMENT

A. When required by the technical specifications, perform field testing on installed equipment. Field testing shall be in addition to, and not in lieu of, any shop testing either required or otherwise performed. Perform field testing as a part of the overall physical and functional testing process defined herein and in accordance with the reviewed checkout plan. However, the following specific instructions shall also apply. Provide ninety (90) days written notice indicating the date and time for testing one piece of equipment, or a series of equipment pieces. Submit with this notice the following for review by the Owner:

1. Description of the tests: Specifically outlining how the test will conform to the requirements in the technical specifications.

2. Testing devices that will be used in the tests: Description shall state what portion of the tests that the devices will perform or measure, and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel used to perform the tests: Submit resumes, qualifications, and experience. Personnel must have three years experience with the manufacture and operation of the equipment to be tested and will have participated in five similar tests during this period of experience which shall have occurred over the last five years.

4. Schedule of Testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or test failure.

5. Test forms: Submit Contractor provided test forms to the Owner for recording and reporting on the Field Test data, prior to the test.

6. Material and equipment required for the test: This material and equipment shall be supplied at no additional cost to the Owner.

7. Water and Power For Field Testing: Water and power for field testing shall be provided by the Contractor at no additional cost to the Owner. The Contractor shall provide all temporary piping and wiring required for field testing; and equipment and labor for the reuse of the test water. When testing is performed with water during freezing conditions the Contractor shall take measures to prevent damage to the Work caused by freezing of the water.

8. Provide seven days written notice to the Owner prior to the actual start of any testing. This will include a statement by the Contractor that the equipment and facilities to be tested have been thoroughly inspected and cleaned of construction debris or other extraneous materials and all lubrication, materials, and preparations are completed.

B. Field test procedures will be reviewed and returned by the Owner within 30 days of receipt. Incorporate minor comments on the procedures, equipment, or personnel prior to testing. Major comments by the Owner will require a resubmission of the field test procedure and proposed test date. The Contractor will be notified, in writing, by the Owner if a formal resubmission is required with the transmittal of the review comments.

C. Submit within one week after completion of the tests, the following to the Owner for review:

1. Completed test forms, for each device tested, on forms provided prior to the tests.

2. Completed certification documentation, the content of which was reviewed prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if more testing is required. Perform any retesting required to fulfill the intent of the technical specification test requirements at no additional cost to the Owner.

1.13 - PHYSICAL CHECKOUT AND INSPECTIONS

A. Physical Checkout and inspections provide verification of conformance to the requirements of the technical specifications and contract drawings for physical presence; dimensions; and location, for proper materials, parts, and items; and for integrity of materials, equipment and systems to determine their condition and readiness for field and/or functional testing, and for Substantial Completion. Inspection includes the following elements, where applicable:

1. Exterior areas for backfill, grading, surfacing, drainage, landscaping, roadways, fencing, gates, and signage.

2. Building structural integrity, masonry, architectural, mechanical systems, electrical/lighting, communications, and HVAC systems.

3. Concrete structures for structural integrity, finish, tolerance, durability, appearance, embedded and inserted items, painting and surface applications.

4. Steel structures for member alignment, connection bolts torque, connection welds integrity, painting, fire proofing and surface applications.

5. Mechanical systems and items for installation, alignment and securing, adjustments of packing and seals, lubrication, drive connection and alignment, motor rotation, belt/chain tension, painting or surface applications, and tagging for identification.
Piping systems for material, size, components, direction, alignment of joints and bolting/welding, valves, packing and seals, screens, filters and strainers, painting, identification labeling and color coding, hangers, anchors, supports, and expansion provisions.

6. Electrical and control/instrumentation systems for conduit and tray installation, wire/cable material and size, circuit identification, terminal installation and identification, major switches, circuit breakers and components, and labeling for system identification.

7. Communication systems including telephone, fire/smoke alarm, security, page/party; similar to electrical above.

8. Computer systems by station, function, and network interface.

B. Tanks, pipes, conduits, vessels, equipment, systems, buildings, areas and other items provided under the contract must be clean and free from debris or materials which will interfere with subsequent testing requirements or routine operations.

C. Upon completion of the inspection, submit to the Owner six copies of each completed inspection form, developed by the Contractor and reviewed by the Owner prior to the inspection, signed by an authorized representative of the Contractor who participated in the inspection. The Owner will review and comment on the contents of the forms. A copy of each reviewed inspection form will be provided to the Owner. Should a re-inspection be required, it shall be performed at no additional cost to the Owner

1.14 - FUNCTIONAL TESTING

A. When listed in Part 4, Appendix A of this section, specific functional tests shall be performed in addition to the requirement for shop, field, and other tests called for in the technical specifications. Functional tests will be performed with fluid or gaseous substances that are generally non-septic, non-corrosive, non-toxic, and non-inflammable.

B. Provide thirty (30) days written notice indicating the date and time during which the specific functional test is proposed. Submit with this notice, the following to the Owner for review:

1. Changes to the test procedures (if any) outlined in the technical specifications.

2. Testing devices that will be used in the tests: Description must state what portion of the tests that the devices will perform or measure and device accuracy. Submit sample measurement results and catalog cuts.

3. Personnel used to perform the tests: Submit resumes, and qualifications. Personnel must have three years experience with the operation of the equipment and/or system to be tested and have participated in five similar tests during this period of experience.

4. Schedule for Testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or system test failure.

5. Test forms: Submit test forms for review by the Owner for recording and reporting on the test data prior to the test.

6. List of material and equipment required for the test. This material and equipment will be in addition to that specified in SECTION 01600, CONTROL OF MATERIALS.

C. Operational requirements: Include valve positions, set-ups, and gate positions that are required to run the tests in the written request so that the Owner can anticipate and plan for the testing. Provide all temporary piping, connections or other temporary requirements related to performance of the functional tests including water and power.

D. The Owner may witness these tests, at their option. Provide seven (7) days written notice to the Owner prior to the actual start of any testing. This will include a statement by the Contractor that the equipment and facilities to be tested have been thoroughly inspected and cleaned of construction debris or other extraneous materials and all lubrication, materials, and preparations are completed.

E. Review of the functional test plan and requirements as provided in Part B above by the Owner will be made within two weeks of the test date. Incorporate comments on the procedures, equipment, and personnel prior to testing.

F. Submit within one week after completion of the tests, the following to the Owner for review:

1. Completed test forms, for each device, or system tested, on forms reviewed prior to the test.

2. Completed certification, the content of which was reviewed prior to the tests.

3. A written summary of testing, reporting on the results and summarizing the entire procedure.

4. A schedule for retesting, if more testing is required, including changes to procedures, testing devices, or personnel. Any retesting required to fulfill the intent of the test requirements, due to negligence, poor workmanship, or Products that fail to meet the Contract requirements, shall be at no additional cost to the Owner.

1.15 - CORRECTIONS TO THE WORK

A. Correct any items of Work failing to meet the specified requirements, at no additional cost to the Owner. Correct the nonconforming items by re-work, modification, or if the equipment fails to pass the specified requirements after three testing attempts, replace the items. This includes the provision of all required labor, materials, and requirements for retesting as specified herein, to verify that the items conform with Contract Documents.

1.12 - SAFETY

A. Conduct all specified test procedures in compliance with all applicable safety standards and regulations.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL 1
1.01 SCOPE 1
1.02 MEASUREMENT AND PAYMENT 1
1.03 DEFINITIONS 1
1.04 SUBMITTALS – Not Used 2
1.05 SPECIAL REQUIREMENTS – Not Used 2
PART 2 - PRODUCTS – Not Used 2
PART 3 - EXECUTION 2
3.01 CLOSEOUT PROCEDURES 2
3.02 FINAL CLEANING 2
3.03 ADJUSTING 2

PART 1 - GENERAL

1.01 - SCOPE

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to: Closeout procedures; Final Cleaning; and Adjusting.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS – Not Used

1.05 - SPECIAL REQUIREMENTS – Not Used

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 - CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Provide submittals to Engineer that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payment and sum remaining due.

3.02 - FINAL CLEANING

A. Complete the following cleaning operations, as applicable, before requesting inspection for Certification of Substantial Completion.

1. Remove labels that are not permanent labels.
2. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean.
3. The installing Subcontractor shall wipe surface of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
4. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

3.03 - ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

END OF SECTION

SECTION 01710

CLEANING UP

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 2
1.03 - DEFINITIONS 2
1.04 - SUBMITTALS – Not Used 2
1.05 - PRODUCT HANDLING – Not Used 2
1.06 - DESIGN CRITERIA – Not Used 2
1.07 - SPECIAL REQUIREMENTS – Not Used 2
PART 2 - PRODUCTS – Not Used 2
PART 3 - EXECUTION 2
3.01 – CONTRACT CLOSEOUT 2

PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes all labor, equipment, tools, and materials necessary for the performance of all cleaning up the project sites, as specified herein, and as shown on the drawings.

1. During its progress, the work and the adjacent areas affected thereby shall be cleaned up and all rubbish, surplus materials, and unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.

2. Where material or debris has washed or flowed into or been placed in existing watercourses, ditches, gutters, drains, pipes structures, work done under this contract, or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the work, and the ditches, channels, drains, pipes, structures, and work, etc., shall, upon completion of the work, be left in a clean and neat condition.

3. On or before the completion of the work, the Contractor shall, unless otherwise especially directed or permitted in writing, tear down and remove all temporary buildings and structures built by him; shall remove all temporary works, tools, and machinery or other construction equipment furnished by him; shall remove, acceptably disinfect, and cover all organic matter and material containing organic matter in, under, and around privies, houses, and other buildings used by him; shall remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by his operations in a neat and satisfactory condition.

4. The Contractor shall thoroughly clean all materials and equipment installed by him and his sub-contractors, and on completion of the work shall deliver it undamaged and in fresh and new-appearing condition. All mechanical equipment shall be left fully charged with lubricant and ready for operation.

5. The Contractor shall restore or replace, when and as directed, any public or private property damaged by his work, equipment, or employees, to a condition at least equal to that existing immediately prior to the beginning of operations. To this end the Contractor shall do as required all necessary highway or driveway, walk, and landscaping work. Suitable materials, equipment, and methods shall be used for such restoration. The restoration of existing property or structures shall be done as promptly as practicable as work progresses and shall not be left until the end of the contract period.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS – Not Used

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA – Not Used

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

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

1.07 - SPECIAL REQUIREMENTS – Not Used

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 – CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 01740

WARRANTIES AND BONDS

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING – Not Used 3
1.06 - DESIGN CRITERIA – Not Used 3
1.07 - REFERENCED STANDARDS – Not Used 3
1.08 - WARRANTY REQUIREMENT 3
PART 2 - PRODUCTS AND SERVICES – Not Used 3
PART 3 - EXECUTION 3
3.01 - CONTRACT CLOSEOUT 3

PART 1 - GENERAL

1.01 - SCOPE

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. Standard Product Warranties are pre-printed written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
11. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.04 - SUBMITTALS

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

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

1. Submit written warranties to the Owner prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Owner.
2. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Owner within fifteen days of completion of that designated portion of the Work.
3. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Engineer for approval prior to final execution.
4. Refer to individual Sections of DIVISION 2 through DIVISION 16, inclusive, for specific content requirements, and particular requirements for submittal of special warranties.
5. At Final Completion, compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Operation and Maintenacne.
6. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-in. by 11-in. paper.
7. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification Section in which specified, and the name of the product or work item.
8. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer, supplier, and manufacturer.
9. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name, address, and telephone numbers of the Contractor and equipment supplier.
10. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.
11. Schedule of Special Warranties

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA – Not Used

1.07 - REFERENCED STANDARDS – Not Used

1.08 - WARRANTY REQUIREMENT

A. Related Damages and Losses - When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty - When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost - Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse - Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights or remedies.

E. Rejection of Warranties - The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. Disclaimers and Limitations - Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

G. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

PART 2 - PRODUCTS AND SERVICES – Not Used

PART 3 - EXECUTION

3.01 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 01900

SEISMIC AND WIND REQUIREMENTS

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING – NOT USED 2
1.06 - DESIGN CRITERIA – NOT USED 2
1.07 - REFERENCES 2
1.08 - SEISMIC AND WIND DESIGN REQUIREMENTS 3
1.09 - SPECIFIC COMPONENTS 3
PART 2 – PRODUCTS – Not Used 3
PART 3 – EXECUTION – Not Used 3

PART 1 - GENERAL

1.01 - SCOPE

A. This section establishes the minimum seismic and wind loading design requirements for architectural, mechanical, electrical and non-structural components.

B. The Contractor shall be responsible for compliance with the seismic and wind requirements specified including conformance by all Subcontractors, manufacturers and Suppliers.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. Components are defined as systems, equipment, parts, or other elements, including supporting structures and attachments.
11. The reference Building Code is the building code cited on the structural drawings or specified herein for the design of the basic structure.
12. The specified seismic criteria is defined as the seismic criteria cited on the structural drawings or specified herein for the design of the basic structure.
13. The specified wind criteria is defined as the wind criteria cited on the structural drawings or specified herein for the design of the basic structure.
14. The specified wind criteria is defined as the wind criteria cited on the structural drawings or specified herein for the design of the basic structure.

1.04 - SUBMITTALS

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

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

1. Where specified in the technical specifications, provide and complete the Certificate of Unit Responsibility form in SECTION 01300, SUBMITTALS and submit to Engineer prior to manufacture of components.
2. In addition, submit the following support data along with Certificate of Unit Responsibility:
    a. Certification, signed and sealed by a Professional Structural Engineer registered in the jurisdiction in which the project is located stating that all systems, equipment, and other elements, including supporting structures, attachments and connections are designed to withstand the required seismic and wind forces and displacements.
    b. Codes and specifications to which structural design conforms.

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA – Not Used

1.07 - REFERENCES

A. American Society of Civil Engineers (ASCE):

1. ASCE/SEI 7: Minimum Design Loads for Buildings and Other Structures

B. American Society of Mechanical Engineers (ASME):

1. B31: Code for Pressure Piping

C. International Code Council (ICC):

1. International Building Code

D. Manufacturers Standardization Society of the Valve and Fitting Industry:

1. SP-58: Pipe Hangers and Supports - Materials, Design and Manufacture

E. National Fire Protection Association (NFPA):

1. Standard for the Installation of Sprinkler Systems

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

1.08 - SEISMIC AND WIND DESIGN REQUIREMENTS

A. Refer to structural drawings for project specific seismic and wind requirements and also conform to the requirements specified herein.

B. Seismic and wind design shall conform to the International Building Code and ASCE/SEI 7.

C. Architectural, mechanical, electrical and non-structural components shall be designed and constructed to resist the seismic and wind forces and displacements based upon ASCE/SEI 7, the reference building code, and the specified seismic and wind criteria. In the case of conflict the more stringent requirements shall govern.

D. The interrelationship of components and their effect on each other shall be such that the failure of one component shall not cause the failure of any other component.

E. Components shall be anchored to the building structure to transfer seismic and wind forces. Connections shall be bolted, welded or otherwise positively anchored to the structure. Anchorage shall not rely on friction for force transfer.

F. Post-installed anchors in concrete shall be prequalified for seismic applications in accordance with ACI 355.2, ICC-ES AC-193, or ICC-ES AC-308. Drop-in anchors are prohibited for concrete anchorage.

G. Post-installed anchors in masonry shall be prequalified for seismic applications in accordance with ICC-ES AC-01, or ICC-ES AC-58. Drop-in anchors are prohibited for masonry anchorage.

H. Exceptions: Exemption from the requirements for seismic and wind analysis and design are permitted only to the extent permitted by applicable codes and standards.

1.09 - SPECIFIC COMPONENTS

A. Compound Equipment: Connecting elements for equipment combinations such as pumps and motors, valves and operators, engines and generators, etc. which are not capable of transferring seismic and/or wind loads or accommodating seismic and wind displacements shall be protected by appropriate design.

B. Storage Tanks: Tanks, supporting structures and anchorages shall be designed for the weight of the tank, appurtenances and the tank contents at the maximum capacity. Tank contents shall not be considered in resistance to seismic and wind loads.

C. Ductwork: Equipment installed within ductwork shall be independently supported and braced. Support and bracing of heating and cooling coils shall account for the weight of the contents.

D. Piping Systems: Support and bracing of piping systems shall account for the weight and hydrodynamic effects of the contents.

E. Pressure Piping: Pressure piping support and bracing shall conform to ASME B 31 in addition to the force and displacement requirements of the reference code.

F. Sprinkler Systems: Sprinkler system support and bracing shall conform to NFPA 13 in addition to the force and displacement requirements of the reference code.

G. General Supports: Pipe, duct, raceways and cable tray supports and bracing shall conform to the AISC Manual of Steel Construction and MSS SP-58 in addition to the force and displacement requirements of the reference code.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

END OF SECTION

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SECTION 02100

SITE PREPARATION

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS – Not Used 2
1.05 - PRODUCT HANDLING – Not Used 2
1.06 - DESIGN CRITERIA 2
1.07 - SPECIAL REQUIREMENTS 2
PART 2 - PRODUCTS – Not Used 2
PART 3 - EXECUTION 3
3.01 - GENERAL REQUIREMENTS 3
3.02 - CLEARING, GRUBBING, TREE AND STUMP REMOVAL 3
3.03 - DISPOSAL OF WASTE MATERIALS 3
3.04 - SEDIMENT AND EROSION CONTROL 4
3.05 - CONTRACT CLOSEOUT 4

PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes all labor, equipment, tools, and materials necessary for the performance of all operations in connection with clearing and grubbing, and the removal of pavement, curbing and all incidental and appurtenant work pertaining thereto, as specified herein, and as shown on the drawings.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS – Not Used

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA

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

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

1.07 - SPECIAL REQUIREMENTS

A. Prior to the performance of any work of this section or any related work required by other sections of the specifications, the Limit of Work Line shall be laid out and staked in the field by the Contractor, according to the drawings. The Contractor shall be responsible for maintaining the Limit of Work Line during the construction operation.

B. At all times throughout the duration of this contract, the Contractor shall be responsible for the appearance and condition of the area within and surrounding the project site. The Contractor shall repair or replace, at no additional expense to the Owner, any structures, either natural or man-made such, as but not limited to, utilities, trees, plants, water bodies, and pavements that are damaged or destroyed by any actions or sequences of events related to the Contractor's operations.

C. Any existing plant materials designated to be saved, protected and/or undisturbed, that are cut or damaged without prior approval of the Engineer, shall be replaced in kind and size by the Contractor, at no expense to the Owner. If the Engineer agrees that tree replacement is impossible or impractical, the Contractor shall pay the Owner damages of One Thousand Five Hundred Dollars ($1,500.00) per inch of diameter measured four (4) feet from the ground surface.

D. Disposal of waste/surplus materials may involve securing permits, licenses, or approvals, which may vary according to the type of material to be disposed of prior to the start of construction. The Contractor shall apply for these, as they may be required by the various governing agencies and pay all required fees. The Contractor shall have sole responsibility for the legal disposal of all waste surplus material of this project. The Contractor shall be responsible for any and all fines due to any illegal activity with regards to the disposal of waste/surplus materials.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 - GENERAL REQUIREMENTS

A. All graded areas, and all areas within the Limit of Work Line on which proposed work is to be installed, shall be cleared and grubbed as indicated on the drawings.

B. The Contractor shall be careful to note any areas that may be designated on the drawings to receive only selective clearing and thinning.

3.02 - CLEARING, GRUBBING, TREE AND STUMP REMOVAL

A. Trees

1. Preparation of the site shall include the complete removal of all trees within the Limit of Work Line, except in those areas where selective clearing and thinning is required. Any trees within the Limit of Work Line not to be removed shall be protected from damage during clearing and construction operations by barriers or by such other methods as conditions may require. No construction materials or debris shall be stored or stockpiled, or vehicles parked or operated within the limits of the branch spread of the trees to be saved.

2. Clearing operations shall be performed in a manner which will prevent damage by falling trees to trees left standing or to structures under construction, and by methods which will provide for the safety of employees and other persons.

3. Limited clearing and thinning shall be performed in areas identified on the drawings, as required or as directed by the Engineer. This work will involve the removal of brush, small trees, dead, damaged and/or diseased trees. The Engineer will tag or otherwise mark and designate trees and brush to be saved. Where branches of trees which are to be saved interfere with the work, limbs and branches shall be trimmed off neatly and cleanly close to the bole of the tree or to main branches. Cut surfaces shall be painted with a tree wound paint. Pruning shall be done in accordance with the National Arborist Association "Pruning Standards for Shade Trees" and only by persons experienced with this work. The Contractor shall legally dispose of all branches and limbs off site.

4. All trees, above a four-inch caliper, which are designated to be removed shall become the property of the Contractor to be disposed of by sale or otherwise, provided that such material shall be removed from the property of the Owner before the completion of the site clearance work. The Owner assumes no responsibility for the protection and safekeeping of such materials. The Contractor shall be responsible for all taxes, if any, incurred in the sale of materials.

B. Grubbing shall consist of the grubbing up, removal and disposal of all stumps, roots larger than 1-1/2 inches in diameter, and matted root formations from the designated areas. All rocks or boulders near the existing surface grade, which may interfere with planned construction operations, shall be removed and disposed of as surplus/waste material, or used as fill, where specifically permitted by the Engineer.

3.03 - DISPOSAL OF WASTE MATERIALS

A. All cleared and grubbed materials shall be legally disposed of off-site by the Contractor. Burning of cleared and grubbed materials is not permitted.

B. 500 Cubic yards of pavement millings shall be disposed of at the Orleans Public Works Department, 40 Giddiah Hill Road, Orleans, MA 02563. The remaining pavement millings shall be legally disposed of off-site by the contractor.

C. All waste materials shall be legally disposed of off-site by the Contractor.

3.04 - SEDIMENT AND EROSION CONTROL

A. The Contractor shall take such actions as may be required to ensure that his construction activities do not interfere with or adversely impact the hydraulic characteristics or aesthetic qualities of any natural or manmade watercourse or drain.

B. The Contractor shall provide acceptable siltation control devices such as straw bales and/or straw wattles sediment control devices; control basins for the settling and filtering of fine sands, silts and clay resulting from rainfall runoff or dewatering operations. Any natural areas or manmade structures which have been affected by siltation or erosion due to construction activities shall be restored to their pre-construction condition by the Contractor at no additional cost to the Owner.

C. For more specific requirements for control of erosion and siltation, refer to SECTION 01140, ENVIRONMENTAL PROTECTION.

3.05 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02140

DEWATERING

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 2
1.03 - DEFINITIONS 2
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 3
1.06 - DESIGN CRITERIA 3
1.07 - QUALITY ASSURANCE 3
1.06 - PROJECT/SITE CONDITIONS 4
PART 2 - PRODUCTS 4
2.01 - MATERIALS 4
PART 3 - EXECUTION 4
3.01 - EXECUTION 4
3.02 - CONTRACT CLOSEOUT 5

PART 1 - GENERAL

1.01 - SCOPE

A. Design, furnish, operate, maintain, and remove temporary dewatering systems to control groundwater and surface water to maintain stable, undisturbed subgrades, and permit work to be performed under dry and stable conditions. Work to be done as part of dewatering includes, but is not limited to:

1. Lower the groundwater level.
2. Lower hydrostatic pressure.
3. Prevent surface water from entering the excavation and other work areas on the project during construction.
4. Control and remove seepage, surface water, and precipitation in excavations and/or work areas.
5. Implement erosion control measures for disposing of discharge water.
6. Provide and monitor observation wells and geotechnical instrumentation as specified.

B. Groundwater within the excavation area shall be lowered to at least 2 feet below the lowest excavation levels as specified and as indicated.

C. Common dewatering methods include, but are not limited to, sump pumping, deep wells, well points, vacuum well points or any combinations thereof.

D. The Contractor shall obtain the required permits for discharge from the Contractor’s dewatering systems in accordance with 40 CFR Part 122 and 61 FR 19284. The discharge location shall be in accordance with permit requirements.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Brochures and/or Catalogue Cuts of All Materials.
2. Qualification of the Contractor’s dewatering specialist's or firm's qualifications a minimum of four (4) weeks prior to execution of any dewatering. The submittal shall include, but not be limited to:
    a. Qualifications of specialist's or firm's Registered Professional Engineer in the Commonwealth of Massachusetts and as specified in Paragraph 1.07.
    b. Qualifications of specialist's or firm's field representative, as specified in Paragraph 1.07, who shall oversee the installation, operation and maintenance of the dewatering system.
3. Submit a dewatering plan at least two weeks prior to start of any dewatering operation. Do not submit design calculations. The review will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:
    a. Dewatering plan and details stamped and signed by a Registered Professional Engineer in the Commonwealth of Massachusetts.
    b. Certificate of Design: Refer to SECTION 01300, SUBMITTALS.
    c. A list of equipment including, but not limited to, pumps, prime movers, and standby equipment.
    d. Detailed description of dewatering, maintenance, and system removal procedures.

e. Monitoring plan and details, including, but not limited to, number and locations of observation wells, and geotechnical instruments such as settlement markers and piezometers, and frequency of reading the monitoring devices.

f. Erosion/sedimentation control measures, and methods of disposal of pumped water.

g. List of all applicable laws, regulations, rules, and codes to which dewatering design conforms.

h. List of assumptions and mode for design of dewatering, including but not limited to groundwater levels, soil profile, permeabilities, and duration of pumping.

i. The proposed methods for removing the dewatering system elements, including method to ensure that no significant ground movements will occur as a result of extraction that could adversely impact any structures. If deemed necessary, the Contractor shall describe locations of, or conditions under which dewatering systems will be left in place, including proposed cutoff levels and methods for tremie grouting the wells or well points.

4. Measurement records consisting of observation well groundwater records and the geotechnical instrumentation readings within one day of monitoring.

5. A modified dewatering plan within 24 hours, if open pumping from sumps and ditches results in boils, loss of fines or softening of the ground.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance.

B. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

C. If stored for more than two (2) weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

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

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

1.07 - QUALITY ASSURANCE

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

B. Employ the services of a dewatering specialist or firm having the following qualifications:

1. Have completed at least five (5) successful dewatering projects of equal size and complexity and with equal systems within the last five (5) years.

2. Retain the services of a Registered Professional Engineer registered in the Commonwealth of Massachusetts and having a minimum of five (5) years experience in the design of well points, deep wells, or equal systems.

3. Retain the services of a field representative having a minimum of 5 years experience in installation of well points, deep wells, or equal systems.

C. If subgrade soils are disturbed or become unstable due to dewatering operation or an inadequate dewatering system, notify the Engineer, stabilize the subgrade, and modify system to perform as specified at no additional cost to the Owner.

D. Notify the Engineer immediately if any settlement or movement is detected on structures. If the settlement or movement is deemed by the Engineer to be related to the dewatering, take actions to protect the adjacent structures and submit a modified dewatering plan to the Engineer within 24 hours. Implement the modified plan and repair any damage incurred to the adjacent structures at no additional cost to the Owner.

E. If oil and/or other hazardous materials are encountered after dewatering begins, immediately notify the Engineer.

1.06 - PROJECT/SITE CONDITIONS

A. Subsurface Conditions: Refer to Appendix A.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Provide observation wells, settlement markers, piezometers and/or any other geotechnical instruments in accordance with the submitted dewatering plan or as specified.

B. Provide casings, well screens, piping, fittings, pumps, power and other items required for dewatering system.

C. Provide sand and gravel filter around the well screen. Wrapping geotextile fabric directly around the well screen shall not be allowed.

D. When deep wells, well points, or vacuum well points are used, provide pumping units capable of maintaining high vacuum and handling large volumes of air and water at the same time.

E. Provide and store auxiliary dewatering equipment, consisting of pumps and hoses on the site in the event of breakdown, at least one (1) pump for every five (5) used.

F. Provide and maintain erosion/sedimentation control devices as indicated or specified and in accordance with the dewatering plan.

G. Provide temporary pipes, hoses, flumes, or channels for the transport of discharge water to the discharge location.

H. Provide cement grout having a water to cement ratio of 1 to 1 by volume.

PART 3 - EXECUTION

3.01 - EXECUTION

A. Execution of any earth excavation, installing earth retention systems, and dewatering shall not commence until the related submittals have been reviewed by the Engineer with all Engineer's comments satisfactorily addressed and the geotechnical instrumentation has been installed.

B. Furnish, install and maintain dewatering system in accordance with the dewatering plan.

C. Permanent utilities and piping shall not be used as part of the dewatering system.

D. Carry out dewatering program in such a manner as to prevent undermining or disturbing foundations of existing structures or of work ongoing or previously completed.

E. Do not excavate until the dewatering system is operational.

F. Unless otherwise specified, continue dewatering uninterrupted until all structures, pipes, and appurtenances below groundwater level have been completed such that they will not be floated or otherwise damaged by an increase in groundwater elevation.

G. Discontinue open pumping from sumps and ditches, if such pumping is resulting in boils, loss of fines, softening of the ground, or instability of the slopes. Modify dewatering plan and submit to the Engineer at no additional cost to the Owner.

H. Where subgrade materials are disturbed or become unstable due to dewatering operations, remove and replace the materials in accordance with SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING at no additional cost to the Owner.

I. Dewatering Discharge

1. Install sand and gravel filters in conjunction with well points and deep wells to prevent the migration of fines from the existing soil during the dewatering operation.
2. Transport pumped or drained water to discharge location without interference to other work, damage to pavement, other surfaces, or property.
3. Provide separately controllable pumping lines.
4. The Engineer reserves the right to sample discharge water at any time.
5. Immediately notify the Engineer if suspected contaminated groundwater is encountered. Do not pump water found to be contaminated with oil or other hazardous material to the discharge locations.
6. The Contractor will be subject to a $5,000./day fine for direct discharge of dewatering water to a wetland or stormwater system without treatment to remove silt and sediment from the water.

J. Monitoring Devices and Records

1. Install, maintain, monitor and take readings from the observation wells and geotechnical instruments in accordance with the dewatering plan.
2. Install settlement markers on structures within the zone of influence for dewatering a distance equal to twice the depth of the excavation, from the closest edge of the excavation. Conduct and report settlement surveys to 0.01 feet.
3. For linear excavations such as trenches, the zone of influence for dewatering shall be established by the Contractor's specialist based on the soil conditions and depth of dewatering.
4. For large rectangular, square or circular mass excavations the zone of influence shall be defined by the actual cone of watering influence corresponding to a 10 percent increase in effective vertical stress.

K. Install and maintain erosion/sedimentation control devices at the point of discharge as indicated or specified and in accordance with the dewatering plan.

L. Removal

1. Do not remove dewatering system without written approval from the Engineer.
2. Backfill and compact sumps or ditches with screened gravel or crushed stone wrapped with geotextile fabric in accordance with SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.
3. All dewatering wells shall be abandoned upon completion of the work, and completely backfilled with cement grout.

3.02 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 02160

EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 2
1.03 - DEFINITIONS 2
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1.05 - PRODUCT HANDLING 4
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1.08 - REFERENCES 6
1.09 - PROJECT/SITE CONDITIONS 6
PART 2 - PRODUCTS 6
2.01 - MATERIALS 6
2.02 - EQUIPMENT 7
PART 3 - EXECUTION 7
3.01 - INSTALLATION 7
3.02 - GROUND DEFORMATION ADJACENT TO EXCAVATION SUPPORT SYSTEMS 7
3.03 - REMOVAL OF EARTH RETENTION SYSTEM 8
3.04 - CONTRACT CLOSEOUT 8

PART 1 - GENERAL

1.01 - SCOPE

A. Design, furnish and install excavation support systems as required to maintain lateral support, prevent loss of ground, limit soil movements to acceptable limits and protect from damage existing and proposed improvements including, but not limited to, pipelines, utilities, structures, roadways, railroads and other facilities.

B. The requirement of sheeting left in place in areas indicated on the drawings does not relieve the Contractor from the responsibility of furnishing and installing proper excavation support systems in other areas.

C. Common types of excavation support system include, but are not limited to, singular or multiple stages comprised of cantilevered or internally braced soldier piles and lagging, steel sheet pile wall, timber sheet pile wall, trench box, or combinations thereof. Trench box temporary excavation support system is only acceptable for pipe or utility trench excavations. Temporary unsupported open cut excavation with stable sloping sides is allowed where applicable.

D. Wherever the word "sheeting" is used in this section or on the contract drawings, it shall be in reference to any type of excavation support system specified except trench box.

E. Construction of the excavation support systems shall not disturb the existing structures or the completed proposed structures. Damage to such structures shall be repaired by the Contractor at no additional cost to the Owner.

F. Adjacent structures are those that bear upon soils above the proposed excavation depth and within a distance equal to twice the total depth of the excavation away from the closest edge of the excavation. Monitor and protect adjacent structures as specified and indicated.

G. Vibration monitoring for excavation support systems will be performed by Contractor's vibration consultant and monitoring firm. Vibration due to Contractor's operations shall not exceed thresholds specified herein.

H. Construction operations not to exceed specified noise limits in accordance with SECTION 01110, ENVIRONMENTAL PROTECTION PROCEDURES.

I. The Contractor shall bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval or cave-ins as a result of improper installation, maintenance or design of the excavation support systems. The Contractor shall pay for all claims, costs and damages that arise as a result of the work performed at no additional cost to the Owner.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

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

1. Submit the following qualifications four (4) weeks prior to the construction:

a. Qualifications of independent vibration consulting and monitoring firm as specified in Paragraph 1.07 D.

b. Qualifications of Contractor's excavation support system designer as specified in Paragraph 1.07 G.

c. Qualifications of Contractor's excavation support system installer as specified in Paragraph 1.07 H.

d. Qualifications of Contractor's independent tieback testing laboratory as specified in Paragraph 1.07 I, if a tieback system is utilized.

e. Qualifications of Contractor's excavation support system installation supervisor as specified in Paragraph 1.07 J.

f. Qualifications of vacuum excavation subcontractor as specified in Paragraph 1.07 F, if deformation monitoring points (DMPs) for utilities are utilized.

2. Submit an excavation support plan stamped and signed by a Registered Professional Engineer in the Commonwealth of Massachusetts, at least two weeks prior to start of the construction. Do not submit design calculations. The review will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

   a. Proposed excavation support system(s), details, location, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.

   b. Certificate of Design: Refer to SECTION 01300, SUBMITTALS.

   c. A list of all design assumptions, including safety factors used for the excavation support system(s) and all lateral pressures used for each system.

   d. If utilizing a tieback system, include tieback installation procedures and criteria for acceptance of tiebacks for performance and proof tests. Submit the tieback testing results to the Engineer for information only.

   e. Requirements of dewatering during the construction.

   f. Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.

   g. List of equipment used for installing the excavation support systems.

   h. Monitoring schedule, installation procedures and location plans for vibration/noise monitoring, geotechnical instrumentation (deformation monitoring points, inclinometers, etc.) and observation wells/piezometers to monitor ground, excavation support system, adjacent structures and groundwater fluctuation during the entire construction period.

3. Submit a Construction Contingency Plan specifying the methods and procedures to maintain excavation support system stability if the allowable movement of the adjacent ground and adjacent structures is exceeded.

4. Monitoring data within one (1) day of data collection from vibration and noise recording equipment, observation wells, deformation monitoring points and offset lines. Data shall include:

   a. Horizontal and vertical movements of geotechnical instruments and groundwater readings.

   b. New movements since the initial readings of the geotechnical instruments.

   c. Weekly summary in tabular and graphic form at the end of each week.

   d. A schematic plan of excavation and/or relevant construction activities at the time of monitoring.

5. For excavation support systems left in place, submit the following as-built information prior to backfilling and covering the excavation support systems:

   a. Survey locations of the temporary excavation support systems, including coordinates of the ends and points of change in direction.

   b. Type of the excavation support system.

   c. Elevations of top and bottom of the excavation support systems left in place.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

B. If stored for more than two (2) weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Store sheeting and bracing materials to prevent sagging which would produce permanent deformation. Keep concentrated loads which occur during stacking or lifting below the level which would produce permanent deformation of the material.

1.06 - DESIGN CRITERIA

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

B. Design of excavation support systems shall meet the following minimum requirements:

1. Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, temporary stockpiles, construction loads, roadways, railroads, and other surcharge loads.

2. Design a bracing system to provide sufficient reaction to maintain stability.

3. Limit movement of ground adjacent to the excavation support system to be within the allowable ground deformation as specified.

4. Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of braced excavation support systems shall not be less than 5 feet below the bottom of the excavation.

5. Design temporary excavation support systems to withstand an additional 2 feet of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.

6. Maximum width of pipe trench excavation shall be as indicated on the drawings.

7. Do not cast permanent structure walls directly against excavation support walls.

8. The design location of the excavation support wall shall be determined such that the installed wall and bracing system components are all located outside the limits of the permanent structure. Construction tolerances (e.g. wall verticality) shall be considered in determining the plan location.

1.07 - QUALITY ASSURANCE

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

B. Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring", and all other applicable laws, regulations, rules, and codes.

C. Construction operations to conform to noise regulations provided in the Noise Control Plan and as required by local regulations.

D. Retain the services of an independent vibration consulting firm with the following in-house personnel to conduct the following vibration monitoring requirements:

1. Preparing, reviewing and signing of monitoring plans and daily reports, and overseeing of the monitoring and interpretation of the vibration data shall be performed by personnel with the following qualifications:

a. Be a Registered Professional Engineer in the Commonwealth of Massachusetts.

b. Have a minimum of five (5) years' experience in the vibration consulting field.

c. Have successfully completed at least five (5) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

2. Assist Contractor in selecting pile driving equipment which will generate the lowest vibration and noise levels.

3. Installation, monitoring and interpretation of monitoring equipment shall be performed by personnel with the following qualifications:

a. Have at least three (3) years of experience in the operation of monitoring equipment proposed for use and interpretation of records produced by such equipment.

b. Have installed, operated, monitored and interpreted equipment and records on at least three (3) projects with vibration-inducing construction operations, pile driving, and noise levels equal to or more severe than those to be encountered.

E. The peak particle velocity for pile driving, or other vibration-inducing operations, shall not exceed the following:

Type of Concrete	Age of Concrete hrs.	Peak Particle Velocity in/sec
Mass Concrete (footings, mats, slab-on-grade, fill concrete, etc.)	0 – 11 11 and over	1.0 2.0
Concrete Structures (walls, columns, elevated slabs, etc.)	0 – 11 11 – 24 24 and over	0.5 1.0 2.0
Existing Structures, residences or utilities		0.5

F. If utilizing DMPs for utilities, vacuum excavation shall be performed by subcontractor having five (5) years of experience in non-destructive vacuum excavation methods for utilities.

G. Prepare design, including calculations and drawings, under the direction of a Professional Engineer registered in the Commonwealth of Massachusetts and having the following qualifications:

1. Not less than ten (10) years' experience in the design of specific excavation support systems to be used.

2. Completed not less than five (5) successful excavation support system projects of equal type, size, and complexity within the last five (5) years.

H. Excavation Support System Installer's Qualifications:

1. Not less than five (5) years' experience in the installation of similar types and equal complexity as the proposed system.

2. Completed not less than five (5) successful excavation support systems of similar type and equal complexity as the proposed system.

I. If utilizing a tieback system, employ an independent testing laboratory to test the tieback system with the following qualifications:

1. Be accredited by the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program.

2. Employ personnel conducting testing who are trained in the methods and procedures to test and monitor tieback systems of similar type and equal complexity, as the proposed system.

3. Have not less than five (5) years' experience in testing of tieback systems of similar type and equal complexity as the proposed system.
4. Have successfully tested at least three (3) tieback systems of similar type and equal complexity as the proposed system.

J. Install all temporary excavation support systems under the supervision of a supervisor having the following qualifications:

1. Not less than five (5) years' experience in installation of systems of similar type and equal complexity as the proposed system.
2. Completed at least five (5) successful excavation support systems of similar type and equal complexity as the proposed system.

K. All welding shall be performed in accordance with AWS D1.1.

1.08 - REFERENCES

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

1. A36: Standard Specification for Carbon Structural Steel
2. A416: Standard Specification for Low Relaxation, Seven-Wire Steel Strand for Prestressed Concrete
3. A572: Standard Specification for High-Strength Low Alloy Columbium Vanadium Structural Steel.
4. A722: Specification for High-Strength Steel Bars for Prestressed Concrete
5. A615: Standard Specifications for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

B. American Wood Protection Association (AWPA) Standards.

C. American Welding Society (AWS) Code: D1.1.

D. Federal Standard, FS TT-W-571 and Supplements: Wood Preservation and Treating Practices.

E. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching and Shoring.

F. American Concrete Institute (ACI)

1. ACI 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

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

1.09 - PROJECT/SITE CONDITIONS

A. Subsurface Conditions: Refer to SECTION 01310, MISCELLANEOUS TESTING AND SOIL DATA.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Structural Steel: All soldier piles, wales, rakers, struts, wedges, plates, waterstops and accessory steel shapes shall conform to ASTM A36.

B. Steel Sheet Piling: ASTM A572, continuous interlocking type.

C. Timber Lagging Left in Place: Pressure treated per appropriate AWPA standards.

D. Tieback Tendons: Tieback tendons shall be high strength steel wire strand cables conforming to ASTM A416, or bars conforming to ASTM A722. Splicing of individual cables shall not be permitted.

E. Raker Ties: ASTM A615 Grade 60.

F. Cement Grout Materials and Admixtures for Tieback Anchorages: Grout cube strength shall be a minimum 3500 psi at 7 days and 5000 psi at 28 days.

G. Concrete: SECTION 03300, CAST-IN-PLACE CONCRETE.

H. Tamping tools adapted for backfilling voids after removal of the excavation support system.

I. Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in OSHA's 29 CFR Part 1926 Subpart P.

2.02 - EQUIPMENT

A. Vibration Monitoring Equipment to include:

1. Solar Vibration Monitor (SVM) Automated Vibration Monitor with solar panel.

2. Monthly provision of equipment and services to include:

a. Self-standing frame, weatherproof enclosure, vibration monitor, triaxial geophone with 6ft cable, battery with charging regulator, solar panel, cell modem with data service, and project website with automated processing data archive, and alerts by email or SMS.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Installation of the excavation support systems shall not commence until the related earth excavation and dewatering submittals have been reviewed by the Engineer with all Engineer’s comments satisfactorily addressed.

B. Install excavation support systems in accordance with the excavation support plan.

C. If utilizing a tieback system, all performance and proof tests shall be conducted in the presence of the Engineer. Testing performed without the Engineer present will not be accepted. Repeat testing in the Engineer's presence at no additional cost to the Owner.

D. Do not drive sheeting within 100 feet of concrete less than seven (7) days old.

E. Carry out program of excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures of work ongoing or previously completed.

F. Bottom of the trench box excavation support system shall be above the pipe invert prior to installing the pipe.

G. Install and read geotechnical instrumentation in accordance with the excavation support plan. Notify the Engineer immediately if any geotechnical instrumentation is damaged. Repair or replace damaged geotechnical instrumentation at the sole option of the Engineer and at no additional cost to the Owner.

H. Continuously monitor movements of the ground adjacent to excavation support systems and adjacent structures. In events of the measured movements approaching or exceeding the allowable movements, take immediate steps to arrest further movement by revising procedures such as providing supplementary bracing, filling voids behind the trench box, supporting utilities or other measures (Construction Contingency Plan) as required.

I. Notify utility owners if existing utilities interfere with the excavation support system. Modify the existing utility with the utility owner’s permission or have the utility owner make the modifications at no additional cost to Owner.

3.02 - GROUND DEFORMATION ADJACENT TO EXCAVATION SUPPORT SYSTEMS

A. Allowable Vertical (heave/settlement) and Lateral Movements: 2 inches maximum for the trench box excavation support system, and 1 inch maximum for other types of excavation support systems at any location behind the excavation support system.

B. Monitoring personnel shall use a procedure for reading and recording geotechnical instrumentation data which compares the current reading to the last reading during data collection to eliminate spurious readings.

C. Plot the observed ground deformation readings versus time. Annotate the plots with construction loading and excavation events having an impact on the readings. Evaluate plots by means of secondary rate-of-change plots to provide early warning of accelerating ground movements.

D. Notify the Engineer when the allowable ground deformation is exceeded.

E. Implement Construction Contingency Plan under direction of the excavation support system designer and the Engineer.

3.03 - REMOVAL OF EARTH RETENTION SYSTEM

A. Sheeting shall be left in place unless otherwise indicated or approved in writing by the Engineer.

B. When indicated or approved by the Engineer, remove the excavation support system without endangering the constructed or adjacent structures, utilities, or property. Immediately backfill all voids left or caused by withdrawal of excavation support systems with bank-run gravel, screened gravel or select borrow by tamping with tools specifically adapted for that purpose.

C. When tiebacks are used, release tension in tiebacks as the excavation is backfilled. Do not leave tensioned tieback in place at the completion of the work.

D. The excavation support system left-in-place shall be cut-off a minimum of 2 feet below the bottom of the next higher foundation level or a minimum of 5 feet below finished grade.

E. Conduct survey of the locations and final cut-off elevations of the excavation support systems left in place.

3.04 – VIBRATION MONITORING

A. The default alarm is to be set at 0.5 inches/second which is half of the allowable limit. If vibrations exceed this default setting, the Contractor shall stop all construction activities and reassess.

B. During the vibration monitoring period, daily reports are to be generated, distributed, and reviewed by the Town, Engineer and Contractor.

C. Vibration Monitoring to occur only during construction activity. Upon construction completion, equipment shall be legally removed.

D. Contractor to cover setup fee for project website.

E. Contractor to cover field service rate.

3.05 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02210

EARTH EXCAVATION, BACKFILL, FILL AND GRADING

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PART 1 - GENERAL

1.01 - SCOPE

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

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

C. Perform the following earth excavation, backfill, fill and grading as indicated or specified:

1. Make excavations to accommodate piping, conduits, foundations and other structures.
2. Provide materials for backfilling excavations and constructing embankments and fills as indicated and specified.
3. Construct embankments of compacted materials. Grade surfaces to meet finished grades indicated.
4. Immediately notify the Engineer if suspected hazardous materials are encountered and cease operations in that part of work.
5. Remove boulders within the excavation limits.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.
10. Percentage of compaction is defined as the ratio of the field dry density, as determined by ASTM D1556 to the maximum dry density determined by ASTM D1557 Procedure C, multiplied by 100.
11. Proof Roll: Compaction with a minimum of 4 passes of a vibratory steel drum or rubber tire roller. Vibratory plate compactors shall be used in small areas where vibratory steel drum or rubber tire roller cannot be used.

12. Acceptable Material: Material which does not contain organic silt or organic clay, peat, vegetation, wood or roots, stones or rock fragments over 6-inch in diameter, porous biodegradable matter, loose or soft fill, excavated pavement, construction debris, or refuse. Stones or rock fragments shall not exceed 40 percent by weight of the backfill material.

13. Unacceptable Materials: Materials that do not comply with the requirements for the acceptable material or which cannot be compacted to the specified or indicated density.

1.04 - SUBMITTALS

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

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

1. Qualifications of the Contractor's Independent Testing Laboratory as specified in Paragraph 1.06.G, four (4) weeks prior to the execution of any earth excavation, backfilling, filling, or compaction process.

2. Submit an excavation, backfilling, and filling plan at least two weeks prior to start of any earth moving activities. The review will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include, but not be limited to the following items:

a. Detailed sequence of work.

b. General description of construction methods.

c. Numbers, types, and sizes of equipment proposed to perform excavation and compaction.

d. Details of dust control measures.

e. Proposed locations of stockpiled excavation and/or backfill materials.

f. Proposed surplus excavated material off-site disposal areas and required permits.

g. Details of erosion and sedimentation control measures which will prevent erosion and sedimentation during the earth moving activities.

3. The following material submittals shall be submitted to the Engineer prior to backfilling and filling:

a. Screened Gravel: As specified in SECTION 02223, SCREENED GRAVEL.

b. Bank-run Gravel: As specified in SECTION 02224, BANK-RUN GRAVEL.

c. Select Borrow: As specified in SECTION 02225, SELECT BORROW.

d. Crushed Stone: As specified in SECTION 02435, CRUSHED STONE.

e. Other Acceptable Materials: Laboratory testing results of gradation and moisture-density relationship. Submittal shall include specific location of the source and the date when sample was taken.

4. During Construction, submit written confirmation of fill lift thickness, in-place soil moisture content, and percentage of compaction to the Engineer before placing the next lift or constructing foundations.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

B. All products delivered to the project site shall be accompanied by test reports certifying that the product conforms to the ASTM specifications listed herein, where applicable. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

C. If stored for more than two (2) weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

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

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

1.07 – QUALITY ASSURANCE

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

B. Dewatering and Groundwater Control: Provide and maintain as specified in SECTION 02140, DEWATERING.

C. Excavations shall be performed in the dry, and kept free from water, snow and ice during construction. Bedding and backfill material shall not be placed in water. Water shall not be allowed to rise upon or flow over the bedding and backfill material.

D. Temporary Excavation Support Systems: Provide and maintain as specified in SECTION 02160, EXCAVATION SUPPORT SYSTEMS.

1. The Contractor shall be solely responsible for making all excavations in a safe manner. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) and State requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

2. Do not excavate, construct embankments, or fill until all the required submittals have been reviewed by the Engineer.

3. Formulate excavation, backfilling, and filling schedule and procedures to eliminate possibility of undermining or disturbing foundations of partially and completed structures, pipelines and embankments or existing structures and pipelines.

E. Employ an Independent Testing Laboratory to perform particle size and gradation analyses in accordance with ASTM D422, and to determine compactibility in accordance with ASTM D1557 for all the proposed backfill and fill materials, and monitoring field compaction operations. The Contractor’s Independent Testing Laboratory shall have the following qualifications:

1. Be accredited by the American Associates of State Highway and Transportation Officials (AASHTO) Accreditation Program.

2. Have three (3) years’ experience in sampling, testing and analysis of soil and aggregates, and monitoring field compaction operations.

3. Able to provide three (3) references from previous work.

F. Field Testing and Inspections

1. By Contractor’s Independent Testing Laboratory, acceptable to the Engineer, at Contractor's expense as specified in herein.

2. Location of tests mutually acceptable to testing laboratory and the Engineer or as directed by the Engineer.

3. In the event compacted material does not meet specified in-place density, recompact material and retest this area until specified results are obtained at no additional cost to the Owner.

4. Contractor’s Independent Testing Laboratory to perform inspection at least once daily to confirm lift thickness and compaction effort for entire fill area.

G. Methods of Field Testing

1. In-Place Density: ASTM D1556, ASTM D2167, or ASTM D6938.

2. In-Place Moisture Content: ASTM D6938, ASTM D4944, or ASTM D4959.

H. Material Testing Frequency: The following testing frequencies are minimum required for all structural and non-structural fill, grading and embankment.

1. Field In-Place Density and Moisture Content - Screened gravel and crushed stone shall be compacted as specified and indicated. For other backfill and fill materials, minimum test frequency shall be as follows, and no less than one test per:

    a. Trenches under structures' foundation preparation or roadways subbase: Every 1,000 lin. ft. per lift.

    b. Trenches in areas without structures or roadways: Every 1,000 lin. ft. per alternate lift.

    c. Paved Roadways: Every 200 lin. ft. per lift.

    d. Paved Areas: 3,500 sq. ft. per lift.

    e. Under Structure: 1,000 sq. ft. per lift.

    f. Around Structures: 1,500 sq. ft. per lift.

    g. Embankment Fills: 10,000 sq. ft. per lift.

2. Moisture Density - One per source, except for screened gravel and crushed stone. Repeat the moisture density test for every 5,000 cubic yard of material use, and whenever visual inspection indicates a change in material gradation as determined by the Engineer.

3. Gradation Analysis – A minimum of one per source and for each moisture density test and whenever visual inspection indicates a change in material gradation.

4. Liquid Limit, Plastic Limit and Plasticity Index - Minimum of one test per 5,000 cubic yard of soil for use as fill material and whenever classification of material is in doubt as determined by the Engineer

I. Construction Tolerances

1. Construct finished surfaces to plus or minus 1 inch of the elevations indicated.

2. Grade cut and fill areas to plus or minus 0.20 foot of the grades indicated.

3. Complete embankment edges to plus or minus 6 inches of the slope lines indicated.

4. Provide the Engineer with adequate survey information to verify compliance with above tolerances.

J. Cut pavement with a saw or pneumatic tools to prevent damage to remaining pavement without extra compensation. Where pavement is removed in large pieces, dispose of pieces before proceeding with excavation.

K. Pipes, drains, and other utilities may exist in certain locations not indicated on drawings. No attempt has been made to show all services. Completeness or accuracy of information given is not guaranteed.

L. Dig test pits considered as incidental to the normal excavation as indicated and specified in this Section, at no additional compensation.

M. Carefully support and protect from damage, existing pipes, poles, wires, fences, curbs, property line markers, and other structures, which the Engineer determines must be preserved in place without being temporarily or permanently relocated. Should such items be damaged, restore without compensation therefore, to at least as good condition as that in which they were found immediately before the work was begun.

N. Whenever certain existing structures, as described below, are encountered, and the Engineer so directs, change the location, remove and later restore, or replace such structures, or assist the Owner in doing so. Such work to be paid for under applicable items of work, otherwise as Extra Work.

O. In removing existing pipes or other structures, include for payment only those new materials which are necessary to replace those unavoidably damaged as determined by the Engineer.

P. The preceding two paragraphs apply to pipes, wires, and other structures which meet the following: (a) are not indicated on the drawings or otherwise provided for, (b) encroach upon or are encountered near and substantially parallel to the edge of the excavation, and (c) in the opinion of the Engineer, will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced.

Q. Restore existing property or structures as promptly as practicable.

R. If material unacceptable for foundation (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the drawings and/or specifications, remove such material to the required width and depth as directed by the Engineer and replace it with screened gravel, select borrow, or concrete.

S. Do not remove excavation materials from the site of the work or dispose of except as directed or permitted by the Engineer.

T. Haul away and dispose of surplus excavated materials at locations directed by the Engineer at no additional cost to the Owner.

U. During progress of work, conduct earth moving operations and maintain work site so as to minimize the creation and dispersion of dust. Furnish and spread calcium chloride if the Engineer decides that it is necessary for more effective dust control.

V. Provide suitable and safe bridges and other crossings where required for accommodation of travel, and to provide access to private property during construction, and remove said structures thereafter.

1.08 - REFERENCES

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

1. ASTM C33 - Specification for Concrete Aggregates.
2. ASTM C136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.
3. ASTM D6913 – Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
4. ASTM D7928 - Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.
5. ASTM D1140 - Test Methods for Determining the Amount of Material Finer than the 75 µm (No. 200) Sieve in Soils by Washing.
6. ASTM D1556 - Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
7. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3 (2,700 kN-m/m^3)).
8. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
9. ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
10. ASTM D4718 - Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.
11. ASTM D4944 - Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester.
12. ASTM D4959 - Test Method for Determination of Water Content of Soil by Direct Heating.
13. ASTM D5080 - Test Method for Rapid Determination of Percent Compaction.
14. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching and Shoring.

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

1.09 - SITE CONDITIONS

A. Subsurface Conditions: Refer to SECTION 01310, MISCELLANEOUS TESTING AND SOIL DATA.

PART 2 - PRODUCTS

2.01 - GENERAL

A. Use only acceptable materials from excavations or borrows.

B. Provide 1,500 psi concrete, Screened Gravel, Bank-Run Gravel, fine aggregate, Select Borrow, and Crushed Stone.

C. Provide Fine Aggregate conforming to ASTM C33.

D. Provide erosion/sedimentation control devices as indicated, including geotextile fabric in accordance with SECTION 02223, SCREENED GRAVEL.

E. Provide geotextile fabric as indicated, meeting the requirements and conforming to SECTION 02273, GEOTEXTILE FABRIC.

2.02 - EQUIPMENT

A. The compaction equipment shall be selected by the Contractor and shall be capable of consistently achieving the specified compaction requirements. The selected compaction equipment shall meet the following minimum requirements:

1. Manually operated vibratory plate compactors weighing no less than 200 pounds with vibration frequency no less than 1,600 cycles per minute.

2. Vibratory steel drum or rubber tire roller weighing at least 12,000 pounds.

PART 3 - EXECUTION

3.01 - SITE MAINTENANCE

A. Roadway and Site Leveling: Grade roadway and site as to maintain them in a level unrutted condition and to eliminate puddling of surface and subsurface water.

3.02 - EXCAVATION

A. Execution of any earth excavation shall not commence until the related dewatering, excavation support systems, and backfill and fill materials submittals are reviewed by the Engineer and all Engineer’s comments satisfactorily addressed.

B. Carry out program of excavation, dewatering, and excavation support systems to eliminate possibility of undermining or disturbing foundations of existing structures or of work previously completed under this contract.

C. Excavate to widths that give suitable room for building structures or laying and jointing piping.

D. Do not plow, scrape or dig by machinery near to finished subgrade in a manner that would result in disturbance of subgrade.

E. Excavate to lines and grades indicated in an orderly and continuous program.

F. Establish limits of excavation to allow adequate working space for installing forms and for safety of personnel.

G. Excavate to elevations indicated, or deeper, as directed by the Engineer, to remove unacceptable bottom material.

H. Exercise care to preserve material below and beyond the lines of excavations.

I. Place excavated material at the approved stockpile locations and in no case closer than 3 feet from edge of excavations to prevent cave-ins of bank slides.

J. Regard small, less than one cubic yard, boulders, rock fragments, and concrete encountered during excavation as a normal part of in-place soils and not included for payment as rock.

K. Excavate for depressed foundations, where mat foundations are indicated as depressed. Sheet and shore existing ground so that adjacent sections of foundation mat will rest on undisturbed ground as indicated. Installation of sheeting shall be in accordance with SECTION 02160, EXCAVATION SUPPORT SYSTEMS.

3.03 - SEPARATION OF EXCAVATED MATERIALS FOR REUSE

A. Remove only existing pavement that is necessary for prosecution of work.

B. Carefully remove loam and topsoil from excavated areas. Store separately for further use or furnish equivalent loam and topsoil as directed.

C. Carefully remove acceptable material from excavated areas and store separately for further use as backfill material.

3.04 - TRENCH EXCAVATION

A. When pipe is to be laid in gravel bedding or concrete cradle, excavate trench by machinery to, or just below designated subgrade. If material remaining at bottom of trench is disturbed, recompaction shall be required.

B. When pipe is to be laid directly on bottom of trench, do not excavate lower part of trenches by machinery to subgrade. Remove remainder of material to be excavated just before placing of pipe by use of hand tools. Form a flat or shaped bottom, true to grade, so pipe will have a uniform and continuous bearing. Support on firm and undisturbed material between joints, except for limited areas where use of pipe slings has disturbed bottom.

3.05 - DEPTH OF TRENCH

A. Excavate trenches to depths so as to permit pipe to be laid at elevations, slopes, or depths of cover indicated on drawings, and at uniform slopes between indicated elevations.

3.06 - WIDTH OF TRENCH

A. Make pipe trenches as narrow as practicable and do not widen by scraping or loosening materials from the sides. Make every effort to maintain sides of trenches firm and undisturbed until backfilling has been placed and compacted.

B. Excavate trenches with approximately vertical sides between spring line of pipe and elevation of 1 foot above the top of pipe.

3.07 - TRENCH EXCAVATION IN FILL

A. Place and compact material to top of fill or to a minimum height of 1 foot above the top of pipe, whichever is less, when pipe is to be laid in embankment or other recently filled material. Take particular care to ensure maximum consolidation of material under pipe location. Excavate pipe trench as though in undisturbed material.

3.08 - EXCAVATION NEAR EXISTING STRUCTURES

A. Discontinue digging by machinery when excavation approaches pipes, conduits, or other underground structures. Continue excavation by use of hand tools. Include such manual excavation in work to be done when incidental to normal excavation and under items involving normal excavation.

B. Excavate test pits when determination of exact location of pipe or other underground structure is necessary for doing work properly.

3.09 - REMOVAL OF SUBSURFACE OBSTRUCTIONS

A. Remove indicated subsurface structures and related obstructions to extent shown.

B. Promptly notify the Engineer when any unexpected subsurface facilities are encountered during excavation such as utility lines and appurtenances, walls and foundations.

3.10 - UNAUTHORIZED EXCAVATION

A. When the bottom of any excavation for structures is taken out beyond limits indicated or specified, backfill, with screened gravel and crushed stone wrapped with non-woven geotextile fabric or with 1,500 psi concrete.

3.11 - REUSE AND DISPOSAL OF SURPLUS EXCAVATED MATERIALS

A. Reuse surplus acceptable excavated materials for backfill; deposit neatly and grade so as to make or widen fills, flatten side slopes, or fill depressions; or legally dispose off-site; all as directed or permitted and without additional compensation.

3.12 - SUBGRADE PREPARATION AND PROTECTION

A. Remove loam and topsoil, loose vegetative matter, stumps and large roots from areas upon which embankments will be built or material will be placed for grading. Shape subgrade as indicated on drawings, and prepare by forking, furrowing, or plowing so that the first layer of new material placed thereon will be well bonded to it.

B. As directed by the Engineer, over-excavate unacceptable materials below the foundation subgrade. Backfill the over-excavation with compacted screened gravel or crushed stone wrapped with nonwoven geotextile fabric. In no case shall the screened gravel be placed directly on the exposed subgrade prior to placing the geotextile fabric.

C. Proof roll the foundation subgrade prior to backfilling and filling operation or placing foundation concrete.

D. Proof roll the pipe trench foundation subgrade prior to backfilling and filling operation or placing soil-supported pipeline.

E. Utilize excavating equipment equipped with a toothless or smooth edged, excavating bucket to expose the pipe trench foundation subgrade to avoid disturbance of the bearing surface. Tamp the exposed subgrade with the excavating bucket prior to backfilling and filling operation or placing soil-supported pipeline.

3.13 - CARE AND RESTORATION OF PROPERTY

A. Enclose uncut tree trunks adjacent to work in wooden boxes of such height as may be necessary for protection from injury from piled material, equipment, operations, or otherwise due to work. Operate excavating machinery and cranes of suitable type with care to prevent injury to trees not to be cut and particularly to overhanging branches and limbs.

B. Cut all branches, limbs, and roots smoothly and neatly without splitting or crushing. Neatly trim, cut the injured portions and cover with an application of grafting wax or tree healing paint as directed.

C. Protect cultivated hedges, shrubs, and plants which might be injured by the Contractor's operations by suitable means or dig up and temporarily replant and maintain. After construction operations have been substantially completed, replant in original positions and care for until growth is reestablished. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish in their beauty or usefulness, replace by items of equal kind and quality existing at the start of the work.

D. Do not use or operate tractors, bulldozers, or other power-operated equipment on paved surfaces when their treads or wheels are so shaped as to cut or otherwise damage such surfaces.

E. Restore surfaces damaged by the Contractor's operations to a condition at least equal to that in which they were found immediately before work commenced. Use suitable materials and methods for such restoration.

3.14 - BACKFILLING - GENERAL

A. Do not place frozen materials in backfill or place backfill upon frozen material. Remove previously frozen material or treat before new backfill is placed.

B. Do not place, spread, roll or compact fill material during unfavorable weather conditions. If interrupted by heavy rain or other unfavorable conditions, do not resume until ascertaining that the moisture content and density of the previously placed soil are as specified.

C. Do not use puddling, ponding or flooding as a means of compaction.

3.15 - MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS

A. Select Borrow, and Fine Aggregate:

1. Dump and spread in layers not to exceed 8-inch uncompacted thickness.

2. Compact, fill and backfill under structure and bedding for pipes (from below pipe to spring line) as indicated but to not less than 95 percent. Compact to not less than 90 percent in other areas unless otherwise indicated.

B. Screened Gravel and Crushed Stone:

1. Dump and spread in layers not to exceed 8-inch uncompacted thickness.

2. Compact using self-propelled vibratory steel drum or rubber tire rollers with a minimum of 4 passes in directions perpendicular to one another in open areas. In small areas, use manually operated vibratory plate compactors with a minimum of 4 passes.

C. Bank-Run Gravel and Acceptable materials for use as non-structural fill:

1. Dump and spread in layers not to exceed 12-inch. uncompacted thickness.

2. Compact to not less than 90 percent unless otherwise indicated.

D. Backfilling and filling operation shall be suspended in areas where tests are being made until tests are completed and the testing laboratory has advised the Engineer that adequate densities are obtained.

E. **Material Placement and Compaction Requirements – State Roads**

1. Material placement and compaction requirements for work in State Roads shall comply with the requirements of MassDOT Permit No. 5-2019-0487.

2. The Contractor shall perform the work for backfill testing methods as follows:

a. All methods used to determine and verify the proper compaction of backfill shall be in accordance with AASHTO Standard Specifications of Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth) (Designation T238-86 Method B - Direct Transmission shall be used to determine in-place density) and Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth) (Designation T239-91). Backfill material shall be in accordance with MassDOT, Highway Division Standard Specifications, Section 150.64, Subsection C.

b. All methods and work shall be performed by a technician on location certified in "soils" by the New England Transportation Technician Certification Program (NETTCP). All data and results shall be submitted to the appropriate District Highway Director for its review and acceptance.

3.16 - STRUCTURAL FILL AND BACKFILL UNDER STRUCTURES

A. Compact fill and backfill under structures and pavements with screened gravel, crushed stone, select borrow, or fine aggregate as specified and indicated.

3.17 - NON-STRUCTURAL BACKFILL AROUND STRUCTURES

A. Use acceptable materials for non-structural backfill around structures and compacted as specified and indicated.

B. Conduct hydraulic testing as soon as practicable after structures are constructed and other necessary work has been done. Start backfilling promptly after completion of tests.

C. Deposit material evenly around structure to avoid unequal soil pressure.

D. Do not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking, or other damage.

3.18 - BACKFILLING PIPE TRENCHES

A. General:

1. Begin backfilling and proceed until completed after: the pipes and conduits have been laid, joints have acquired maximum degree of hardness, pipelines and conduits have successfully passed tests and inspections as required in the Specifications, and concrete or masonry structures within the trench have reached their design strength to support all loads.

2. Backfill and compact indicated material under, around, and above pipes, conduits, and other structures to the indicated or specified compaction density requirement. Utilize compaction devices which will not damage the pipe, conduit, or structure within the trench.

3. Do not drop backfill material into trench from a height of more than 5 ft., or in a manner which will damage the pipe, conduit, or other structure within trench.

B. Pipe Trenches:

1. Materials:

a. From below pipe to 1 foot above the top of pipe: Use Screened Gravel, or Crushed Stone, unless otherwise indicated.

b. One foot above top of pipe to finished grade or to pavement subbase: Use Bank-Run Gravel or acceptable materials, unless otherwise indicated.

2. Compacting Around Pipes: Compact material around circumference of pipe and the area between the trench wall and the pipe by hand tamping in 6 inches layers.

3. Compacting Above Pipe: Compact material by hand tamping. If trench width is wide enough to accommodate power tools and the compacted material over the pipe will support the load of the power tools without damage to the pipe, use rollers or other powered compaction equipment able to more readily achieve compaction requirements.

3.19 - MATERIAL FOR FILLING AND EMBANKMENTS

A. Use acceptable materials for filling and building embankments unless otherwise indicated.

3.20 - PLACING AND COMPACTING EMBANKMENT MATERIAL

A. Compact fill material as specified and indicated.

B. Perform fill operation in an orderly and systematic manner using equipment in proper sequence to meet the specified compaction requirements.

C. Place fill on surfaces which are free of unacceptable materials.

D. Begin filling in lowest section of work area. Grade surface of fill approximately horizontal but provide with sufficient longitudinal and transverse slope to allow for runoff of surface water from every point.

E. Conduct filling so that no obstruction to drainage from other sections of fill area is created at any time.

F. Install temporary dewatering sumps in low areas during filling operation where excessive amounts of rain runoff collect.

G. Reduce moisture content of fill material, if necessary, in source area by working it over under warm and dry atmospheric conditions. A large disc harrow with two to three-foot diameter disks may be required for working soil in a drying operation.

H. Compact uniformly throughout. Keep surfaces of fill reasonably smooth and free from humps and hollows which would prevent proper and uniform compaction. Do not permit hauling equipment to follow a single track on the same layer but direct equipment to spread out to prevent over-compaction in localized areas. Take care in obtaining thorough compaction at edges of fill.

I. Slightly slope surface of fill to ensure drainage during periods of wet weather. Do not place fill while rain is falling or after a rain-storm until the Engineer considers conditions satisfactory. During such periods and upon suspension of filling operations for any period in excess of 12 hours, roll smooth the surface of fill using a smooth wheel static roller to prevent excessive absorption of rainfall and surface moisture. Prior to resuming compaction operations, remove muddy material off surface to expose firm, compacted material, as determined by the Engineer.

J. When fill is placed against an earlier fill or against in-situ material under and around structures, including around piping beneath structures or embankments, slope junction between two sections of fill, 1 vertical to 1.5 horizontal. Bench edge of existing fill 24-inches to form a serrated edge of compact stable material against which to place the new fill. Ensure that rolling extends over junction between fills.

K. When fill is placed directly upon another older fill, clean surface thoroughly of debris and remove any loose material. Then proof roll the entire old surface.

L. After spreading each loose lift to the required thickness and adjusting its moisture content as necessary, roll with sufficient number of passes to obtain the required compaction. One pass is defined as the required number of successive trips which by means of sufficient overlap will insure complete coverage and uniform compaction of an entire lift. Do not make additional passes until previous pass has been completed.

M. In the case that material of any fill sinks and weaves under roller or under hauling units and other equipment, required degree of compaction is not being obtained. Reduce the moisture content. If such sinking and weaving produces surface cracks, suspend operations on that part of the embankment until it becomes sufficiently stabilized. Ideal condition in fill is that attained when the entire fill below the surface being rolled is so firm and hard as to show only the slightest weaving and deflection as roller passes. Spread out rolling operations over the maximum practicable area to minimize condition of sinking and weaving.

N. If because of defective workmanship, compaction obtained over any area is less than that required, remedy condition at no cost to Owner. If additional rolling or other means fail to produce satisfactory results, remove material in that area down to a level of satisfactory density. Perform removal, replacement, and rerolling without additional compensation.

3.21 - COMPACTION CONTROL OF BACKFILL, FILL, AND EMBANKMENT

A. Compact to density specified and indicated for various types of material. Control moisture content of material being placed as specified or if not specified, at a level slightly lower than optimum.

B. The soil testing laboratory shall provide inspection during filling or backfilling operations to ensure compaction of screened gravel or crushed stone and record compaction equipment in use.

C. Moisture control may be required either at the stockpile area, pits, or on embankment or backfill. Increase moisture content when material is too dry by sprinkling or other means of wetting uniformly. Reduce moisture content when material is too wet by using ditches, pumps, drainage wells, or other devices and by exposing the greatest possible area to sun and air in conjunction with harrowing, plowing, spreading of material or any other effective methods.

3.22 - ALLOWANCE FOR SHRINKAGE

A. Build embankments or backfill to a height above finished grade which will, in the opinion of the Engineer, allow for the shrinkage or consolidation of material. Initially, provide at all points, an excess of at least one percent of total height of backfill measured from stripped surface to top of finished surface.

B. Supply specified materials and build up low places as directed, without additional cost if embankment or backfilling settles so as to be below the indicated level for proposed finished surface at any time before final acceptance of the work.

3.23 -CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02223

SCREENED GRAVEL

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
1.07 - REFERENCES 2
PART 2 – PRODUCTS 2
2.01 - MATERIAL 2
PART 3 – EXECUTION 3
3.01 - PLACEMENT AND COMPACTION 3
3.02 - CONTRACT CLOSEOUT 3

PART 1 - GENERAL

1.01 - SCOPE

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

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

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

1. Gradation test result from the Contractor’s Independent Testing Laboratory, at least two (2) weeks prior to hauling material, for the Engineer’s acceptance.
2. Submit a 20-pound sample of the material when requested by the Engineer.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

1.06 - DESIGN CRITERIA

A. Qualifications of the Independent Testing Laboratory as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D6913.

C. Material testing frequency and requirements as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

1.07 - REFERENCES

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

1. ASTM C33 - Specification for Concrete Aggregates
2. ASTM D6913 - Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

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

PART 2 – PRODUCTS

2.01 - MATERIAL

A. Screened Gravel: Gradation and physical property requirements of Screened Gravel shall conform to ASTM C33, Coarse Aggregate Number 67.

B. Screened Gravel shall be free from roots, vegetation, leaves, and other organic materials, and free of ice, snow, clay, frost, frozen soil particles and other fine or harmful substances.

C. Crushed rock of equivalent size and grading may be used instead of Screened Gravel.

PART 3 – EXECUTION

3.01 - PLACEMENT AND COMPACTION

A. Specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING and as indicated on the drawings.

3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

END OF SECTION

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SECTION 02224

BANK-RUN GRAVEL

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
1.07 - REFERENCES 2
PART 2 – PRODUCTS 2
2.01 - MATERIAL 2
PART 3 – EXECUTION 3
3.01 - PLACEMENT AND COMPACTION 3
3.02 - CONTRACT CLOSEOUT 3

PART 1 - GENERAL

1.01 - SCOPE

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

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

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

1. Gradation and compaction test results from the Contractor’s Independent Testing Laboratory, at least two (2) weeks prior to hauling material, for the Engineer’s acceptance.
2. Submit a 20-pound sample of the material when requested by the Engineer.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

1.06 - QUALITY ASSURANCE

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

B. Qualifications of the Independent Testing Laboratory as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D6913 and D1140. Soil compaction test shall be performed in accordance with ASTM D1557 Procedure C.

D. Material testing frequency and requirements as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

1.07 - REFERENCES

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

1. C33: Specification for Concrete Aggregates.
2. D1140: Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing.
3. D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (600 kN-m/m^3).
4. D6913: Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

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

PART 2 – PRODUCTS

2.01 - MATERIAL

A. Bank-Run Gravel shall be obtained from approved natural deposits and unprocessed except for the removal of deleterious materials and stones larger than the maximum size permitted.

B. Bank-Run Gravel shall be unfrozen and substantially free from vegetation, roots, loam and other organic matter, clay, snow, frozen particles and other fine or harmful substances.

C. Bank-Run Gravel: Inorganic granular material meeting the following gradation:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
6 in.	100
2 in.	80 - 100
No. 4.	20 - 65
No. 200	0 - 12

PART 3 – EXECUTION

3.01 - PLACEMENT AND COMPACTION

A. Specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING and as indicated on the drawings.

3.02 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 02225

SELECT BORROW

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
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1.05 - PRODUCT HANDLING 2
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PART 2 - PRODUCTS 3
2.01 - MATERIAL 3
PART 3 – EXECUTION 3
3.01 - PLACEMENT AND COMPACTION 3
3.02 - CONTRACT CLOSEOUT 3

PART 1 - GENERAL

1.01 - SCOPE

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

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

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

1. Gradation and compaction test results from the Contractor’s Independent Testing Laboratory, at least two (2) weeks prior to hauling material, for the Engineer’s acceptance.
2. Submit a 20-pound sample of the material when requested by the Engineer.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the supplier and as to not degrade quality, serviceability or appearance.

1.06 - QUALITY ASSURANCE

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

B. Qualifications of the Independent Testing Laboratory as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D6913 and D1140. Soil compaction test shall be performed in accordance with ASTM D1557 Procedure C.

D. Material testing frequency and requirements as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

1.07 - REFERENCES

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

1. C33: Specification for Concrete Aggregates
2. D6913: Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
3. D1140: Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing.
4. D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3).
5. D2487: Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

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

PART 2 - PRODUCTS

2.01 - MATERIAL

A. Use only material free from roots, leaves, and organic matter, and free of ice, snow, frost and frozen soil particles.

B. Select Borrow shall be well-graded coarse-grained soil in accordance with ASTM D2487 and shall meet the following gradation:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
3 in.	100
1-1/2 in.	70 - 100
3/4 in.	50 - 85
No. 4	30 - 60
No. 50	10 - 25
No. 200	0 - 5

Soil particles shall conform to the physical property requirements of ASTM C33.

PART 3 – EXECUTION

3.01 - PLACEMENT AND COMPACTION

A. Specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING and as indicated on the drawings.

3.02 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 02273

GEOTEXTILE FABRIC

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
1.07 - REFERENCES 2
PART 2 - PRODUCTS 3
2.01 - MANUFACTURERS 3
2.02 - MATERIAL 3
PART 3 - EXECUTION 4
3.01 - INSTALLATION 4
3.02 - CONTRACT CLOSEOUT 4

PART 1 - GENERAL

1.01 - SCOPE

A. Provide nonwoven geotextile fabric in foundation preparation for separation of existing soil from Screened Gravel or Crushed Stone.

B. Provide woven geotextile fabric for temporary road reinforcement, and riprap separation as indicated or specified.

C. Provide woven geotextile fabric for silt fence as indicated or specified.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

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

1. At least two weeks prior to shipment, submit manufacturer's certificate of compliance and physical property data sheet indicating that requirements for materials and manufacture are in conformance as specified.
2. For informational purposes only, submit manufacturer’s printed installation instructions.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

B. Provide geotextile fabric in rolls wrapped with protective covering to protect geotextile fabric from mud, dirt, dust, debris, and ultraviolet light. Label each roll of geotextile fabric with number or symbol to identify production run.

C. Protect geotextile fabric from sunlight during transportation and storage. Do not leave geotextile fabric exposed to sunlight for more than 14 days during installation operations.

1.06 - QUALITY ASSURANCE

A. Producer of the geotextile fabric is to maintain competent laboratory at point of manufacture to insure quality control in accordance with ASTM testing procedures. Laboratory to maintain records of quality control results.

B. Do not expose geotextile fabric, except the geotextile fabric for silt fence, to ultraviolet radiation (sunlight) for more than 14 days total during the period of time following manufacture, until geotextile fabric is installed and covered with fill or backfill material.

C. Take all precautions to protect geotextile fabric from damage resulting from any cause. Either repair or replace geotextile fabric to Engineer's satisfaction at no additional cost to the Owner.

1.07 - REFERENCES

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

1. D4355: Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon ARC Type Apparatus.
2. D4491: Test Methods for Water Permeability of Geotextiles by Permittivity.
3. D4533: Test Method for Trapezoid Tearing Strength of Geotextiles.
4. D4632: Test Method for Grab Breaking Load and Elongation of Geotextiles.
5. D4751: Test Method for Determining Apparent Opening Size of a Geotextile.
6. D4833: Test Method for Index Puncture Resistance of Geomembranes and Related Products.
7. D6241: Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

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

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

A. Provide the following nonwoven geotextile fabric:

1. Geotex 601 as manufactured by Propex.
2. Mirafi 160N as manufactured by TenCate Geosynthetics.
3. 150 EX as manufactured by Thrace-LINQ.
4. Or acceptable equivalent product.

B. Provide the following woven geotextile fabric except for silt fence:

1. Geotex 200 ST as manufactured by Propex.
2. Mirafi 500X as manufactured by TenCate Geosynthetics.
3. GTF 200 as manufactured by Thrace-LINQ.
4. Or acceptable equivalent product.

C. Provide the following woven geotextile fabric for silt fence:

1. Geotex 2130 as manufactured by Propex.
2. Mirafi 100X as manufactured by TenCate Geosynthetics.
3. Beltech 1935 by Belton Industries Inc.
4. Or acceptable equivalent product.

2.02 - MATERIAL

A. Geotextile fabric shall conforms to test requirements for minimum average roll value (weakest principle direction) for strength properties of any individual roll tested from manufacturing lot or lots of particular shipment in excess of minimum average roll value (weakest principle direction) as specified hereafter:

B. Physical Properties of Minimum Average Roll of the Nonwoven Geotextile Fabric shall be as follows:

Property	ASTM Test Method	Units	Value
1. Grab Strength	D4632	lbs.	150 (min.)
2. Grab Elongation	D4632	%	50 (min.)
3. Trapezoidal Tear Strength	D4533	lbs.	60 (min.)
4. Puncture Strength	D4833	lbs.	75 (min.)
5. Permittivity	D4491	sec -1	1.3 (min.)
6. Apparent Opening Size	D4751	Sieve Number	70 - 100
7. Ultraviolet Stability	D4355	Percent	70 (min.)

C. Physical Properties of Minimum Average Roll of Woven Geotextile Fabric, except for silt fence, shall be as follows:

Property	ASTM Test Method	Units	Value
1. Grab Strength	D4632	lbs.	200 (min.)
2. Grab Elongation	D4632	%	15 (min.)
3. Trapezoidal Tear Strength	D4533	lbs.	75 (min.)
4. Puncture Strength	D4833	lbs.	80 (min.)
5. Permittivity	D4491	sec -1	0.02 (min.)
6. Apparent Opening Size	D4751	Sieve Number	30 - 70
7. Ultraviolet Stability	D4355	Percent	70 (min.)

D. Physical Properties of Minimum Average Roll of the Woven Geotextile Fabric for silt fence shall be as follows:

Property	ASTM Test Method	Units	Value
1. Grab Strength	D4632	lbs.	100 (min.)
2. Permittivity	D4491	sec -1	0.10 (min.)
3. Apparent Opening Size	D4751	Sieve Number	20 - 30
4. Ultraviolet Stability	D4355	Percent	70 (min.)

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Install geotextile fabric in accordance with manufacturer's printed instructions.

B. Place geotextile fabric on the foundation subgrade prior to placing the screened gravel or crushed stone.

C. Overlap geotextile fabric 18-inches minimum for unsewn lap joint. Overlap fabric 6-inches at seam for sewn joint.

D. Do not permit traffic or construction equipment to travel directly on geotextile fabric.

E. Place geotextile fabric in relatively smooth condition to prevent tearing or puncturing. Lay geotextile fabric loosely but without wrinkles or creases so that placement of the backfill materials will not stretch or tear geotextile fabric. Leave sufficient slack in geotextile fabric around irregularities to allow for readjustments.

F. Patch all tears in geotextile fabric by placing additional section of geotextile fabric over tear with a minimum of 3-feet overlay.

G. Extend the geotextile fabric and wrap around the Screened Gravel or Crushed Stone along the perimeter of the foundation.

H. Install silt fence in accordance with the manufacturer's printed instructions and as indicated.

3.02 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

END OF SECTION

SECTION 02435

CRUSHED STONE

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
1.07 - REFERENCES: 2
PART 2 - PRODUCTS 2
2.01 - MATERIAL 2
PART 3 - EXECUTION 3
3.01 - PLACEMENT AND COMPACTION 3
3.02 - CONTRACT CLOSEOUT 3

PART 1 - GENERAL

1.01 - SCOPE

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

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

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

1. Gradation test result from the Contractor’s Independent Testing Laboratory, at least two (2) weeks prior to hauling material, for the Engineer’s acceptance.
2. If crushed stone is utilized, a 10-pound sample shall be submitted, if requested by the Engineer.
3. If PGA is utilized, a 10-pound sample shall be submitted. In addition, provide a certified test report that indicates that the PGA is free of debris and other materials that is associated with the glass recycling process.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the written recommendations of the manufacturer and as to not degrade quality, serviceability or appearance.

1.06 - DESIGN ASSURANCE

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

B. Qualifications of the independent soil testing laboratory as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Maximum particle size and gradation analyses shall be performed in accordance with ASTM D6913.

D. Material testing frequency and requirements as specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

1.07 - REFERENCES:

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

1. C33: Specification for Concrete Aggregates
2. D6913: Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.

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

PART 2 - PRODUCTS

2.01 - MATERIAL

A. Crushed Stone

1. Gradation and physical property requirements of crushed stone shall conform to ASTM C33, Coarse Aggregate Number 67.

Crushed Stone shall be free from roots, vegetation, leaves, and other organic materials, and free of ice, snow, clay, frost, frozen soil particles and other fine or harmful substances.

B. Processed Glass Aggregate (PGA)

1. In lieu Crushed Stone, the Contractor may utilize PGA for bedding of pipe lines.

2. Processed Glass Aggregate shall be manufactured from an approved supplier of crushed cullet. The material shall consist of recycled glass food or beverage containers free of debris such as paper, metals, fabrics, toxins, clay, loam, or other materials that would be associated with the glass recycling process. A maximum of 5 percent mass of the material may be produced from china dishes, ceramics, plate glass or other glass products. Other glass products (i.e. fluorescent lights, video screens, automobile glass, lead crystal, etc.) shall not be incorporated into PGA.

3. The material will have a nominal aggregate size of 3/8 inch and meet the following gradation requirements.

Sieve Designation	Percent by Mass Passing
3/8 inch	100
No. 4	70-100
No. 8	35-88
No. 16	15-40
No. 50	4-12
No. 200	0-5

4. The percent wear as determined by the Los Angeles Abrasion Test, Class C or D will be a maximum of 40 percent.

5. Sources of PGA are as follows:

6. David Johansen, Director Department of Public Works
Town of Dennis
120 Theophilus F. Smith Road
South Dennis, MA 02660
Phone: 508-760-6220
e-Mail: djohansen@town.dennis.ma.us

7. Reagan Bissonnette, Executive Director
Northeast Resource Recovery Association
2101 Dover Road
Epsom, NH 03234
Phone: 603-736-4401
e-Mail: rbissonnette@nrra.net

PART 3 - EXECUTION

3.01 - PLACEMENT AND COMPACTION

A. Specified in SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING and as indicated on the drawings.

3.02 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 02483

PLANTING OPERATIONS

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 2
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
PART 2 - PRODUCTS 3
2.01 - MATERIALS FOR GUYING, STAKING AND WRAPPING 3
2.02 - PLANTING SOIL FOR PLANTING PITS AND PLANTING BEDS 3
PART 3 - EXECUTION 4
3.01 - SEASONS FOR PLANTING 4
3.02 - PLANTING OPERATIONS 4
3.03 - OBSTRUCTIONS BELOW GROUND 5
3.04 - UNDERGROUND UTILITIES 5
3.05 - WRAPPING 5
3.06 - PRUNING, MULCHING AND WATERING 5
3.07 - INSPECTION AND ACCEPTANCE 5
3.08 – CONTRACT CLOSEOUT 6

PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes furnishing all labor, equipment, tools, materials and accessories necessary for the complete planting and maintenance of trees, shrubs and ground cover as may be indicated on the drawings, and as specified herein.

B. Attention is directed to all sections within BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT; all sections within OTHER DOCUMENTS; DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

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

B. An allowance has been established to provide planting materials. Should the actual charges exceed or be less than the amount indicated, the difference will be paid by or returned to the Owner. A paid invoice from the nursery shall be submitted to the Engineer by the Contractor. Refer to SECTION 01020, ALLOWANCES.

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

A. Shop drawings and brochures shall be submitted for all items to be furnished in accordance with provisions of DOCUMENT 00700, GENERAL CONDITIONS.

B. Submittals shall include shop drawings including at least the following:

1. Information about the Landscape Contractor or Arborist.

2. Complete list of all materials to be provided showing the details identified herein.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the American Association of Nurserymen’s written recommendations.

B. The Contractor shall maintain all plant material and associated work until final acceptance by the Engineer. Maintenance shall include all pruning, spraying, watering, cultivation and weeding of all planted areas, and the repairing or replacement of all staking, wrapping, mulching and edging materials and any other operations necessary until final acceptance.

C. Water will be furnished by the Contractor. The Contractor shall furnish all necessary hoses and such other accessories as may be required.

1.06 - DESIGN CRITERIA

A. Plant material shall be installed by a competent Landscape Contractor or Arborist. Such company shall be certified, or licensed, or affiliated (by membership) with the American Association of Nurserymen or appropriate State organization. The Landscape Contractor or Arborist shall provide references of similar installations.

B. All planting materials shall comply with the American Association of Nurserymen's American Standard for Nursery Stock as last amended. All plant names shall be "Standardized Plant Names" as designated by the American Joint Committee on Horticultural Nomenclature (1942), as last amended.

C. All plant material shall be inspected and approved by the Engineer prior to planting. Any plant material which does not meet the criteria specified shall be replaced with approved plants at the Contractor's expense.

D. All plants shall meet the requirements specified on the planting plan.

E. All plant material shall be nursery grown and shall be shapely, well-grown, healthy, sound, and free of disease, insect pests, eggs or larvae, and shall have a well developed root system.

F. All trees and shrubs shall be freshly dug; no heeled-in plants or plants from cold storage will be accepted. All plants shall be hardy under climatic conditions similar to those in the locality of the project.

G. All plants shall be handled so that roots will be adequately protected at all times from drying out and from other injury. All plants shall be covered and braced during transportation.

H. Each tree or shrub shall be properly identified by name on legible, weatherproof labels securely attached thereto. Balled and burlapped plants shall have firm, natural balls of soil, the diameter and depth of which shall be sufficient to include the roots. The earth ball shall be adequately wrapped and secured with burlap. Container grown shrubs may be substituted for balled and burlapped shrubs.

I. Container grown plants shall have sufficient roots to hold planting mix in tact after removal from containers without being root bound.

J. When plants of kinds and sizes specified are not available within a reasonable distance, substitutions may be made upon written approval of the Engineer.

K. All plants shall conform to the measurements specified in the plant list and as set forth in American Association of Nurserymen's American Standard for Nursery Stock as last amended. Where a size range is given, at least 40 percent of those plants shall be at or above the average for that size range. Exceptions are as follows: Plants larger than specified in the plant list may be used if approved by the Owner, but use of such plants shall not increase the cost to the Owner.

L. Prior to planting, all planting pits will be inspected by the Engineer. Planting pits which do not meet the minimum requirements of the details indicated, shall be reshaped as necessary for approval by the Engineer.

PART 2 - PRODUCTS

2.01 - MATERIALS FOR GUYING, STAKING AND WRAPPING

A. Stakes - Stakes for supporting trees shall be of the sound wood of uniform size, reasonably free of knots and capable of standing in the ground at least two years. Stakes shall be 2 inches square and shall not be less than 8 feet in length.

B. Wire - Wire for tree bracing and guywire shall be pliable No. 12 gauge galvanized soft steel wire.

C. Hose - Cinch-tie or approved equal hose, if used, shall be two-ply fiber bearing garden hose, not less than 1 inch inside diameter.

D. Webbing - Web straps shall be three inches wide as manufactured by Duckbill, or equal and shall be provided with grommets. Hose shall not be allowed.

E. Wrapping Material - Wrapping material shall be first quality, heavy waterproof crepe paper manufactured for this purpose.

2.02 - PLANTING SOIL FOR PLANTING PITS AND PLANTING BEDS

A. Topsoil shall meet the specifications and shall be analyzed as described in SECTION 02485, LOAMING AND SEEDING.

B. Prepared planting mixture shall conform to standard planting practices and the following minimum requirements. Any deviations will be subject to the Engineer's approval.

1. Prepared planting mix shall be 1/3 peat and 2/3 topsoil plus fertilizer/additives as required by the Engineer based on recommendations from testing laboratory reports.

2. Ground cover and shrub planting beds shall have 1-inch layer of peat plus fertilizer/additives as required spread evenly over beds. Peat/additives shall then be cultivated into the top six inches of soil.

C. Peat shall be a commercial grade peat meeting the approval of the Engineer.

D. Fertilizer shall be furnished in manufacturer's standard containers clearly marked with the guaranteed chemical analysis of the product and shall be of the type and formulation specified by the Engineer. The fertilizer shall conform to local and federal regulations.

E. Limestone shall be standard agricultural ground limestone and shall be delivered in the manufacturer's standard containers with a guaranteed analysis appearing on each container.

F. Mulch shall be chip or chunk bark. Bark shall be fresh and undecayed, clean and free from weeds, leaves, moss, sticks and any other debris, and be of such a texture to resist washing or blowing. No long strips, decayed material nor sawdust will be permitted.

G. Wetting agent shall be non-ionic surfactant consisting of a 50 percent polyoxyethylene ether and 50 percent polyoxyethylene ether chemical type, preferably in a granular form for spreader application.

H. Anti-Transpirant shall be delivered in manufacturer's containers, unopened, with manufacturer's labels attached.

PART 3 - EXECUTION

3.01 - SEASONS FOR PLANTING

A. Seasons for planting shall be as recommended to the Contractor by the nursery supplying the plant materials, relating to site conditions, plant species, and region where planting is to be done.

B. Planting shall be prohibited in frozen or muddy ground.

C. Approximate planting dates shall be furnished to the Engineer for approval. Material planted out-of-season shall be given extra care and attention by the Contractor. Any out-of-season planting shall be entirely at the Contractor's risk.

3.02 - PLANTING OPERATIONS

A. Locations for planting beds, trees and shrubs shall be staked out by the Contractor as shown on the drawings and approved by the Engineer.

B. Plant pits shall be excavated with vertical sides in accordance with the details on the drawings. Plant pits shall not be backfilled with prepared topsoil mixture until they have been approved by the Engineer. If pits are prepared and backfilled with topsoil to grade prior to planting, their location shall be marked and recorded on the plans so that when planting proceeds they can readily be located.

C. Prepared topsoil mixture for backfill in all planting areas shall have all fertilizer/additives, as specified herein, thoroughly incorporated before backfilling.

D. Plants shall be set in center of pits plumb and straight and at such a level that after settlement, the crown of the plant will be at the surrounding finished grade.

E. Backfilling and Watering

1. When balled and burlapped trees are set, topsoil shall be compacted around bases of balls to fill all voids. All burlap, ropes or wires shall be removed from the tops of balls.

2. Planting pit shall be backfilled to its depth. Backfill shall be compacted and pit then filled with water.

3. After two waterings have been completely absorbed, the top half of the pit shall be backfilled and compacted.

4. 1-3/4 pounds of granular wetting agent/100 square foot shall be applied to newly planted area. Wetting agent shall be raked lightly into top inch of soil and then soil raked smooth.

5. A shallow saucer larger than pit shall be formed with a 4-inch ridge of soil to facilitate and contain watering.

6. Immediately after planting, the plant shall be thoroughly watered by completely filling the saucer with water a minimum of two times.

7. Ground cover beds shall be watered to a minimum depth of 4 inches immediately after planting (after application of wetting agent).

F. Tree guying or staking shall be in accordance with the plan detail. Care shall be taken that stakes do not pierce rootballs.

3.03 - OBSTRUCTIONS BELOW GROUND

A. In the event that rock, underground construction work or obstructions are encountered in any plant pit excavation work to be done under this contract, alternative locations may be selected by the Engineer.

B. Where locations cannot be changed, the obstruction shall be removed to a depth of not more than 3 feet below grade and no less than 6 inches below bottom of ball or roots when plant is properly set at the required grade.

C. The Contractor shall be paid for the removal of such rock or underground obstructions encountered at the Contract rate per cubic yard, under the appropriate item in the proposal. Limits of payment for excavation in rock fill are 1 foot outside the plant or tree root ball as shown on the drawings.

3.04 - UNDERGROUND UTILITIES

A. The Contractor shall be responsible for obtaining plans and locations of utilities and existing underground structures.

3.05 - WRAPPING

A. Wrapping of all trees shall be done immediately after they are planted. The trunks of all trees shall be wrapped spirally from the bottom to top with material as specified and shall be adequately secured. The wrapping shall overlap and entirely cover the trunk from the ground to the height of the second branches and shall be neat and snug. Overlap shall be approximately 2 inches apart.

3.06 - PRUNING, MULCHING AND WATERING

A. Each tree and shrub shall be pruned in accordance with American Nurserymen Association Standards to preserve the natural character of the plant and in a manner to meet its particular requirements in the landscape plan.

B. All dead wood, suckers and all broken or badly bruised branches shall be removed. Leaders shall not be cut back. Container grown plants shall not be thinned.

C. Pruning shall be done with clean, sharp tools. All cuts are to be made flush and clean.

D. Cuts over 1 inch in diameter shall be painted with an approved tree wound paint. Paint shall cover all exposed cambium as well as other exposed living tissue.

E. Immediately after planting operations are completed, all tree and shrub pits and ground cover beds shall be covered with a uniform 4-inch layer of bark mulch as indicated on the drawings. All remaining planting beds and disturbed areas where no grass is specified shall be mulched with a uniform 4-inch layer of bark mulch which shall extend to edging strips, walks, walls, curbs or other hard surfaces or undisturbed areas.

F. All plant material shall be watered (by flooding) twice during the first 24-hour period after planting.

G. If a problem should arise with a planting, an anti-transparent shall be applied as directed by the Engineer.

3.07 - INSPECTION AND ACCEPTANCE

A. Inspection for Provisional Acceptance

1. Upon completion of work, the Contractor shall request an inspection for provisional acceptance by the Engineer. The request shall be received at least 10 days prior to the requested date for provisional inspection.

2. Upon completion of all repairs and replacements by the Contractor as requested by the Engineer, the Engineer shall issue a dated written order of provisional acceptance.

B. All plantings shall be guaranteed by the Contractor for one year. Provisional acceptance will be given by the Engineer following inspection to ensure compliance with the drawings, details and specifications.

C. At the end of the guarantee period, a final inspection of the work shall be made to determine the condition of plant materials. All plants not in a healthy growing condition as determined by the Engineer shall be removed from the site and promptly replaced with plants as specified for the original planting at no expense to the Owner.

D. Plantings replaced at final inspection shall be subject to all requirements in the specifications for the original work including planting, provisional acceptance, guarantee period and final inspection.

3.08 – CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02485

LOAMING AND SEEDING

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PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes the furnishing of all labor, materials, tools and equipment required to furnish and install loam and seeding in areas as shown on the drawings, unpaved areas disturbed by the Contractor's operations and work, or any cross-country or lawn areas disturbed by the Contractor's operations during the course of construction.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Soil test results and recommendations for liming and fertilizing shall be submitted to the Engineer at least 45 days prior to loaming operations.
2. Certification of variety, proportions and percent germination of species in the seed mixture and percentage of crop seeds, weed seeds, noxious weeds and inert matter shall be submitted to the Engineer at least 45 days prior to loaming and seeding operations.
3. Brochures and samples for woven jute mesh netting and erosion control blanket.

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, handled and installed according to the American Association of Nurserymen’s written recommendations.

1.06 - DESIGN CRITERIA

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

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

1.07 - SEASONS FOR PLANTING

A. Seeding shall take place as soon as possible after each loam area has been prepared, in accordance with the recommendations of the seed supplier relating to the site conditions and region where seeding is to be done. Seeding shall be prohibited during windy or inclement weather, or in frozen or muddy ground; in general, conditions for seeding shall meet with the approval of the Engineer. This does not relieve the Contractor of the responsibility of providing a growth that is full and healthy, in the opinion of the Engineer.

PART 2 - MATERIALS

2.01 - LOAM

A. Testing

1. All loam used in the work of this section of the specifications will be tested and approved for use by the Engineer prior to being spread. Stripped material may be used if approved in accordance with the following requirements. Approved material shall be stockpiled so as not to interfere with the other work and other subgrade or fill materials.

2. All testing shall be done by an independent test laboratory approved by the Engineer. The Contractor shall provide the laboratory with representative soil samples for testing and send test reports directly to the Engineer.

3. Loam shall be tested for the following: pH, organics, buffer pH, soluble salts (expressed in millimhos), available Nitrogen, Phosphorous, exchangeable Potassium, Magnesium, Calcium and Sodium, Cation Exchange Capacity, percent H base saturation, percent Ca base saturation, percent M base saturation, and available Zinc, Manganese, Copper, Iron, humus content and soil type. All nutrient results shall be expressed in parts per million (ppm).

4. Test reports shall also contain specific recommendations as to the exact types and times and rates of application of soil additives and fertilizers based upon the soil test results. These recommendations shall be followed during lawn construction. All Contractors shall note that any and all materials and procedures, with respect to soil additives and fertilizers, contained herein are approximate and are given to assist bidding and that they will be adjusted to comply with test reports.

B. Loam shall be a "fine sandy loam", or a "sandy loam" determined by mechanical analysis and based on the "U.S.D.A. Classification System". It shall be of uniform composition, without mixture of subsoil. It shall be free of stones, lumps, plants and their roots, debris and other extraneous matter over 1/2 inches in diameter or excess quantities of smaller pieces of the same materials as determined by the Engineer. It shall not contain toxic substances harmful to plant growth. It shall be obtained from naturally well drained areas which have never been stripped before.

C. No more than 10 percent of loam shall be clay, with organic matter comprising not less than 4 percent, nor more than 20 percent of the total weight per load.

D. Loam shall not be delivered or worked in a frozen or muddy condition.

E. Soluble salts shall not be higher than 75 parts per million.

2.02 - LIME

A. Limestone shall be standard commercial ground limestone and shall be applied at a rate to be determined by the Engineer subsequent to the testing of loam; however, the rate shall not exceed 4,000 pounds per acre. Limestone shall not be installed during windy or inclement weather. Limestone in hydro-seeding operations shall be restricted in building areas. Any buildings or structures discolored or damaged from limestone spray shall be the Contractor's responsibility.

B. The Contractor shall take whatever precautions are deemed necessary to prevent damage by distribution of limestone. Any damage incurred by the Contractor's negligence shall be repaired at no additional cost to the Owner.

2.03 - COMMERCIAL FERTILIZER

A. Commercial fertilizer shall be a standard dry granular mixture, delivered in the manufacturer's containers and containing a guaranteed analysis by weight of Nitrogen, Phosphorous and Potash, applied at the rate to be determined by testing.

2.04 - SEED

A. Grass seed shall be fresh, clean new crop seed. It may be mixed by an approved method on the site or may be mixed by the dealer. If mixed on the site, each variety shall be delivered in the original containers which shall bear the dealers analysis. If the seed is mixed by the dealer, the Contractor shall furnish to the Engineer, the dealer's guaranteed statement of the composition of the mixture and the percentage of purity and germination of each variety.

B. The seed shall be furnished and delivered premixed in the proportions specified below. All seed shall comply with the State and Federal seed laws.

C. Grass seed shall be the previous year's crop and in no case shall the weed seed content exceed 1 percent by weight.

D. The seed mixture specified for slopes are for use on slopes graded at the rate of 4:1 and steeper slopes.

E. A manufacture's certificate of compliance to the specifications shall be submitted to the Engineer by the manufacturers with each shipment of each type of seed. These certificates shall include the guaranteed percentages of purity, weed content and sown until the contractor has submitted the certificates to the Engineer.

F. Within MassDOT right of ways, seed Mixture shall conform with MassDOT M6.03.0 and shall be used for all loamed areas (150 pounds/acre). Seed mixture shall be in accordance with the following:

Seed Type	Proportion	Germination Minimum	Purity Minimum
For Grassplots & Islands			
Creeping Red Fescue	50%	85%	95%
Kentucky Blue	25%	85%	90%
Domestic Rye	10%	90%	98%
Red Top	10%	85%	92%
Ladino Clover	5%	85%	96%
For Slopes & Shoulders			
Creeping Red Fescue	50%	85%	95%
Kentucky 31	30%	85%	95%
Domestic Rye	10%	90%	98%
Red Top	5%	85%	92%
Ladino Clover	5%	85%	96%

G. Cape Cod Special Seed Mixture for Town right of ways shall be in accordance with the following:

Seed Type	Proportion
Cape Cod Special Mixture	
Aztec II Tall Fescue	40%
Escalade Tall Fescue	35%
Allaire II Perennial Ryegrass	15%
Blue Bonnet Kentucky Bluegrass	10%

Wildflower Seed Mixture (34 pounds/acre)

1. Wildflower seed mixture shall be eight pounds of Loft's "Pinto" Wildflower Mix, mixed with 26 pounds sheep or hard fescue per acre of seeding.
2. Northeast Mixture by Applewood Seed Co., Arvada, Co., or Northeastern U.S. Wild Flowers by Environmental Seed Producers, Inc., El Monte, CA will be considered at double the manufacturer's recommended rate of application, mixed with sheep or hard fescue as specified above.
3. Wildflower Seed Mixture shall only be allowed in locations approved by the Owner and Engineer.

H. Wetland Seed Mixture

1. Wetland Seed Mixture shall be applied at a rate of 35 pounds per acre. Wetland Seed Mixture shall consist of a mixture of plant species as described below. Unavailability of the specified seed types or mix shall be verified in writing to the Engineer. Substitutions for the above table will be permitted only upon approval of the Engineer. Seed which has become wet, moldy, or otherwise damaged shall not be used.
2. The seeds shall be delivered to the project in labeled and sealed containers. Official Seed tags and shipment invoices from the seed suppliers shall be furnished to the Engineer. Seed may be sampled and tested by the Owner to verify the seed tag information. The Engineer will inspect each shipment for acceptability, upon delivery to the project.
3. The weight of the pure live seed (PLS) is computed by the labeled purity percent times the labeled germination percent times the weight. For example: Requirement is for 20 pounds of pure live seed of a specified variety and the Seed Tag data indicates that the variety is 99.41 percent pure and with 92 percent germination. Then the conversion to PLS is: 20 pounds divided by the product of 0.9941 and 0.92 equals 21.8 pounds, which meets the 20 pounds PLS requirement.
4. The wetland seed mix shall conform to MassDOT Wetland Seed Mixes 765.554 Seasonally Flooded Mix.
   a) No woody plant species will be acceptable.
   b) Seed mixes containing species included in the list of Invasive and other Unacceptable Plant Species in the most recent version of the U. S. Army Corps of Engineers New England District's "Guidelines for Mitigation Plan Checklist" will not be accepted. (The document is available at: http://www.nae.usace.army.mil/reg/check3.pdf).
3. Wetland Seed Mixture shall only be allowed in locations approved by the Owner and Engineer.

I. All topsoil stockpiles shall be stabilized by seeding with annual ryegrass at the rate specified for mowable grass seed mixture. Stockpiles shall be reseeded as necessary to maintain good cover for enrichment and to prevent erosion.

2.05 - EROSION CONTROL BLANKET

A. Erosion control blanket shall be "Hi-Velocity Curlex Blanket", as manufactured by American Excelsior, Co., Arlington, TX, or an approved equal. Erosion control blanket shall be placed on all slopes greater than 3 to 1. Erosion control blanket will be required for the protection of all seed areas or in any area where erosion is a problem.

2.06 - WOVEN JUTE MESH NETTING

A. Woven jute mesh netting shall be "Ludlow Soil Saver", as manufactured by the Ludlow Corp., Needham Heights, Massachusetts, or an equal manufactured by Advance Netting Company, Lodi, New Jersey, or "Jute - Net" by Bemis, Inc., St. Louis, Missouri, and shall be placed on all slopes greater than 3 to 1, and all slopes 3 to 1 which are higher than 10 feet. Woven Jute Mesh Netting will only be required for the protection of mowable grassed areas or in any other areas where erosion is a problem.

2.07 - STRAW

A. Straw for erosion control and moisture retention shall consist of stems or stalks after threshing. Straw shall be kept in place by stakes, netting, pins or liquid coatings as may be required and as approved by the Engineer.

PART 3 - EXECUTION

3.01 - SEEDING OPERATIONS

A. Personnel for lawn work shall be familiar with lawn construction and shall be under the constant supervision of a qualified foreman.

B. Preparation for Seeding

1. Preparation of Subgrade. After the Engineer has accepted the subgrade, the Contractor shall do whatever additional grading is necessary to bring the subgrade to a true smooth slope, parallel to finish grade or to the level of adjacent existing loam areas. Subgrade depth for Lawn Areas shall be 6 inches while Subgrade depth for Cross Country Areas shall be 4 inches.

2. The top 3 inches of the subgrade immediately prior to being covered with loam shall be raked or otherwise loosened and shall be free from stones, rock and other foreign materials 3 inches or greater in dimension.

3. Sufficient grade stakes as determined by the Engineer shall be provided to insure correct line and grade of subgrade and of finished grade.

4. Subgrade shall be inspected and approved by Engineer before placing of loam.

5. Loam shall be as specified herein and shall be placed and spread over approved areas to a sufficient depth so that after natural settlement and light rolling for lawn areas, the completed work will conform to the lines, grades and elevations indicated.

6. Finish grading. After loam has been spread, it shall be prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter, and stones over 1 inch in diameter shall be removed from the loam which shall also be free of smaller stones in excessive quantities.

7. The surface for lawn areas shall then be rolled with a hand roller weighing not more than 100 pounds per foot of width.

8. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until presenting a smooth and even finish to the required grade.

9. Subsequent to or during raking of the loam and at least 4 days prior to seeding, lime shall be applied and raked into the soil over all loam areas.

10. After the lime has been applied and worked into the loam, the entire area shall receive an application of commercial fertilizer. Fertilizer shall be spread in advance of seeding by approved mechanical spreading devices and lightly taken into the top of the soil.

C. Placement of Seed

1. Seed shall be spread at least 4 days after fertilization of the soil by an approved mechanical method and at the rate of 5 pounds per thousand square feet or as noted with seed mix. Seed shall be lightly raked into the soil to a depth of approximately 1/8 inch and no greater than 1/4 inch and the entire seeded area shall be rolled with a lightweight roller.

2. Seeding shall not be done during windy weather.

3. For lawn areas, seeding shall be done in 3 directions, 2 at right angles to each other, and one diagonally.

4. Culti-packer or approved similar equipment may be used to cover the seed and to form the seed bed in one operation. Due to the small size of the seed in the cross-country mix, the Contractor shall increase the bulk prior to seeding by the addition and thorough mixing of sand, Milorganite or other approved materials.

5. Immediately after seeding, all seeded areas shall be watered to a depth of approximately 4 inches and shall be covered with a loose, uniform layer of straw or hay.

3.02 - INSTALLATION OF EROSION CONTROL BLANKET

A. Erosion control blanket shall be installed in accordance with the accepted practices and the manufacturer's instructions and recommendations by personnel experienced with similar installations. All products and/or fastenings shall be as supplied by or recommended by the manufacturer, subject to approval by the Engineer.

B. Erosion control blanket shall lay loose on the grade and shall not be stretched or tightened in any direction. The blanket shall conform naturally to the contour and grade of the proposed topography.

C. Anchor slots, butts with structures, walls, curbs, etc., side and junction overlaps and terminal folds shall be made and fastened in accordance with the manufacturer's recommendations or as directed by the Engineer.

3.03 - INSTALLATION OF MESH NETTING

A. Mesh netting shall be installed in accordance with accepted practices and the manufacturer's instructions and recommendations by personnel experienced with similar installations. All products and/or fastenings shall be as supplied by or recommended by the manufacturer, subject to approval by the Engineer.

B. Netting shall lay loose on the grade and shall not be stretched or tightened in any direction. The netting shall conform naturally to the contour and grade of the proposed topography.

C. Anchor slots, butts with structures, walls, curbs, etc., side and junction overlaps and terminal folds shall be made and fastened in accordance with the manufacturer's recommendations or as directed by the Engineer.

3.04 - MAINTENANCE AND PROTECTION

A. Maintenance shall begin immediately after each portion of the lawn is installed.

B. Lawns shall be maintained for at least 60 days or as much longer as necessary to establish a uniform stand of the specified grasses.

C. Maintenance and protection of seeded areas shall consist of temporary protective fences, barriers, signs, watering, weeding, cutting, and reseeding as necessary, as well as maintaining the straw or mesh cover in a uniform layer.

D. The surface layer of soil shall be kept damp at all times during the germination period. In the absence of adequate rainfall, watering shall be performed two or three times daily or as often as necessary during the germination period and in sufficient quantities to maintain moist soil to a depth of at least 4 inches. Watering shall be done during the heat of the day to prevent the soil from drying out.

E. After first cutting, watering shall be once per week as necessary to supplement natural rain, to the equivalent of 1 inch per week, or to 4 inches in depth. Weekly inspection shall be made to determine the moisture content of the soil and the approved schedule shall be adjusted to fit conditions.

F. At the time of the first cutting, when grass is 4 inches high, mower blades shall be set at 2-l/2 inches high. In subsequent mowings, lawn areas shall be cut to a 2-l/2 inches height with not more than 40 percent of the grass leaf being removed. Naturalized seed mixture shall be cut only once per year during dormant periods as recommended by the manufacturer.

G. All clippings shall be removed after each mowing. Mowing shall be done only in dry weather.

H. The Contractor shall be responsible for providing a second application of commercial fertilizer should lawn work not be accepted within a 90-day period following the first application of fertilizer.

I. Excessive weeds shall be removed by methods approved by the Engineer.

J. The Contractor shall, at his own expense, repair bare spots and/or damage resulting from erosion, gulleys, washouts, or other causes by filling with topsoil and reseeding.

K. In the event that lawn operations are completed too late in the fall for adequate germination and/or growth of grass, maintenance shall continue into the following spring.

3.05 - INSPECTION AND ACCEPTANCE

A. The Engineer will inspect the seeded areas upon written request by the Contractor. The request shall be received at least 10 days before the anticipated date of inspection.

B. Inspection and acceptance of seeded areas may be requested and granted in part, provided the area for which acceptance is requested is relatively substantial in size and reasonably regular in shape with clearly definable boundaries.

C. An acceptable seeded area shall be one that has a dense, uniform stand of the specified species. It shall be free of ruts, gullies, bare spots, and the grass areas shall be healthy and free of weeds.

D. Upon acceptance of the work, the Contractor shall be relieved of further responsibility for care or maintenance of accepted lawns.

3.06 - DAMAGE AFTER ACCEPTANCE

A. Any lawns damaged after final acceptance of seeded areas and before project acceptance shall be repaired, reseeded, and maintained as specified above with an inspection and formal acceptance required.

3.07 - CLEANING UP

A. When any of this work is done while buildings are occupied, pavements shall be kept clear at all times, and broomed clean to prevent tracking dirt into buildings.

B. After completion of all landscaping work, all debris and excess material shall be disposed of to the satisfaction of the Engineer. All pavements shall be broomed and hosed clean.

3.18 – CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02503

PAVING, CURBING, SIDEWALKS AND ROADWAYS

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PART 1 - GENERAL

1.01 - SCOPE

A. The work covered by this section of the specifications includes furnishing all labor, equipment, tools, and materials, and in performing all operations in connection with roadway pavement overlay, and the replacement of existing paved surfaces, tack coat, installation of bituminous concrete curb, brick sidewalks, cement concrete sidewalks, bituminous concrete sidewalks, pavement markings, and all incidental work pertaining thereto as indicated on the drawings and as specified herein.

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

1.02 - MEASUREMENT AND PAYMENT

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

B. Prior to the start of construction, the Contractor shall prepare, submit and obtain written approval from the Owner for the various proposed methods of site restoration work. As part of this approval process and prior to the start of grading and paving operations, the Contractor and the Contractor's paving subcontractor shall meet with the Owner and Engineer to review the requirements for Project Site restoration. No payment shall be made for any work on this project unless these requirements have been met.

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Material reports for bituminous concrete pavement job mix formula and tack coat.
2. Material report (job mix formula) for cement concrete.
3. Survey of establishment of roadway grades along the entire length of each roadway.

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA

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

B. Environmental Conditions

1. Permanent paving shall be placed only when the underlying surface is dry, when the atmospheric temperature in the shade is above 40 degrees F, and when the weather is not foggy or rainy, provided, however, that the Engineer may permit, in case of sudden rain, the placing of mixture then in transit from the plant, if laid at proper temperature and if the roadbed is free from pools of water. Such permission shall in no way relax the requirements for quality of the pavement and smoothness of surface.
2. No material shall be laid upon a frozen base course or when wind conditions are such that rapid cooling will prevent satisfactory compaction. No load shall be sent out so late in the day that spreading and compaction cannot be completed during daylight.

PART 2 - PRODUCTS

2.01 - GENERAL

A. All materials shall conform to the requirements of "The Commonwealth of Massachusetts Highway Department (MHD), Standard Specifications for Highways and Bridges", latest edition (hereinafter referred to as the "State Specifications") and as specified herein.

2.02 - CALCIUM CHLORIDE – Not Used

2.03 - BASE COURSE

A. Gravel base course shall conform to the requirements for gravel fill in SECTION 02220, EARTHWORK, except that the maximum size of stone in the gravel shall be 3 inches.

B. Dense graded crushed stone base course shall conform to the requirements of Section M2.01.7 of the State Specifications.

C. Base Course in State Highways shall conform with the requirements of MassDOT Permit 5-2019-0487. The Base Course shall consist of 8-inches of gravel plus 4-inches of Dense Graded Crushed Stone over it. Materials shall meet MassDOT’s latest (2020) Standards and Specifications for Highways and Bridges.

2.04 - BITUMINOUS CONCRETE PAVEMENT

A. The binder and top courses for Class I, Type I-1, bituminous concrete pavement shall conform to the requirements of Section M3.11.00 of the State Specifications.

B. The general composition limits of materials, which make up the Job Mix Formula, shall conform to columns entitled "Binder Course" and "Top Course" as listed in Section M3.11.03 of the State Specifications. No bituminous concrete pavement shall be placed until the Engineer approves the Job Mix Formula.

2.05 - BITUMINOUS CONCRETE FOR TEMPORARY SURFACING

A. Hot mixed bituminous concrete shall be as specified hereinbefore for binder course or top course unless otherwise authorized by the Engineer.

B. Cold mixed bituminous concrete shall be a suitable type as approved by the Engineer. Cold mix may only be used when hot mixed bituminous concrete is not available and when authorized by the Engineer.

2.06 - TACK COAT

A. Tack Coat shall conform to the requirements of Section M3.03.0 of the State Specifications.

2.07 - CONCRETE SIDEWALKS

A. Cement concrete for walks shall be of 5,000 psi compressive strength at 28 days and shall conform to Section M4.02.00 (air entrained) of the State Specifications.

B. Welded steel wire fabric shall conform to the requirements of Section M8.01.2 of the State Specifications and shall meet AASHTO-M55 and shall have a minimum end-lap of six inches except where expansion joints occur. Mesh shall be 6 inches by 6 inches, W2.9 by W2.9 welded wire fabric.

C. Pre-molded expansion joint filler shall conform to Section M9.14.0 of the State Specifications and shall meet AASHTO-M153 thickness and widths required for the expansion joint widths.

2.08 - TEXTURED CONCRETE SIDEWALKS – Not Used

2.09 - GRANITE CURBING

A. Curbing shall be of a hard and durable granite, light gray in color, free from seams which would impair its structural integrity, and of a smooth splitting character. Natural color variations characteristic of the deposit will be permitted. Curbing shall be of the sizes indicated on the drawings.

B. Vertical Curbing shall be type VA-4 and shall conform to Section M9.04.1 of the State Specifications. Stone set on a radius of 100 feet or less shall be cut to the curve required.

C. Sloped Curbing shall be Type SA and shall conform to Section M9.04.2 of the State Specifications.

D. Transition Stones shall be as manufactured by Fletcher Co., Baretto Granite Corp., North Carolina Granite Corp. or equal. Stone shall match curb Type VA-4 at one end and SA at the other and shall conform in all other respects to the State Specifications.

E. Curb Inlets shall conform to Section M9.04.5 of the State Specifications.

F. Curb Corners shall be Type A (2 foot radius) and shall conform to Section M9.04.6 of the State Specifications.

2.10 - MORTAR – Not Used

A. Mortar for pointing joints in granite curbing shall be composed of equal parts of cement and sand with sufficient water to form a workable mixture. The materials shall conform to the requirements of Section M4.02.15 of the State Specifications.

2.11 - GUARDRAIL – Not Used

2.12 - PARKING AND ROADWAY MARKINGS

A. Paint for parking and roadway markings shall be a white and/or yellow reflectorized, fast drying paint, conforming to Section M7.01.0 of the State Specification with glass beads conforming to Section M7.01.07.

B. Temporary markings for parking and/or roadways shall conform to Section M7.01.16 for reflective glass spheres.

2.13 - VEHICLE LOOP DETECTORS

A. Products used for the installation of Vehicle Loop Detectors shall be installed in accordance with the applicable provisions of the MassDOT Standard Specification for Traffic Control Devices (Section 800), and the latest NEMA standards.

2.14 – PAVEMENT MARKINGS

A. State Roadways

1. Thermoplastic Road Paint shall be utilized for Pavement Markings located in State roadways. Thermoplastic Road Paint shall conform to MassDOT requirements.

2. Glass beads shall be added to the Thermoplastic Road Paint for extra reflectivity.

3. The colors of the marking materials shall be the standard highway colors of white or yellow and as outlined in the Manual on Uniform Traffic Control Devices.

B. Town Roadways

4. Acetone Road Paint shall be utilized for Pavement Markings located in Town roadways. Acetone Road Paint shall meet Federal Specification AA 2886 Type II.

5. Glass beads shall be added to the Acetone Road Paint for extra reflectivity.

C. Glass beads, tapes and paints used for pavement markings shall be lead free, conform to MassDOT requirements and meet the retro-reflectivity requirements of the Manual on Uniform Traffic Control Devices.

PART 3 - EXECUTION

3.01 - DUST CONTROL

A. Water shall be applied to control dust. The use of calcium chloride is not allowed.

B. Water shall be uniformly applied at least once a week or as directed by the Owner and/or Engineer.

C. Water for dust control shall be metered and paid for by the Contractor.

3.02 - PREPARATIONS FOR BITUMINOUS CONCRETE PAVING

A. Subgrade Preparation

1. All trenches shall be backfilled and compacted as required under the SECTION 02220, EARTHWORK. The edges of all pavements along the line of the trench shall be cut back from exposed edges thereof, a sufficient distance to form a clean, sharp straight edge essentially parallel to the centerline of the trench. The minimum lateral cut back to be allowed will be 12 inches. Cut back pavement shall be carefully removed to minimize any disturbance to foundation materials. The exposed surface of the foundation material shall then be rolled, wetting the surface as necessary to obtain a firm, even surface. Any depressions or uneven areas shall be regraded and re-rolled until the surface is smooth and satisfactorily compacted.

2. The edges of all other pavements (driveways and intersecting roadways) along shall be cut back from exposed edges thereof, a sufficient distance (as determined in the field by the Engineer) to form a clean, sharp straight edge essentially parallel to the centerline of the trench.

3. The Contractor shall rough grade and fine grade all roadways. In order to facilitate grading of the roadways, the Contractor shall establish grades along the entire length of each roadway. Grades shall be established along the centerline of each roadway as well as each side of the roadways. Grading shall be adjusted for driveways aprons and sidewalks. The Contractor shall engage an independent Registered Land Surveyor in the state of Massachusetts with experience with establishing roadways grades. The survey shall be submitted as a shop drawing for review and approval. The Owner has the right to adjust existing roadways grades as part of the final rough grading and fine grading at no cost to the Owner.

4. All surfaces to receive pavements shall be examined by the paving subcontractor to see that they are in proper condition to receive paving. Starting work in any area shall constitute acceptance of that surface. Sub-grade shall be maintained in satisfactory condition and properly drained until surface improvement is placed. All defects resulting from use of unaccepted surfaces shall be corrected by the Contractor at no cost to the Owner.

B. The Contractor shall raise all Owner drain and sewer manhole frames and covers, catch basin frames and grates and gate boxes to the established grades as shown on the Contract Drawings before paving is applied.

C. Prior to submitting its bid, the Contractor shall contact the other utilities so as to gain their requirements concerning any possible adjustment of gate boxes and other such structures. If the utility wishes the Contractor to raise these boxes it shall be in accordance with the utilities requirements. If the utility wishes to adjust their own gate boxes the Contractor shall give the utility adequate notice of his paving schedule.

D. If the gravel base course is disturbed by the adjustment of utilities, the disturbed base material shall be carefully removed and replaced with Portland cement concrete. For additional requirements see DIVISION 3 - CONCRETE.

3.03 - DRIVEWAYS

A. All driveways shall be adjusted as required to meet the final grades of the roadway.

B. Bituminous Driveways - Where trenches are excavated through existing bituminous concrete paved driveways, the trench shall be resurfaced to match the existing depth or 2-inch binder course of bituminous concrete (whichever is greater) followed by a 1-1/2-inch top course over the full width of the existing paved driveway. The limits of the overlay course shall be as defined by the Engineer.

C. Brick and Cobblestone Driveways - Where trenches are excavated through existing brick and/or cobblestone driveways, the trench shall be restored with similar materials utilizing existing materials and/or new materials meeting the requirements specified herein. The limits of the restoration shall be as defined by the Engineer

D. Other Types of Driveways - Where trenches are excavated through existing driveway materials not included above, the trench shall be restored with similar materials, including but not limited to color, type, and size, utilizing existing materials and/or new materials. The limits of the restoration shall be as defined by the Engineer.

3.04 - LEVELING COURSE

A. Where specified or directed by the Engineer, the Contractor shall install a leveling course of bituminous concrete to the depths as required and as approved by the Engineer.

B. The leveling course shall be installed utilizing bituminous material as specified above for a top course.

3.05 - TEMPORARY SURFACING

A. Contractor shall place temporary surfacing as directed by the Engineer. Temporary surfacing shall be placed over trenches in hard surfaced streets and roads, and other areas where directed. Temporary surfacing shall be of bituminous concrete base course as specified herein before, laid in one courses, 3-inches thick. Backfill at top of trench shall be removed to allow for placing temporary surfacing.

B. Contractor shall maintain temporary surfacing in good condition. Trenches shall be inspected at least once a week and also immediately after each storm. Holes and settlements shall be promptly refilled with bituminous mixture.

3.06 - PERMANENT SURFACING OF STATE STREETS AND MUNICIPAL STREETS

A. Permanent resurfacing shall occur as specified in SECTION 01030, SPECIAL REQUIREMENTS.

B. Construction requirements for bituminous concrete pavement shall conform to Section 460 of the State Specifications.

C. Construction requirements for hot mix asphalt pavement milling shall conform to the Asphalt Institute Publication MS-22, "Construction of Hot Mix Asphalt Pavements.

D. After the trenches have been completely consolidated and when directed by the Engineer the Contractor shall place full width bituminous concrete pavement. If there has been an appreciable lag in time between installing bituminous concrete courses, or if the binder course has been used extensively during construction, the Engineer shall determine whether tack coat and/or cleaning will be required at no cost to the Owner.

E. Prior to placing bituminous concrete resurfacing over existing pavement, the Contractor shall thoroughly clean and repair the existing pavement to the satisfaction of the Engineer. Upon securing approval, the Contractor shall apply a tack coat as specified and shall place a bituminous concrete mix in an approved manner.

F. Prior to placing bituminous concrete resurfacing, the Contractor shall remove and replace existing curbing in the locations as determined by the Engineer.

3.07 - BASE COURSE

A. Construction requirements for gravel base course shall conform to the requirements for gravel fill in SECTION 02220, EARTHWORK.

B. Material as previously specified shall be placed and compacted to the required thickness for the particular application. The moisture content of material may have to be adjusted to obtain the specified compaction. Refer to the SECTION 02220, EARTHWORK for specific compaction requirements. After compaction, all base course for pavements shall be as indicated on the drawings.

3.08 - CEMENT CONCRETE SIDEWALKS

A. Construction requirements for cement concrete walks shall conform to the requirement of Section 476 of the State Specifications.

B. Walks shall be sloped as indicated on drawings and slightly adjust grades at intersections as required.

C. Concrete walk sections shall be one-course construction and of thickness, widths, and lengths shown on drawings.

D. The concrete shall be tamped and screened true to grade and section.

E. Expansion joints shall be ½-inch expansion joints, with pre-molded fillers here shown on the drawings and at walk junctions and intersections, at top and bottom of steps, and where walks abut building, platforms, or other fixed structures. Expansion joints shall extend full depth of concrete. Pre-molded filler shall extend to within 3/8 inch of the walk surfaces.

F. Control joints shall be located as shown on the drawings, depth and width as required.

G. Finish cement concrete walks shall be finished according to Section 476.67 of the State Specifications. A final medium broom finish shall be applied as indicated on the drawings.

3.09 - BITUMINOUS CONCRETE SIDEWALKS – Not Used

3.10 - TEXTURED CONCRETE SIDEWALKS – Not Used

3.11 - INSTALLATION OF GRANITE CURBING AND CURB CORNERS

A. In general, all work shall conform to Section 500 of the State Specifications.

B. The trench for the curb shall be excavated to a width of 18 inches. The subgrade of the trench shall be a depth below the proposed finish grade of the curb equal to six inches in depth, plus the depth of curbstone.

C. Upon the foundation additional gravel shall be spread and compacted as required and granite curb shall be set thereon. All spaces under the curbstones shall be completely supported throughout their length. The curb shall be set at the line and grade required. Gravel shall be carried up evenly on both sides of curb until curb is firmly anchored.

D. Joints between granite curbstones shall be at least 1/4 inch and no greater than 5/8 inch and shall be carefully filled with mortar for a depth of three inches in from the top front and back faces and shall be neatly pointed on the exposed faces.

E. Curb shall be protected from bituminous concrete during paving operations and shall be cleaned if bituminous concrete does adhere to exposed curb surfaces.

3.12 - GUARDRAIL – Not Used

3.13 – PAVEMENT MARKINGS

A. Pavement marking shall be painted on non-windy days using whatever methods are necessary to prevent overspray from discoloring pavement. The locations, dimensions, color, etc. shall match existing/preconstruction conditions.

B. The Contractor is responsible for replacing all existing pavement markings including center lines, edge line, stop lines, crosswalks and lettering following temporary and permanent restoration of pavement.

3.14 - REPLACEMENT OF CURBS, WALKS, FENCES, STONE WALLS AND OTHER SIMILAR ITEMS

A. All existing curbs, walks, fences, stone walls and other similar items removed for the construction of the sanitary sewer, services, connections, water and/or storm drain lines shall be replaced in a manner equal or better than their original condition.

3.15 - REPLACEMENT OF BRICK AND COBBLESTONE ROADWAYS, SIDEWALKS, AND DRIVEWAYS

A. Existing brick and cobblestones used for roadways, sidewalks, driveways and/or cross walks, as applicable, shall be removed and place in a protected area.

B. Remove and place in a protected area all edging used for existing roadways, sidewalks, driveways and/or cross walks. It should be noted that existing edging consists of but not limited to steel, aluminum, granite and brick. Reset edging and/or replace any edging broken during removal at no additional cost to the Owner.

C. Remove sufficient depth of existing base materials replace with 6-inches of compacted stone dust for bricks and 6-inches of compacted stone dust and sand mixture at a 50/50 ratio for cobblestone. Rough and fine grade stone dust and compact to the required thickness for the particular application. Reset bricks and/or cobblestones with the smooth (worn and “weathered”) side up. Replace any bricks and/or cobblestones broken during removal at no additional cost to the Owner. Spread stone dust between the bricks and/or cobblestones to lock bricks and/or cobblestones in place.

D. Adjust all existing and newly installed utility boxes, frames and covers.

E. Sidewalks shall be sloped away from buildings to no more the ¼-inch per foot maximum toward the roadway. All existing structures including but not limited to tree grades, window wells, curbing, benches, utility boxes, and manholes shall match the elevation of the reset sidewalk.

3.16 - VEHICLE LOOP DETECTORS

A. General

1. The installation of Vehicle Loop Detectors shall be installed in accordance with the applicable provisions of the MassDOT Standard Specification for Traffic Control Devices (Section 800), and the latest NEMA standards.

2. Any Electrical Contractor performing work on roadways or signals under the jurisdiction of MassDOT and the Owner shall have International Municipal Signal Association (IMSA) Certification as a Traffic Signal Electrician Level II.

B. Installation

1. The detector lead-in cables shall be installed in the appropriate loop detector amplifier and labeled with the corresponding street name, approach direction, lane assignment, and phase and terminal number, both in the controller cabinet and in the pull box containing the detector lead-in splice. This labeling and attachment shall be of durable materials such as brass or plastic, attached by wire or plastic ties. Adhesive attachment of the label shall not be acceptable.

2. Wire loop detectors shall be installed in the roadway for vehicle detection. In advance of the loop detector installation, the Contractor shall mark, on site, the loop detectors with any changes required by field conditions such as manholes. The loop detector layout shall be inspected and approved by the Engineer before the loop detectors are installed.

3. Loop wire shall be encased in a protected plastic tubing of PVC or polyethylene plastic, IMSA 51-5, 1-1/4-inch outside diameter, and the wire may have cross-linked polyethylene insulation or it may have THHN/THWN insulation.

4. Splicing insulator shall be an approved re-enterable body splice kit with a non-hardening sealing compound compatible with the wire insulation. Klick-it buried wire closure kit as manufactured by Communication Technology, Inc., or approved equivalent.

5. Splice and Connection: Splicing and connection shall be made in the pull box nearest the roadway loop sensor but not exceeding four loops per pull box. All loops included in a detector group as shown on the plans shall be spliced in a single pull box. Each lead and lead-in connector shall be stripped back and spliced using a pressure type wire connector applied with a crimping tool. Multiple loop sensors shall be identified as detailed on the plans.

6. Lead-in splicing shall be staggered to prevent contact with each other. Each crimped splice shall be soldered and insulated. The insulation material shall be heat-shrinked polyolefin. The shielded lead-in cable outer jacket and shield shall be stripped back sufficiently to ensure that the shield cannot come into contact with the spliced conductors. Follow the instructions of the manufacturer when installing the re-enterable splice kit. The splice shall be done on the day of the loop wire installation to prevent the entrance of any moisture into the plastic tubing.

7. The lead-in conductors shall be connected to the appropriate terminals in the controller cabinet, by using crimped and soldered terminal ends.

8. The heat source for soldering shall be electrical not exceeding 30W capacity.

C. Testing of Loops

1. The test procedure shall be performed in the presence of the Engineer before and after the loop sensor is sealed in the pavement as stipulated in subsection 815.66. The cost of equipment, labor, and materials to perform such testing and similar re- testing following repairs, replacement, or adjustment of any detector within the project area shall be included in the price bid for the traffic control signal items.

2. After installation of wire loop sensors in the roadway and installation of shielded lead-in connecting the loop sensors to the controller cabinet, each loop sensor and lead-in combination shall be tested (at the controller cabinet) for proper installation. The resistance from lead to lead of the same loop shall not exceed three (3) ohms per 305 meters as measured by a high quality meter suitable for measurements of low resistance in the range of 1 to 6 ohms.

3. A megohm meter test at 500 volts DC shall be made between the two leads of a loop/lead-in combination temporarily spliced together, but otherwise disconnected from all terminals, and the shield drain wire and the earth ground connection. These resistances shall be at least one hundred (100) megohms.

4. A megohm meter test at 500 volts DC shall be made between lead-in shield and the earth ground rod. This resistance shall be at least one hundred (100) megohms.

5. The meter used for these tests shall be checked for calibration each day of use by using a resistor block of ±5 percent resistors simulating loads of 1 megohm, 20 megohm and 100 megohms. The observed meter reading shall be +10 percent of the nominal resistor load.

6. If any loop sensor and lead-in combination fails to pass any one of the four (4) tests, it shall be repaired and then re-tested on two occasions at least two (2) weeks apart and then shall pass on each re-test occasion. If the loop sensor lead-in combination does not pass all these re-tests, a new loop sensor and/or lead-in shall be installed, and shall pass these tests, at no additional cost.
7. After the above tests have been satisfactorily completed, all loop sensor/shielded lead-in inductance shall be measured and a written report of the results shall be filed with the Engineer and a copy stored with the "box prints" at the intersection.

3.17 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02600

WATER MAINS AND APPURTENANCES

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes the furnishing of all labor, tools, equipment and materials necessary to perform all operations required for the construction of the replacement of the existing water mains, fittings, valves, hydrants and other related items necessary to complete the Work as specified.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Pipe and fittings.
2. Gaskets.
3. Couplings and solid sleeves.
4. Hydrants.
5. Valves.
6. Tapping Sleeves and Valves.
7. Water Service and Blowoff Materials.

8. Manufacturer's Certificates of Compliance with these Specifications and certification that the ductile iron pipe and fittings have been manufactured and tested in accordance with AWWA/ANSI specifications.
9. Manufacturer's documentation demonstrating at least 10 years of successful experience in manufacturing ductile iron pipe and fittings.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. All pipe when shipped shall be packed and separated by wood separators such that pipe-to-pipe contact is prevented during transit and/or storage.

D. Take appropriate measures during the loading, trucking, unloading, and handling of pipe and appurtenant materials so as not to damage them or the roadway surface. Dropping of materials directly from the trucks upon the ground will not be permitted. Suitable effective buffers or runners shall be provided. Metal chain shall not be used for lifting materials.

E. Distribution of pipeline materials along the line of Work is not permitted without written approval of the Owner. Do not obstruct driveways, sidewalks and/or walkways or place materials on private property.

1.06 - DESIGN CRITERIA

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

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

C. All products and materials shall conform to the applicable standards of ANSI and AWWA and/or as specified herein.

D. All materials supplied shall be manufactured in the United States.

1.07 - REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs 60,000 PSI Tensile Strength.

B. American Water Works Association (AWWA)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pressure Pipe and Fittings
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings for Water
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115 - Standard for Flanged Ductile-Iron Pipe with Threaded Flanges
6. AWWA C150 - Thickness Design of Ductile-Iron Pipe
7. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids
8. AWWA C153 - Ductile-Iron Compact Fittings, 3-in through 16-in for Water and Other Liquids
9. AWWA C500 - Gate Valves for Water and Sewerage System.

10. AWWA C502 - Dry-Barrel Fire Hydrants
11. AWWA C504 - Standard for Rubber-Seated Butterfly Valves
12. AWWA C600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
13. AWWA C651 - Disinfecting Water Mains
14. AWWA C800 - Underground Service Line Valves and Fittings

C. American National Standards Institute (ANSI)

1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

D. Underwriters Laboratory (UL)

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

PART 2 - PRODUCTS

2.01 - PIPE

A. All ductile iron pipe shall be designed and manufactured in accordance with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51 and the following class:

Pipe Diameter (inches)	Thickness (inches)	Special Thickness Class
6	0.31	52
8	0.33	52
10	0.35	52
12	0.37	52
16	0.37	51
20	0.39	51

B. Pipe shall be designed for the rated working pressure in pounds per square inch shown below and for laying condition Type 2 (Flat bottom trench, backfill consolidated to centerline of pipe) and for eight (8) feet of earth cover.

C. The pipe shall be in nominal laying lengths of eighteen (18) to twenty (20) feet. The grade of iron from which the pipe is made shall be 60-42-10; having 60,000 psi minimum tensile strength, 42,000 psi minimum yield strength and ten (10) percent minimum elongation.

D. Ductile iron pipe shall have either push-on or restrained joints. Restrained joint pipe shall be used in lieu of thrust blocks to resist the movement of the pipe. The “Minimum Restrained Joint Pipe Length” shall be in accordance with the manufacturer’s requirements and operating conditions. All other pipe shall have push-on joints.

E. Gaskets shall meet the material requirements of ANSI/AWWA C111 for mechanical joint gaskets.

F. The interior of the pipe shall be cement-mortar lined to twice the thickness specified in ANSI/AWWA C104/A21.4. The pipe manufacturer under controlled factory conditions shall apply the cement-mortar lining and field application is strictly prohibited. The cement-mortar lining shall be seal coated with an asphaltic material in accordance with ANSI/AWWA C150/A21.50 and NSF Standard 61. Asphaltic seal coat shall not impart taste or odor, or toxic or carcinogenic compounds to the water contained therein. Asphaltic seal coat shall be a product acceptable to the NSF for use in potable water and shall be so listed in the NSF summary of approved products. The asphaltic seal coat shall be applied and cured in strict conformance with the coating manufacturer's instructions. The manufacturer under controlled factory conditions shall apply the asphaltic seal coat and field application is strictly prohibited.

G. The outside of the pipe shall be asphaltic coated to a minimum 1 mil thickness in accordance with ANSI/AWWA C150/A21.50. The manufacturer under controlled factory conditions shall apply the asphaltic seal coat and field application is strictly prohibited

H. Restrained joint pipe shall be TR FLEX® as manufactured by the United States Pipe and Foundry Company or equal.

2.02 - FITTINGS

A. All ductile iron fittings including plugs, caps and blank flanges, shall be Class 350, mechanical joint, conforming to ANSI Specification A21.53 (AWWA C153) and conform to the weights and dimensions shown in the latest edition of the Ductile Iron Pipe Research Association (DIPRA) “Handbook of Ductile Iron Pipe” and be provided complete with all joint accessories.

B. All fittings shall be marked with the weight and shall have distinctly cast upon them the pressure rating, the manufacturer's identification, nominal diameter of openings and the number of degrees or fraction of the circle on all bends.

C. Hydrant tees shall be mechanical joint anchoring tees and have a rotatable mechanical joint gland on the 6-inch plain end branch to provide positive valve restraint.

D. Caps and plugs shall be provided with a threaded corporation or bleeder valve so that air and water pressure can be relieved prior to a future connection.

E. The interior surface of all fittings shall be cement-mortar lined to twice the thickness specified in ANSI/AWWA C104/A21.4. The pipe manufacturer under controlled factory conditions shall apply the cement-mortar lining and field application is strictly prohibited. The cement-mortar lining shall be seal coated with an asphaltic material in accordance with ANSI/AWWA C150/A21.50 and NSF Standard 61. Asphaltic seal coat shall not impart taste or odor, or toxic or carcinogenic compounds to the water contained therein. Asphaltic seal coat shall be a product acceptable to the NSF for use in potable water and shall be so listed in the NSF summary of approved products. The asphaltic seal coat shall be applied and cured in strict conformance with the coating manufacturer's instructions. The manufacturer under controlled factory conditions shall apply the asphaltic seal coat and field application is strictly prohibited.

F. The outside of all fittings shall be asphaltic coated to a minimum one (1) mil thickness in accordance with ANSI/AWWA C150/A21.50. The manufacturer under controlled factory conditions shall apply the asphaltic seal coat and field application is strictly prohibited.

2.03 - FLEXIBLE AND TRANSITION COUPLINGS

A. Flexible couplings shall be Dresser Style 138 or equal. Couplings shall be furnished with black steel bolts and nuts and with pipe stop removed. Gaskets shall be of a material suitable for exposure to liquid within the pipe.

B. Transition couplings shall be Dresser Style 162 or equal. Couplings shall be furnished with black steel bolts and nuts and with pipe stop removed. Gaskets shall be of a material suitable for exposure to liquid within the pipe.

2.04 - SOLID SLEEVES

A. Solid sleeves shall be long body type, ductile iron with mechanical joints.

B. All sleeves shall conform to the weights and dimensions shown in the latest edition of the Ductile Iron Pipe Research Association (DIPRA) “Handbook of Ductile Iron Pipe” and be provided complete with all joint accessories.

2.05 - RESILIENT SEATED GATE VALVES

A. Valves shall be manufactured in full compliance with the content and intent of this specification. Valve body shall be cast iron conforming to the latest edition of ASTM A126, Class B. Valves shall mechanical joint, with a 2-inch operating nut, a non-rising stem and shall conform in every respect to AWWA C509. Valves shall be designed for 250 psi working pressure, 350 psi test pressure and shall be hydrostatically tested with twice the specified rated pressure applied to one side of the gate and 0 pressure on the other side.

B. When mechanical joint ends are specified for use, the gasket seating areas shall be fully machined to fixed dimensions and tolerances as per AWWA specifications. All valves shall be provided with "O" rings. The design of the valve shall be such that the seal plate can be fitted with new "O" rings while the valve is under pressure in a fully open position.

C. Interior and exterior surfaces of all valves shall have a 100 percent solids thermoset or fusion bonded epoxy protective coatings, holiday-free in the waterway, which shall meet all requirements of AWWA C550. The epoxy coating shall not impart taste or odor to the water. The coating shall be a product acceptable to the NSF for use in potable water and shall be so listed in the most current NSF summary of approved products. The coating shall be applied and cured in strict conformance with the coating manufacturer's instructions. The valve manufacturer under controlled factory conditions shall apply the coatings and field application is strictly prohibited.

D. Valves shall open left and shall be as manufactured by Mueller or equal.

2.06 - TAPPING SLEEVES AND VALVES

A. Tapping sleeves and valves shall conform to the AWWA specifications for tapping sleeves and valves.

C. Tapping sleeves shall be mechanical joint, 2-part castings, flanged on the vertical centerline, and come complete with all joint accessories. The surface area of each flange shall be thoroughly machined, and the sleeve flanges shall be fitted with gaskets recommended by the manufacturer. Each gasket shall cover the entire surface area of each joint for the full length of the sleeve. Bolts used to assemble the sleeves shall pass directly through each flange and through each gasket. Bolts shall be properly spaced to insure uniform gasket pressure and compression.

D. Sleeve outlets shall have counter-bored flanges to insure proper centering of the tapping valve.

E. All tapping valves shall be flanged by mechanical joint and open left. Tapping sleeve valves shall be AWWA approved and shall meet all applicable requirements including test pressure and exterior coating as specified hereinbefore for resilient seated gate valves.

F. Prior to ordering tapping sleeves verify the circumference of the pipe on which each tapping sleeve is to be installed.

2.07 - VALVE BOXES AND COVERS

A. Valve boxes shall be cast iron, asphalt coated, adjustable sliding type with cast iron covers with a minimum 6-inch overlap is required between sliding sections. Valve box covers shall be drop type with the word "WATER" and a direction-to-open arrow plainly cast in relief on the top surface of the cover. Valve boxes shall be Buffalo Style #5663, with 24-inch top section and 30-inch bottom section.

B. Bell end of the lower sections shall in all cases be sufficiently large enough to fit over the stuffing boxes of the valves. The top section shall be at least 6-1/8-inches and have top flanges. The bottom section shall be at least 36-inches in length. The top section shall be at least 26-inches in length and have a plain bottom. The smallest inside dimension of the shaft shall not be less than 5-1/4 inches and shall have a belled base.

C. Upper section shall have a flange sufficiently strong enough to furnish the bearing for that section so that all weight or jolting from street traffic or the like shall not be transmitted to the valve.

D. Each valve box including cover shall weight at least 100 pounds.

E. No three-piece combinations shall be acceptable

2.08 - HYDRANTS

A. Hydrants shall be of the following type and manufacturer only. The Owner has standardized on this hydrant and therefore no substitutes are allowed.

1.	Make and Model	Mueller Co. A423 “Super Centurion 250”
2.	Type of Thread	National Standard
3.	Number of Outlets	2-1/2 inch hose connection (2 required)
		4-1/2 inch steamer connection (1 required)
4.	Diameter Valve Opening	5-1/4 inches
5.	Diameter of Barrel	8-1/2 inches
6.	Hub	Mechanical joint
7.	Direction of Opening	Open Left
8.	Depth of Bury	Street Level Shoulder Areas: 5-feet 6-inches
		Raised Sidewalk Areas: 6-feet 0-inches
9.	Color	Two coats of prime paint before shipment and once installed are to be cleaned and painted by the Contractor to match color of existing hydrants of the Owner

F. Hydrants shall be designed for one hundred fifty (150) pounds per square inch working pressure and shall conform in every respect to AWWA C502.

G. Hydrants shall be traffic model with dual drain ports and ductile iron retaining glands.

H. Hydrants shall have an oil reservoir to provide lubrication to all stem threads, bearing surfaces and O-rings each time the hydrant is operated.

I. Hydrant shall be marked with an arrow and the word "open" to indicate the direction to turn the stem to open the hydrant.

J. Hydrant barrel extensions shall be as recommended by the manufacturer of the hydrant and shall include all couplings, pins, flanges, gaskets, nuts and bolts necessary to provide a complete and workable installation. If more than one (1) type of extension is available, the Engineer shall approve the type to be provided.

K. Hydrants shall have hydrant markers with reinforced fiberglass shaft heavy duty spring mounted 4-foot long x 3/8-inch diameter. One bolt mounting.

2.09 - THRUST RESTRAINT GLANDS AND JOINTS

A. Thrust restraint glands shall be used on all mechanical joint fittings, valves and sleeves. The thrust restraint system shall incorporate individually activated gripping surfaces integral to the follower gland that makes up the mechanical joint.

B. Glands shall be manufactured of ductile iron conforming to ASTM A536. Gland dimensions shall be such that they can be used with standard mechanical joint bells and tee head bolts that conform to the latest revision of ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153. Twist-off nuts, sized the same as tee-head bolts, shall be used to insure proper actuating of restraining devices. The mechanical joint restraint shall have a working pressure of at least 150 psi with a minimum safety factor of 2:1.

C. Glands shall be specifically designed for use with mechanical joint ductile iron pipe, fittings and valves. Glands shall be Series 1100 MEGALUG by EBBA Iron, Inc., Stargrip Series 3000 as manufactured by Star Pipe Products or equal.

D. Restraints for push-on joints shall be Stargrip Series 3100P as manufactured by Star Pipe Products, Series 1700 as manufactured by EBAA Iron or equal.

2.10 - WATER SERVICE MATERIALS

A. All water service materials, which shall include but is not limited to corporation cocks, curb stops, couplings, adapters, and fittings shall have compression type connections. Castings shall be sufficiently heavy to meet all service conditions without springing or leaking and be clean and free from roughness both inside and out. Waterways shall be smooth, full size and free from obstruction. All threads shall be cut sharp, clean and true. The Owner is standardized on the following Manufacturers specified herein.

B. Polyethylene tubing shall be furnished in accordance with the requirements of AWWA Standards C901. Tubing shall be 1-inch PE 3406, iron pipe size with a pressure class of 200 psi designed for buried service. Tubing shall be approved for use with potable water and shall be shall be NSF approved.

C. Corporation cocks shall be constructed of brass and meet the requirements of AWWA C800 and be for polyethylene tubing. The joint shall be a compression joint and the corporation shall be Model F1001-4 as manufactured by the Ford Meter Box Company. The Owner has standardized on this hydrant and therefore no substitutes are allowed.

D. Curb stops shall be constructed of brass and mee the requirements of AWWA C800 and be a ball-type design with compression joint. Curd stops shall be Model B66-44M as manufactured by the Ford Meter Box Company. The Owner has standardized on this hydrant and therefore no substitutes are allowed.

F. Service boxes shall be tar coated, cast iron, sliding type with 2 Hole Erie pattern cover, with a stationary rod to accommodate required bury depth. Covers shall be held in place with bronze bolts. Service box covers shall be have the word "WATER" cast into the cover.

2.11 - BLOWOFFS

A. Temporary and permanent blowoffs, to be used for disinfection and testing purposes, shall meet the requirements specified for water service materials and shall be constructed in accordance with the details included on the Contract Drawings and/or as directed by the Engineer.

2.12 - POLYETHYLENE ENCASEMENT

A. Polyethylene pipe encasement shall conform to requirements of AWWA C105, latest edition.

B. Virgin polyethylene shall conform to ANSI/ASTM D1248.

C. Minimum nominal thickness shall be 8 mils.

PART 3 - EXECUTION

3.01 - INSTALLATION OF PIPE, FITTINGS AND APPURTENANCES

A. Pipes shall be thoroughly cleaned before being installed. Particular attention shall be paid to the proper positioning of the rubber gaskets. Joining of pipe and fittings shall be done in accordance with the manufacturers written instructions.

B. Temporary watertight plugs shall be utilized at the end of each working day to prevent the intrusion of silt, debris and water into the pipeline. When working in areas with a high potential for flooding of the pipe from groundwater, streams, storm drains, sewers and/or other means, the temporary plug shall be used on each pipe length during installation.

C. In the event of flooding of the pipeline, all pipe laying shall cease until the pipeline has been thoroughly cleaned, as determined by the Engineer.

D. When joined together, pipeline shall form a smooth continuous line and grade on straight sections and on curved sections (both vertical and horizontal) shall have uniform deflections within the required limits and conforming in general to the line and profile of adjacent roadway or easement. Location of rubber rings shall be determined with a checking gauge before backfilling the pipe.

E. Pipe shall be joined and laid in accordance with the manufacturer's latest published instructions.

F. Pipe shall not be laid with deflection of more than one-half (1/2) the maximum deflection recommended by the manufacturer.

G. Backfill shall be placed on both sides of the pipe and compacted simultaneously with approved tamping bars for the full length of pipe. Bell holes shall be excavated as necessary to ensure that the pipe and not the pipe bells are bearing the weight of backfill and the traffic load.

H. Bells or other joints shall not be installed directly under existing utilities or structures. Use short or random lengths to avoid such conditions.

I. Pipe shall not be installed in areas where excavations have been carried below trench grade, or where groundwater conditions create unstable bottoms, until such time as the trench is excavated, refilled and compacted as specified.

3.02 - MECHANICAL JOINTS

A. Mechanical joints shall be installed with all required joint accessories, including gaskets, follower glands with drilled bolt holes, tee head bolts, and hexagonal nuts.

B. Torque wrenches shall be used to take up such joints. Wrenches shall be equipped with adjusting breakable tension gauge, set to break the tension at the tension loading recommended by the manufacturer. Mechanical joints shall be made so as to secure tight joints, every means being taken to secure this result.

3.03 - CUTTING OF PIPE

A. All cuts of ductile iron pipe shall be made with either an electric, pneumatic, or gasoline driven power saw. Blades shall be carbide tipped for cutting cement lined ductile iron pipe. Hydraulic cutters may be used provided the cement lining is not damaged by this method.

B. When lengths of pipe are field cut to provide for short lengths, the outside of the cut ends shall be tapered back about one-eight (l/8) inch at an angle of thirty (30) degrees with the centerline of the pipe and as recommended by the manufacturer before field cut pieces are installed.

3.04 - PIPE BLOCKING

A. Furnish and install wood blocking where required as directed by the Engineer.

B. Blocking shall be new spruce plank one (1) inch and two (2) inches in thickness. Blocks shall be bedded firmly and level across the bottom of the trench and when any block has been sunk too deeply additional blocking of suitable thickness shall be placed to bring the pipeline to the required grade.

C. Blocks shall be placed at a point 1/5th of the span from each joint. Each block shall be two (2) inch by four (4) inch with a length of four (4) inches larger than the diameter of the pipe. A sufficient quantity of wedges twelve (12) inches long of four (4) inch by four (4) inch fir shall be furnished to properly hold valves and special castings in place. A four (4) inch by four (4) inch timber shall be used to brace hydrant posts.

3.05 - CONNECTIONS TO EXISTING MAINS

A. Twenty-four (24) hours prior to connecting to any existing water main notify the water utility. Only the Owner's personnel shall operate existing valves.

B. Make all taps, whether wet or dry and install the required sleeves, tees, couplings, adaptors, reducers, pipe nipples, jointing materials, and other fittings which may be required and make all joints watertight, as specified, where shown on the Contract Drawings and/or as approved by the Engineer. All existing materials removed shall remain the property of the Owner, as determined by the Owner. Legally dispose of all removed materials that the Owner does not want stockpiled.

C. The cutting, removal, plugging and bracing of parts of the existing water system in order to make necessary connections is included in the Work. The shutdown of the existing water system including any subsequent pumping, hand excavating, and time required by the Owner to effect tight closures of existing valves, and any reasonable changes that may be required by the Engineer or any other Work done hereunder shall be considered as an obligation to complete the Work.

D. All Work shall be coordinated with the Owner and such connections that may be required shall be made at such times and in such a manner as to cause as little interference in water service within the existing system as is practicable.

3.06 - INSTALLATION OF TAPPING SLEEVES AND VALVES

A. Pipe upon which a tapping sleeve is to be installed shall be thoroughly cleaned of all foreign matter with scraping tools and wire brushes, a minimum of six (6) inches each side of the sleeve.

B. Clean the flanged surface of the sleeve with a wire brush to remove any excess bituminous coating or burrs. The two (2) sections of the sleeve shall be lined up with care being taken to ensure that they are positioned in the same manner as received from the manufacturer.

C. Sufficient blocking and wedges shall be used to secure the sleeve once it has been leveled and positioned.

D. Sleeve bolts shall be alternatively tightened from the extreme end on one side to the extreme end of the opposite side, with approved torque wrenches, until all are securely tightened.

E. Flange bolts shall be tightened in a similar manner, with care being taken not to disturb the gasket.

F. Take care to ensure that the tapping machine is kept in leveled horizontal position and securely supported so as not to transmit any additional weight to the tapping valve.

3.07 - VALVE BOXES

A. Furnish and install valve boxes over each valve.

B. Valve boxes shall be cut with a wheel cutter, if necessary, to adjust them for height, where approved by the Engineer.

C. Valve boxes shall be properly adjusted over the operating nuts of valves and adjusted to the proper height to correspond to the roadway or ground surface. Operating nuts shall be centered in the valve boxes.

3.08 - ABANDONED VALVE BOXES

A. Upon completion of all Work and successful testing and disinfection of the new pipeline, close all existing valves designated by the Engineer on existing pipelines which have been cut and capped and/or are no longer to remain in service.

B. After closure, each valve box shall be removed, the void filled with gravel and then capped with grout prior to repaving.

3.09 - HYDRANT BRANCHES

A. Furnish and install hydrants on hydrant branches where shown on the Contract Drawings and/or as approved by the Engineer.

B. Each hydrant branch shall consist of the following:

1. Short Hydrant Branch - A valve anchoring tee with a 6-inch branch, 6-inch gate valve (mechanical joint), a 6-inch mechanical joint ductile iron pipe nipple of the required length and thrust restraint glands installed on the joints of all hydrants, valves and fittings. The base of hydrants shall be set on a concrete pad.

2. Long Hydrant Branch – A valve anchoring tee with an 8-inch branch, 8-inch gate valve (mechanical joint), 8-inch mechanical joint ductile iron pipe nipple of the required length, 8-inch by 6-inch reducer (mechanical joint), a 6-inch mechanical joint ductile iron pipe nipple of the required length and thrust restraint glands installed on the joints of all hydrants, valves and fittings. The base of hydrants shall be set on a concrete pad.

C. Hydrant barrel extensions shall be furnished and installed where necessary to provide a hydrant elevation acceptable to the Owner.

D. Construct hydrant drainage wells of one-half (1/2) cubic yard capacity of two (2) inch stone placed in the excavation below and around the hydrant bottom.

E. Hydrants shall be given two (2) coats of paint after installation of the same type and color of the existing hydrants of the Owner.

F. Existing Hydrants

1. Where shown on the Contract Drawings and/or directed by Engineer remove existing hydrants and stack them at a location selected by Owner within the municipal limits. Prior to removing any existing hydrants, the Contractor shall notify the local Fire Department and coordinate this Work with that agency.

2. For each hydrant to be removed and stacked close the branch valve, restrain valve if necessary, cut and cap branch, remove gate box, and remove hydrant. Legally dispose of any hydrant that the Owner decides not to accept.

3. Where shown on the Contract Drawings and/or directed by the Engineer, remove existing hydrants and reinstall them at locations designated by the Engineer. Prior to incorporating such hydrants into the Work, they shall be refurbished and repaired to the satisfaction of the Owner. Inspection and repair of existing hydrants shall be performed in accordance with the applicable procedures described in AWWA Manual M17, including, but not limited to, replacement of all gaskets, packing, seals and any other parts which show indication of wear, corrosion or incipient failure. Reinstallation of existing hydrants shall be performed with materials, and in the manner specified for new hydrants.

3.10 - SERVICE CONNECTIONS

A. Furnish and install all necessary water service materials required to complete the transfer of water services to the new pipeline(s) installed or required to abandon services replaced. The limit of work related to service connections shall be as approved by the Engineer and/or as follows:

1. If a complete transfer of a water service from the existing pipeline to the new pipeline is required, furnish and install all required materials and install the new service in the vicinity of the existing service to the property line. All connections to the customers' side of the curb stop are included as part of the Work.

2. If a portion of the existing water service, such as but not limited to the curb stop or service pipe, are to be reused, then furnish and install all other materials required to connect the new service materials to the existing materials.

3. If the existing pipeline from which services are being transferred is to remain in service at the completion of the Work, excavate down to each abandoned corporation cock and shut it off. Existing corporations to be abandoned shall only be shut off when approved by the Owner.

B. Service connection work shall only be initiated after the new pipeline has been successfully pressure and leakage tested, disinfected and approved for service by the Owner. Service connection work shall result in a minimum disruption of service to existing consumers.

C. Only "wet taps" shall be made on the new pipeline(s) unless written approval is obtained from the Engineer to use dry taps.

1. Pipe shall be tapped in accordance with the manufacturer's latest published recommendations in regard to but not limited to depth of tap and allowable sizes.

2. Drills and/or taps shall be inspected frequently for signs of wear. Do not exceed the number of taps specified by the manufacturer before reconditioning or replacing drills and/or taps. Service pipe shall be cut with approved wheel cutters only.

D. Prior to excavating for service connections, cut and stockpile all sod on established lawns, remove, replant and/or replace shrubs, hedges, fences and trees that are required to be removed or are damaged by the Work.

E. Equipment with rubber tires shall be used to excavate and backfill on established lawns.

F. Service pipe shall be installed to a minimum depth of five (5) feet and laid in a straight line wherever practicable to the structure to be serviced or to the point of termination of existing service. Install the service pipe beneath paved surfaces and sidewalks by jetting, jacking, boring or pulling the existing service pipe. Open cuts shall only be made when written approval is obtained from the Engineer.

3.11 - BLOWOFFS

A. Permanent blowoffs shall be furnished and installed as specified and/or where directed by the Engineer. Copper tubing shall be cut flush with the top of gate boxes.

3.12 - POLYETHYLENE ENCASEMENT

A. Ductile iron pipe and fittings shall be wrapped in polyethylene encasement where pipe depth is at or below normal groundwater level.

B. Ductile iron pipe and fittings installed within 5 feet of gas lines shall be wrapped in polyethylene encasement.

3.13 - CEMENT CONCRETE THRUST RESTRAINTS

A. Furnish and place cement concrete for thrust restraint, where restrained joint pipe cannot be used as directed by the Engineer.

B. Concrete shall be of proportions, one (l) part cement to two (2) parts sand and four (4) parts coarse aggregate.

C. Care shall be taken to ensure that all concrete thrust blocks bear against undisturbed trench walls, and not to encase flanges and bolts on mechanical joint fittings. Where unsuitable bearing material is encountered, excavate and place sufficient concrete ballast, with the approval of the Engineer, to offset the anticipated thrusts.

3.14 - OTHER MATERIALS

A. Furnish and install all necessary materials required for a complete installation as specified.

3.15 – CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02605

TEMPORARY BY-PASS PIPING AND SERVICE CONNECTIONS

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing of all labor, tools, equipment, materials and performing all operations necessary for temporary by-pass piping of Municipal water and service connections as specified herein and/or as shown on the Contract Drawings.

B. Temporary by-pass pipe and service connections are required at Baxter Lane, Lucy’s Lane, Gesner Road and at other locations as identified and approved by the Engineer.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Temporary by-pass pipe, fittings, valves, hydrants and service materials.
2. Provide a complete by-pass piping layout. Layout shall identify the location(s) and pipe diameter(s) of all pipe, hydrants and valves.

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA

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

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The Work of this section shall be coordinated with the Owner.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Each segment of the temporary by-pass piping system shall be fully adequate to withstand the normal working pressures experienced in the Owner’s existing water distribution system or 150 pounds per square inch whichever is greater.

B. All by-pass piping and appurtenances shall be watertight and of materials that do not cause objectionable taste or odor in the potable water system.

PART 3 - EXECUTION

3.01 - GENERAL

A. Each segment of the temporary by-pass piping system, including service connections, shall be flushed clean and disinfected in accordance with AWWA C651 and the Contract Documents, prior to incorporation into temporary use, as approved by the Engineer.

B. In general, temporary by-pass pipe shall be placed at the edge of traveled ways where it will cause the least obstruction and be least susceptible to damage. At roadway intersections the pipe shall be placed in a shallow trench and overlaid with temporary bituminous concrete surfacing as approved by the Owner. Temporary by-pass pipe that crosses driveway areas shall be covered with temporary bituminous concrete cold patch as approved by the Owner.

C. Temporary by-pass piping shall be provided with isolation valves spaced at 500-foot maximum intervals as approved by the Engineer. All temporary service connections shall have an isolation valve located at the connection to the temporary by-pass pipe.

D. Water for temporary by-pass piping service shall be taken from the nearest available fire hydrant(s) or as directed by the Engineer.

E. All temporary by-pass piping attachments to existing fire hydrants shall be made such that they can be easily removed to allow the fire hydrant to be used for fire fighting purposes. Provide a tee with a valve for each hose connection.

3.02 - INSTALLATION

A. Prior to the installation of any segment of temporary by-pass piping, notify the local Fire Department and coordinate with the Owner. Make modifications to the proposed layout of the temporary by-pass piping system as approved by the Owner.

B. The operation of all valves located in the existing water distribution system necessary for the isolation of each temporary by-pass piping segment shall be performed by the Owner.

C. Temporary fire hydrants shall come complete with individual control valves and include all necessary pipe, valves and fittings associated therewith as required by the local Fire Department and as approved by the Owner. In general, temporary hydrants shall be placed adjacent to the existing hydrants that are being removed from service.

D. Provide and maintain until removal of the temporary by-pass piping system, bituminous concrete cold patch or other material approved by the Engineer over each connecting coupling included in the temporary by-pass piping system.

3.03 - MAINTENANCE AND REMOVAL

A. Temporary by-pass piping systems shall be maintained in a safe and operative condition at all times (24 hours per day) during their use.

B. Temporary by-pass piping systems shall be protected against the potential for freezing conditions (November through March).

C. Each temporary by-pass piping system or independent segment thereof shall be removed from the Project immediately after the corresponding segment of permanent potable water distribution piping has been incorporated into the Owner's distribution system as approved by the Owner.

D. Upon removal of the temporary by-pass piping system, all areas affected by its use shall be returned to a neat and orderly condition in every respect equal to or better than its original condition. Service connections connected to the temporary by-pass piping system shall be returned to normal service prior to removal of the temporary by-pass piping system.

E. For cleaning and lining projects, each permanent service connection shall be blown back to the permanent service distribution pipe from the service pipe connection at the water meter prior to the removal of the temporary service connection. If there is no water meter, the service line shall be blown back from a location approved by the Engineer.

3.04 – CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 02615

DUCTILE IRON PIPE AND FITTINGS

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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Ductile Iron Pipe and Fittings as specified and/or as shown on drawings.

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

C. Provide and test ductile iron pipe, fittings and appurtenances as indicated and in compliance with Contract Documents.

D. Options:

1. For buried exterior pipelines provide push-on joint pipe.
    a. Provide restrained push-on pipe as specified
    b. Provide either restrained push-on joint fittings as specified and indicated or provide mechanical joint fittings with restraint system as specified herein
2. For piping exposed as in buildings and galleries, provide flanged or rigid-joint, grooved-coupled pipe and fittings.
3. Cast iron pipe and fittings are not acceptable.

1.02 – MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

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

1. Pipe manufacturer’s technical specification and product data.
2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following.
    a. Pipe layouts in full detail.
    b. Location of hangers and supports.
    c. Location and type of anchors.
    d. Location of couplings and expansion joints.
    e. 1/2-inch = 1 foot-0 inch (1 mm = 25 mm) scale details of all wall penetrations and special fittings.
    f. Schedules of pipe, fittings, special castings, couplings, expansion joints and other appurtenances.
3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed.
4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.
5. Brochures and technical data on coatings and linings and proposed method of application.
6. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.
7. Material Certification
    a. Provide certification from the pipe and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.
    c. A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.
    d. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

8. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 – PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

1.06 – DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

D. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

E. Inspect and test at foundry according to applicable standard specifications.

F. Owner reserves right to inspect and test by independent service at manufacturer's plant or elsewhere at his own expense.

G. Visually inspect before installation.

H. Job Conditions - Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

1.07 - REFERENCES

A. American Society of Mechanical Engineers (ASME)

1. ASME B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

2. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.

3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings.

4. ASME B31.1 - Power Piping.

B. ASTM International (ASTM)

1. ASTM A240 - Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
2. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile.
3. ASTM A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.
4. ASTM A530 - Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
5. ASTM A774 - Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
6. ASTM A778 - Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

C. American Water Works Association (AWWA)

1. AWWA A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA A21.10 - Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.
3. AWWA A21.11 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.
4. AWWA A21.15 - Flanged Ductile-Iron Pipe with Threaded Flanges.
5. AWWA A21.50 - Thickness Design of Ductile-Iron Pipe.
6. AWWA A21.51 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds, or Sand-Lined Molds, for Water or Other Liquids.
7. AWWA A21.53 - Ductile-Iron Compact Fittings, 3-in through 16-in. for Water and Other Liquids.

D. Fluid Sealing Association - Technical Handbook.

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

PART 2 - PRODUCTS

2.01 - PIPE

A. Ductile Iron

1. Design conforming to AWWA A21.50.
2. Manufacture conforming to AWWA A21.15 or AWWA A21.51.
3. Thickness class, unless otherwise indicated or specified:
   a. Minimum Thickness Class 52.
   b. Minimum thickness Class 53 for use with threaded flanges.
   c. Minimum thickness Class 53 for use with flanged pipe.
   d. Minimum thickness for use with grooved couplings conforming to AWWA C606.

2.02 - PIPE FOR USE WITH COUPLINGS

A. As specified above except ends shall be plain.

B. With bolted split sleeve couplings, ends cast or machined at right angles to axis.

C. With grooved type coupling:

1. Ductile-Iron of thickness class specified above.
2. Grooved End dimensions conforming to AWWA C606 for flexible or rigid joints to suit joint requirements.

2.03 - FITTINGS

A. Provide fittings conforming to AWWA A21.10, at least Class 150 and match piping class.

B. Provide all bell push-on or mechanical-joint fittings unless otherwise indicated or specified.

C. Face and drill flanged fittings conforming to AWWA A21.10 except special drilling or tapping for correct alignment and bolting.

D. If flanged fittings are not available under AWWA A21.10 provide fittings conforming to ASME B16.1 in 125 lb. pressure class.

E. Provide standard base fittings where indicated.

F. Provide grooved-end fittings ductile-iron conforming to AWWA A21.10 for center-to-face dimensions.

1. End preparation for grooved-ends conforming to AWWA C606 for flexible or rigid joints as required by type of joint.

2.04 - NONSTANDARD FITTINGS

A. Acceptable design.

1. Same diameter and thickness as standard fittings.

2. Manufactured to meet requirements of same specifications as standard fittings except for laying length and types of ends.

2.05 - WALL CASTINGS

A. Provide size and type indicated and specified.

1. Piping 24-inches and Smaller: Mechanical Joint with specified restraint or Restrained Push-On.

B. Wall Castings: Conform to requirements of AWWA A21.10 or fabricate of Class 53 ductile iron pipe with screwed on flanges and welded on waterstop. Screwed on mechanical or push-on joints are not acceptable.

C. Provide water stop centered in wall. Weld water stops on in factory under controlled conditions to ensure adequate strength to permit waterstop to absorb thrust up to the pressure rating of the pipe.

Wall Castings with Annealed Ductile Iron Water Stops

Pipe Size	Waterstop Thickness, inches
4 inch-12 inch	0.50
14 inch-24 inch	0.75
30 inch-36 inch	1.00
42 inch-48 inch	1.25

Wall Castings with Fabricated Steel Water Stops

Pipe Size	Waterstop Thickness, inches
4 inch-16 inch	0.25
18 inch-24 inch	0.38
30 inch-36 inch	0.50
42 inch-48 inch	0.75
54 inch-64 inch	1.00

D. On flanged wall castings, provide space between the wall and flange to permit mounting the nuts on the flange bolts.

E. Flanged wall castings located with the flange flush with the wall are not acceptable.

F. Locate push-on joint wall castings with space between the bell and the wall to insert the follower bolts.

G. As an option, fabricated wall pipe of Schedule 40 Type 316L stainless steel may be substituted for wall castings specified above. Provide with waterstops of above dimensions and welded continuously on both sides of stop. Flanges of Type 316 stainless steel. Bolts for connection to buried pipe Type 316 stainless steel. Provide flange insulation gaskets, sleeves and washers for all flanges.

H. Testing: Factory pressure test all wall castings to pipe and joint pressure rating for a minimum of 5 minutes. No visible leakage is acceptable.

2.06 - ADAPTERS

A. Furnish and install for joining pipe of different types, unless solid sleeves indicated.

1. Provide ends conforming to above specifications for the correct type of joint, to receive adjoining pipe.

2. Joining two classes of pipe may be of lighter class provided annular space in bell-and-spigot type joints sufficient for jointing.

2.07 - JOINTS

A. Provide push-on joint and mechanical joint pipe with necessary accessories, conforming to AWWA A21.11.

1. Provide gasket composition designed for exposure to liquid within pipe.

B. Provide pipe flanges and accessories conforming to AWWA A21.15.

1. Provide flat faced flanges.

2. Provide 1/8-inch thick, full faced gaskets designed for exposure to liquid within pipe.

C. Provide restrained joint on pipe and fittings where indicated. Provide restrained joint which is:

1. Boltless

2. Capable of being deflected after assembly

3. Designs using set screws or requiring field welding are not acceptable.

4. Manufacturers:

a. American Cast Iron Pipe Co. Flex-Ring.

b. U.S. Pipe TR FLEX.

c. Clow Super-Lock.

2.08 - MECHANICAL JOINT FITTINGS – RESTRAINT SYSTEM

A. Provide restraint devices for pipe consisting of multiple gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, retaining full mechanical joint deflection during assembly and allowing joint deflection after assembly.

2. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.

3. Provide restraint devices Listed by Underwriters Laboratories (3 inch through 24 inch size) and Designed by Factory Mutual (3 inch through 12 inch size).

4. Gland body, wedges and wedge actuating components must be domestic manufactured in the USA.

B. Working Pressure Rating:

1. 16-inch (400 mm) and Smaller: 350 psi .
2. Minimum safety factor: 2 to 1.

C. Materials:

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.
2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.
3. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.
4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.
5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.
6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.
7. Provide coating for restraint devices consisting of the following:
    a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.
    b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
    c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.
    d. Coating system: MEGA-BOND by EBAA Iron, Inc.

D. Manufacturer:

1. EBAA Iron MEGALUG Series 1100
2. Or an acceptable equivalent.

2.09 - FLANGE ADAPTORS

A. Provide restrained flange adaptors for pipe consisting of multiple individual gripping wedges incorporated into a follower gland meeting requirements of AWWA A21.10.

1. Provide actuation of the gripping wedges ensured with torque limiting twist off nuts.
2. Provide restraint devices Listed by Underwriters Laboratories (3-inch through 12 inch size) and Designed by Factory Mutual (4-inch through 12-inch size).
3. Gland body, wedges and wedge actuating components must be domestic manufactured in the USA.

B. Joint Deflection capability:

1. 3-inch through 8-inch: 5 degrees

C. Provide flange adaptor to maintain seal with and 0.6 inch gap between end of pipe and mating flange

D. Working Pressure Rating:

1. 16-inch and Smaller: 350 psi
2. Minimum safety factor: 2 to 1.

E. Materials

1. Gland body, wedges and wedge actuating components: Grade 65-45-12 ductile iron in accordance with ASTM A536.
2. Ductile iron gripping wedges: Heat treated, 370 to 470 BHN.
3. Provide three (3) test bars incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation in accordance with ASTM E8.
4. Provide chemical and nodularity tests performed as recommended by the Ductile Iron Society, on a per ladle basis.
5. Provide an identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number) cast into each gland body.
6. Record all physical and chemical test results such that they can be accessed via the identification number on the casting. Provide the Material Traceability Records (MTRs) available, in hard copy.
7. Provide coating for restraint devices consisting of the following:
    a. Process all wedge assemblies and related parts through a phosphate wash, rinse and drying operation prior to coating application.
    b. Coating: A minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.
    c. Surface pretreat all casting bodies with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. Coating: Polyester based powder to provide corrosion, impact and UV resistance.
    d. Coating system: MEGA-BOND by EBAA Iron, Inc.

F. Manufacturer

1. EBAA Iron MEGAFLANGE Series 2100
2. Or an acceptable equivalent.

2.10 - FLEXIBLE CONNECTIONS

A. Use as specified or indicated:

1. Bolted split sleeve couplings
2. Grooved couplings
3. Expansion joints

2.11 - BOLTED SPLIT SLEEVE COUPLINGS

A. Provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

B. Pressure rating at least equal to that of related pipeline.

C. Provide with gaskets of composition designed for exposure to liquid within pipe.

2.12 - GROOVED COUPLINGS

A. Conform to AWWA C606.

B. Minimum pipe wall thickness specified under "Pipe For Use With Couplings."

C. Where grooved couplings are indicated to provide for expansion or flexibility, cut pipe grooves to provide necessary expansion or flexibility.

D. Where grooved couplings are used instead of flanged joints, joint to be of rigid type with pipe grooves cut to bring pipe ends together. Beam strength of joint shall be equal to or greater than that of flanged joint.

2.13 - FILLING RINGS

A. Provide where necessary.

B. Materials, workmanship, facing, and drilling, conforming to 125 lb. ANSI (Class 125)

C. Suitable length with nonparallel faces and corresponding drilling, if necessary, for correct assembly of adjoining piping or equipment.

2.14 - CONNECTIONS – TAPPED

A. Provide service saddles for all taps for lines 24-inch and smaller.

1. Body: Ductile iron ASTM A395 or Bronze.

2. Straps and Hardware: Type 316 stainless steel.

2.15 - PIPE COATING

A. Outside of pipe and fittings within structures: Clean and apply one shop coat with a 3 to 5 mil DFT of moisture cured urethane.

B. Outside surfaces of castings to be encased in concrete: No coating.

C. Machined surfaces cleaned and coated with rust-preventative compound at shop.

D. Outside of buried pipe and fittings: Standard bituminous coating conforming to AN Standard.

2.16 – CEMENT LINING

A. Inside of pipe and fittings: Provide double thickness cement lining and bituminous seal coat conforming to AWWA A21.4.

2.17 - GASKETS, BOLTS, AND NUTS

A. Provide ring or full face synthetic rubber gaskets for flanged joints and neoprene faced phenolic for insulating gaskets in accordance with AWWA A21.11 and ASME B16.21.

1. 1/8 inch (3 mm) thick.

B. Make flanged joints with:

1. Bolts.

2. Bolt studs with nut on each end.

3. Studs with nuts where flange is tapped.

4. Plastic bolt sleeves and washers for insulating joints.

C. Number and size of bolts conform to same ANS as flanges.

D. Provide Type 316 stainless steel bolts, washers and nuts for all services:

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS – Not Used

3.02 - INSTALLATION

A. Visually inspect before installation.

B. Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.

C. Pitch piping toward low points. Provide for draining low points.

D. Before assembly, remove dirt and chips from inside pipe and fittings.

E. Piping Support: Provide in accordance with SECTION 15056, PIPE SUPPORTS.

F. Pipe and Fittings:

1. Remove and replace defective pieces.

2. Clear of all debris and dirt before installing and keep clean until accepted.

3. Lay accurately to lines and grades indicated or required. Provide accurate alignment, both horizontally and vertically.

4. Provide firm bearing along entire length of buried pipelines.

5. Do not allow deflection of alignment at joints to exceed permissible deflection as specified below:

a. For push-on joint or similar pipe, clean bell of excess tar or other obstruction and wipe out before inserting next pipe spigot. Shove new pipe into place until properly seated and hold securely until joint completed.

b. Set castings to be encased in concrete accurately with bolt holes, if any, carefully aligned. Clean off rust and scale before setting.

PIPE DEFLECTION ALLOWANCES

	Maximum permissible deflection, inches*	
Size of pipe, inches	Push-on joint	Mechanical joint
4	19	31
6	19	27
8	19	20
10	19	20
12	19	20
14	11	13-1/2
16	11	13-1/2
18	11	11
20	11	11
24	11	9
30	11	9
36	11	8
42	7-1/2	7-1/2
48	7-1/2	7-1/2
54	7-1/2	0

* Maximum permissible deflection for 20-feetlengths; for other lengths in proportion of such lengths to 20-feet.

G. Temporary Plugs: When pipe laying not in progress, close open ends of pipe with temporary watertight plugs. If water in trench, do not remove plug until danger of water entering pipe passed.

H. Appurtenances: Set valves, fittings and appurtenances as indicated.

3.03 - JOINTS AND COUPLINGS

A. Push-on Joints:

1. Insert gasket into groove bell. Apply thin film of nontoxic gasket lubricant over inner surface of gasket in contact with spigot end.

2. Insert chamfered end into gasket. Force pipe past it until it seats against socket bottom.

B. Bolted Joints

1. Remove rust-preventive coatings from machined surfaces.
2. Clean pipe ends, sockets, sleeves, housings, and gaskets and smooth all burrs and other defects.
3. Use torque wrench to tighten to correct range of torque not to exceed values specified below:

TORQUE RANGE VALUES

Nominal pipe size, in	Bolt diameter, in	Range of torque, ft-lb
3	5/8	40-60
4-24, incl.	3/4	75-90
30, 36	1	100-120
42, 48	1-1/4	120-150

C. Flanged Joint

1. Make up tight.
2. Do not put strain on nozzles, valves, and other equipment.
3. Bolt threads must fully engage the nuts. At a minimum the bolt must be flush with the nut and no more than 1/2-inch excess thread protruding from the nut.

D. Mechanical Joints

1. Wire brush surfaces in contact with gasket and clean gasket.
2. Lubricate gasket, bell, and spigot with soapy water.
3. Slip gland and gasket over spigot, and insert spigot into bell until seated.
4. Seat gasket and press gland firmly against gasket.
5. After bolts inserted and nuts made finger-tight, tighten diametrically opposite nuts progressively and uniformly around joint by torque wrench. Torque bolts to values specified above.

E. Flexible Joints

1. Clean and dry before assembly.
2. Place gaskets, rings, glands and followers in position in back of spigot ball.
3. Coat ball and socket with thin film of lubricant conforming to joint manufacturer's standards.
4. Insert ball and seat in socket. Seat gasket against ball.
5. Boltless joints:
    a. Assemble retainer rings and glands conforming to manufacturer's standard.
    b. Lock in place with lead strips.

F. Grooved Couplings

1. Clean grooves and other parts.
2. Coat ends of pipe and outside of gasket with soft soap or silicone and slip gasket over one pipe end.
3. Bring pipes to correct position and center gasket over pipe ends with lips against pipe.
4. Place housing sections, insert bolts and tighten nuts until housing sections in metal-to-metal contact.
5. After assembly and inspection and before backfilling, coat exterior surfaces of buried couplings, including bolts and nuts, with heavy-bodied bituminous mastic.

G. Tapped Connection

1. Drill and tap normal to longitudinal axis.
2. Drilled by skilled mechanics using proper tools.
3. Use only tapered threads.

H. Electrical Conductors

1. Install pipes so terminal strips are aligned.
2. Install jumper strips and tighten bolts.

3.04 – FIELD PAINTING

A. Provide in accordance with SECTION 09941, FIELD PAINTING.

3.05 - CLEANUP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.06 - MANUFACTURER'S FIELD SERVICES – Not Used

3.07 - MANUFACTURER'S TRAINING – Not Used

3.08 - LUBRICATION REQUIREMENTS

A. All lubricating oils required shall be provided as specified herein.

3.09 – SPARE PARTS – Not Used

3.10 - HANDLING AND CUTTING

A. Mark pipe and fittings "Rejected" and remove from site when cracked or has received a severe blow.

B. If permitted, cut on sound barrel at a point at least 12 inch from visible limit of crack, at Contractor's expense.

C. Machine cut with milling type cutters, knives, or saws. Snap cutters, torch, or hammer and chisel NOT ALLOWED. Examine for possible cracks.

D. Chamfer cut ends if used for push-on joints.

E. Do not cut glass lined pipes.

3.11 - FIELD TESTING

A. Provide in accordance with SECTION 09941, FIELD PAINTING.

B. Clean of all dirt, dust, oil, grease and other foreign material, before conducting pressure and leakage tests.

C. Pressure and Leakage Tests:

1. Conduct combined pressure and leakage test in pipelines.
2. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.
3. Test when desired and comply with specifications.
4. Test pipelines in excavation or embedded in concrete before backfill or placing of concrete and test exposed piping before field painting.
5. Fill section of pipe with water and expel air. If hydrants or blowoffs are not available at high points for releasing air, make necessary taps and plug after test completion.
6. Maintain section full of water for 24 hours before conducting combined pressure and leakage test.

7. Conduct pressure and leakage test consisting of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to pipe pressure rating, but not more than 150 psi.

8. Maintain pressure and make leakage test by metering water flow into pipe. Acceptable results:

   a. Average leakage during test: less than 10 gallons per inch of diameter per 24 hours per mile.

   b. No visible leakage in joints.

9. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section fails test.

10. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.

11. Modify test procedure only if permitted by Engineer.

3.12 - DISINFECTING AND FLUSHING

A. Disinfect potable water lines using procedures and materials conforming to AWWA C651.

B. Dosage to produce minimum 10 ppm after minimum of 24 hour contact period.

C. After treatment, flush with clean water until residual chlorine content less than 0.2 ppm.

D. Prevent contamination of water in existing water mains. Neutralize chlorine content of water used in disinfecting and flushing accordance with AWWA C651.

3.13 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02620

INSULATION AND JACKETING

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 2
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
PART 2 - PRODUCTS 3
2.01 - MATERIALS 3
PART 3 - EXECUTION 4
3.01 - INSTALLATION 4
3.02 - ACCEPTANCE 4
3.03 - CONTRACT CLOSEOUT 4

PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes furnishing all labor, equipment, materials, and accessories required to install pipe insulation and jacketing were indicated on the drawings and as specified herein.

B. Insulation and jacketing shall be applied to all pipe and fittings at the following locations:

1. Terminal Flushing Manhole with Combination Air Valve;
2. In-Line Flushing Manhole with Combination Air Valve;
3. Low Point Drain Manhole with Isolation Valves; and
4. Other locations as shown on the drawings.

C. Attention is directed to all sections within BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT; all sections within OTHER DOCUMENTS; DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

B. Submittals shall include at least the following:

1. Shop Drawings, including all equipment and components

2. Brochures and/or Catalogue Cuts

3. Installation instructions

4. Certificate of Compliance

5. Manufacturer's Data

1.05 - PRODUCT HANDLING

A. All materials shall be shipped, stored, and handled and installed in such a manner as not to degrade quality, serviceability or appearance. The materials shall be stored in a clean, dry location free from construction dust, precipitation and excess moisture. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

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

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

C. Insulation and jacketing system shall be as manufactured by Urecon, LTD, or equal.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Insulation

1. General. The pipes and fittings shall be insulated by the Urecon "U.I.P"® void free insulation process, with an outer jacket as specified. Polymer coated, form fitting insulation kits shall be used to insulate elbows, tees and other fittings, according to the manufacturer's recommendations.
2. Pipe and Fitting Preparation. Pipes and fittings are to be cleaned of surface dust or dirt and treated, if necessary, to assure a positive bond of the foam to the entire pipe surface.
3. Insulation.
    a. Material: 141B HCFC Rigid polyurethane foam, factory applied.
    b. Insulation thickness: 50 mm (2 in.) for freeze protection.
    c. Density: (ASTM D1622) 35 to 46 kg/m3 (3 lbs/ft3).
    d. Water absorption: (ASTM D2842) 4% by volume.
    e. Closed cell content: (ASTM D2856) 90% minimum.
    f. Compressive strength: (ASTM D1621) up to 206 kPa (up to 30 lbs/in.2).
    g. Thermal conductivity: (ASTM C-518) 0.020 to 0.026 W/m°C. (0.14 to 0.17 Btu –in./ft2 – hr °F).
    h. Service temperature range: -45°C to 120°C (-49°F to + 250°F).
    i. Centering: +6.35 mm/ -0 mm (+250 / -0.0 mils).

C. Jacketing

1. Buried Applications
    a. The pipe and fittings shall be factory jacketed with a polyethylene jacket, UV inhibited.
    b. Minimum density of polyethylene jacket: 940 kg/m3 (58 lbs/ft3).
    c. Sealant: Butyl rubber.
    d. Jacket thickness: 1.27 mm (50 mils).
    e. Maximum elongation: (ASTM D638) 400% 6 month test.
    f. Service temperature range: -34°C to 82°C (-30°F to +180F).
    g. Water vapor transmission rate: (ASTM 0570-63) 3gm/m2 /24 hrs (0.02 g / 100 in2/24 hrs).
    h. Tensile strength: (ASTM G-14-17) 9.8 kg/cm (55 lbs/in.).
2. Exposed Exterior Applications
    a. The pipes and fittings shall be factory jacketed with a Spiwrap® 20 gauge, galvanized steel, 4 ply spiral lock seam jacket or equal.
    b. Insulation joint detail for pre-insulated pipes with Spiwrap® galvanized steel outer jacket for bridge crossing applications or equal.

D. Insulated pipe joints shall be completed with the use of pre-fabricated urethane half shells and a pre-rolled metal sheet of the same material and gauge as the Spiwrap® outer jacket or equal. The metal sheet shall overlap the insulation jacket by a minimum of 75 mm (3 inches). A circumferential bead of silicone caulking shall be applied to the overlap area of the Spiwrap® jacket prior to the installation of the metal sheet. The metal sheet shall be installed with the longitudinal seam in the 3 o'clock position to act as a drip edge and shall be secured with three stainless steel band assemblies.

E. Field installed insulation kits for pipe joints, valves, couplings, expansion joints and fittings shall consist of rigid polyurethane foam with a fully bonded polymer protective coating on all exterior surfaces, including ends. Kits to be supplied complete with silicone caulking for seams, stainless steel attachment straps, clips and heat shrink sleeves to seal between pipe and kits. In the case of metal jacketed pipe, insulation kits shall have outer form fitting covers of the same material as the pipe jacket.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. The insulation and jacketing shall be applied to the pipe and fittings at the factory of the insulation company. The Contractor shall coordinate this work with pipe and insulation supplier. Contractor shall provide the piping (specified in other sections) to the insulation/jacketing company for application. Under no circumstances will the Contractor be allowed to field apply the insulation and jacketing, exclusive of pipe joints, valves and fittings. The Contractor shall install the preinsulated and prejacketed pipe and fittings in strict conformance with the insulator's recommendations.

3.02 - ACCEPTANCE

A. Upon completion all debris shall be removed from any areas involved with work under this section. Any unsealed seam or unsecured jacketing shall be completely repaired to the satisfaction of the Engineer or the entire section of insulation and jacketing shall be removed and replaced at no additional cost to the Owner.

3.03 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02625

POLYVINYL CHLORIDE SEWER PIPE

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 2
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
PART 2 - PRODUCTS 3
2.01 - PIPE AND FITTINGS 3
2.02 - CONCRETE 3
2.03 - UNDERGROUND TAPE AND TRACER WIRE 3
PART 3 - EXECUTION 3
3.01 - PIPE LAYING 3
3.02 - UNDERGROUND TAPE AND TRACER WIRE 4
3.03 - LEAKAGE AND TESTING 4
3.04 - ALLOWABLE PIPE DEFLECTION FOR PVC PIPE 5
3.05 - VISUAL INSPECTION 6
3.06 - CLEANING 6
3.07 - CONTRACT CLOSEOUT 6

PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment and performing all operations in connection with the construction of polyvinyl chloride (PVC) sewer lines, complete with chimneys, wyes, fittings, service connections, service connection cleanout/TV inspection port, and other related items, as specified herein and as shown on the drawings.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Pipe and fittings.

2. Gaskets.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

1.06 - DESIGN CRITERIA

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

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

PART 2 - PRODUCTS

2.01 - PIPE AND FITTINGS

A. Polyvinyl Chloride Pipe, couplings and fittings shall conform to the ASTM D3034, with an SDR of 35 unless otherwise shown on the Contract Drawings or ASTM F789. Joints for PVC pipe shall be push-on joints using permanently bonded elastomeric ring joints. Such joints shall be installed in accordance with the pipe manufacturer's written instructions. Any joint which is not properly made, shows signs of leakage or is in the opinion of the Engineer, defective in any way shall be redone to the satisfaction of the Engineer.

B. Wye Branches or Tees shall be of the same material and of the same class and type so as to be compatible to the pipe they are used with.

C. Pipe utilized for service connections and chimneys shall be 6 inches in diameter and be manufactured of PVC. PVC pipe shall conform to ASTM D3034, with an SDR of 35 or ASTM F789. Joints for PVC pipe shall be push-on using elastomeric ring gaskets.

D. Pipe and fittings for Type I Service Connections and Type II Gravity Service Connection/TV Inspection Ports shall be of the same material and of the same class and type so as to be compatible with the pipe they are used.

E. Caps for Type I Service Connections and Type II Gravity Service Connection/TV Inspection Ports shall be Model SMARTPlug equipped with a 3M electronic disc marker system as manufactured by GPK Products, Inc. or equal.

F. Backwater Check Valves shall be “Clean Check” as manufactured by Rectorseal or equal.

2.02 - CONCRETE

A. Concrete utilized for the encasement of chimneys or sewer pipes shall have a minimum compressive strength of 4,000 psi and conform to the specifications in DIVISION 3, CONCRETE.

2.03 - UNDERGROUND TAPE AND TRACER WIRE

A. Underground tape shall be a 5 mil, 3-inch wide silver metal detectable tape which permanently identifies the underground force main. The tape shall meet APWA requirements and use brown colored stripes with black print indicating “CAUTION BURIED PRESSURE LINE BELOW”.

B. Tracer wire shall be in accordance with SECTION 02890, TRACER WIRE.

PART 3 - EXECUTION

3.01 - PIPE LAYING

A. General

1. All pipe shall be laid with extreme care as to grade and alignment. Each pipe shall be laid so as to form a closed joint with the next adjoining pipe and to bring the inverts continuously to the required grade. In order to insure a minimum amount of movement or disturbance, no more than two lengths of pipe may be laid before backfilling to a minimum of 12 inches over the pipe.

2. Suitable coupling holes shall be excavated to provide ample space for making joints and to allow the pipe to have bedding along its entire length. After laying each length to the line and grade shown, the trench shall be backfilled to the midpoint of the pipe and the trench compacted with special care taken to ensure that compacted material is placed under the bell of the pipe. No walking upon or working over the pipe after it is laid will be permitted until it is covered with earth to a depth of at least 12 inches, except as may be necessary for proper compaction. All openings to the pipelines shall be satisfactorily protected to prevent the entrance of earth or water.

B. Laying Pipe

1. Excavations shall be made to accommodate the specified bedding material. All excavations shall be kept dry while pipe is being laid and until each joint and pipe has been viewed by the Engineer and approval given to commence backfilling operations. Any pipe, which is not laid to grade and alignment, shall be relaid to the satisfaction of the Engineer. No blocking shall be used. Pipe shall be installed in accordance with published recommendations of the pipe manufacturer.

2. The pipe shall be set with a laser beam. The laser beam projector shall be rigidly mounted with two-point suspension to its support platforms. This will assure that all ground equipment vibrations will be kept to a minimum and permit the laser beam to project itself coaxially through the center of the pipe. All units shall have equipment to control atmospheric conditions in the pipe that could affect the acceptable standard of construction. The alignment method selected must be shown to have worked satisfactorily on at lease three prior projects and competent, trained personnel shall operate laser. Establish centerline and offset stakes at each manhole, plus one intermediate centerline and offset stakes as a checkpoint between manholes. Laser aligning shall not be used to establish a continuous line in excess of 900 feet.

C. Installation of Wyes and Tees

1. At locations in the field as determined by the Engineer, provide 6-inch wye branches and/or tees. Watertight end caps shall be provided on all wyes and branches until the service is installed.

2. The depth of cover from the road surface to the top of the branch and the distance from the downstream manhole shall also be recorded. No wyes and tees shall be backfilled before the location measurements are taken.

D. Installation of Chimneys

1. Chimneys shall be located as directed by the Engineer and constructed in accordance with the details shown on the Contract Drawings.

2. Ends of the wye branch shall be capped with standard caps.

E. Service Connections

1. Service connections shall be provided in accordance with the applicable paragraphs of this section of these specifications at a slope of 1/4 inch per foot unless otherwise directed by the Engineer. The extreme end of the service connection shall be capped unless it is to be connected to an existing service.

2. Service connection cleanout/TV inspection ports shall be provided on each service connection at the property line. The service connection/TV inspection ports shall consist of all fittings required including but not limited to pipe, wyes, bends and caps. Service connection cleanout/TV inspection ports are not required for service connections which are less than 10 linear feet in length measured from the property line to the face of the building.

3. No service line shall be connected directly into a manhole unless otherwise directed by the Engineer.

4. All necessary adapters, reducers and the like shall be provided to connect to existing services.

5. A steel rod marker (1/2-inch in diameter by 2-foot-long) shall be installed at the end of capped lines for all locations. Refer to the “Typical Lateral Stub Connection” detail on the drawings.

6. All services lines shall be tied into a minimum of three points including, if possible, the permanent corners of the building which is to be served. The depth of cover from the ground surface to the top of the pipe at the cap shall be recorded. The depth and tie information shall be made part of the Project Record Documents.

3.02 - UNDERGROUND TAPE AND TRACER WIRE

A. Underground Tape shall be installed, centered, along the entire length of the sewer and services at a maximum depth of 18-inches below finished grade.

B. Tracer Wire shall be installed, centered, along the entire length of the sewer and services in accordance with SECTION 02890, TRACER WIRE.

3.03 - LEAKAGE AND TESTING

A. After the completed sewer line, including service connections has been provided, the trench has been backfilled and compacted to specification requirements, and manhole or joints showing noticeable streams or jets have been repaired and/or replaced, perform all tests.

B. Furnish all labor, materials and equipment necessary so that testing can be accomplished at the times and locations the Engineer deems necessary.

C. Test Procedure

1. Sewers not meeting the requirements stated herein shall be repaired as necessary at no cost to the Owner.
2. Low-Pressure Air Test. Utilize equipment specifically designed and manufactured for the purpose of testing sewer pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig.
3. The leakage test using low-pressure air shall be made on each manhole-to-manhole section of pipeline.
4. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressure without requiring external bracing or blocking.
5. All air used shall pass through a single control panel.
6. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of the test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig.
7. At least 2 minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

Pipe diameter (inches)	**Time (minutes)**
6	4.0
8	5.0
10	6.5
12	7.5
14	9.0
15	9.5
18	11.5
Greater then 18	7.7 X Pipe Diameter (feet)

8. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section.

3.04 - ALLOWABLE PIPE DEFLECTION FOR PVC PIPE

A. Pipe installed under this specification shall have a maximum deflection of 5 percent at the time of testing. Such deflection is defined as the amount of vertical deformation (nominal inside diameter less the minimum vertical diameter when measured) multiplied by 100 and divided by the nominal diameter of the pipe.

B. Upon completion of a sewer section, including the placement and compaction of backfill, and the cleaning of the sewer, measure the amount of deflection in all of the sewer lines. This testing shall be done by the use of a deflectometer, calibrated television or photography, or a properly sized "go, no go" mandrel or sewer ball. The method of deflection testing shall have the written approval of the Engineer.

C. All sewer lines with a deflection angle of greater than 5 percent shall be repaired by re-bedding or replacement of the pipe.

3.05 - VISUAL INSPECTION

A. At the conclusion of the work, all pipelines shall be visually inspected by the Engineer to insure a straight and plumb alignment.

B. All pipelines which are not straight and plumb shall be removed and replaced at no cost to the Owner.

3.06 - CLEANING

A. At the conclusion of the work, thoroughly clean the sewers by flushing with water or other means to remove dirt, stones, and other material. Prior to acceptance, all pipelines shall be inspected for cleanliness and to be sure no sandbags, broken pipe or other obstructions exist.

B. Cleaning and television inspection is as specified in SECTION 02702, CLEANING AND TELEVISION INSPECTION OF SEWER LINES.

3.07 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02629

POLYVINYL CHLORIDE LOW-PRESSURE SEWER PIPE

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 2
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
PART 2 - PRODUCTS 3
2.01 - MATERIALS 3
2.02 - CONCRETE 3
2.03 - UNDERGROUND TAPE AND TRACER WIRE 3
2.04 - ENGINEERED STAINLESS STEEL SERVICE LATERALS COMPONENTS – Not Used 3
PART 3 - EXECUTION 4
3.01 - GENERAL 4
3.02 - LAYING PIPE 4
3.03 - THRUST BLOCKS 4
3.04 - UNDERGROUND TAPE AND TRACER WIRE 4
3.05 - SERVICE CONNECTIONS 5
3.06 - TESTING 5
3.07 - CONTRACT CLOSEOUT 5

PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes furnishing all labor, tools, equipment and materials, and performing all operations in connection with the construction of polyvinyl chloride (PVC) low-pressure sewer pipe and pressure sewer pipe stubs, complete with fittings, and other related items, as specified herein and as shown on the drawings.

B. Attention is directed to all sections within BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT; all sections within OTHER DOCUMENTS; DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

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

1. Pipe and fittings.

2. Gaskets.

3. Underground Tape.

4. Gave Valves and Caps.

1.05 - PRODUCT HANDLING

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

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

1.06 - DESIGN CRITERIA

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

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Buried Polyvinyl Chloride Pressure Sewer Pipe, couplings and fittings shall conform to ASTM 2241, with an SDR of 21. Joints for PVC pipe shall be push-on joints using permanently bonded elastomeric ring joints conforming to ASTM F477. Such joints shall be installed in accordance with the pipe manufacturer's written instructions. Any joint which is not properly made, shows signs of leakage or is in the opinion of the Engineer, defective in any way shall be redone to the satisfaction of the Engineer.

B. Exposed PVC pressure sewer pipe inside of all flushing/drain manholes shall be Schedule 80 flanged pipe. This piping, fittings and valves shall be insulated and jacketed.

C. Pipe utilized for service connections shall be 1-1/4-inches in diameter and be manufactured of PVC. Service pipe shall conform to ASTM 2241, with an SDR of 21. Joints for PVC pipe shall be push-on joints using permanently bonded elastomeric ring gaskets.

D. The Contractor has the option of substituting SDR 11 HDPE I.P.S. butt-fused pipe for the SDR 21 PVC gasketed pipe used for pressure main and services at no additional cost to the Owner. All couplings, fittings, adapters, valves, reducers, tees, and wyes shall be compatible with the type of pipe used. HDPE pipe shall be pressure rated for 200 psi and shall conform to ASTM D1248, ASTM D3350, ASTM D2239, and NSF-14. Compression fitting shall be brass and manufactured by Ford, or equal.

E. Service connection wye branches and/or tees shall be of the same material and of the same class and type so as to be compatible to the pipe they are used with. If wyes with a 1-1/4-inch branch and/or run size are not available in the material being used, the Contractor shall furnish and install 1-1/4-inch x 1-1/2-inch reducers and wyes with a 1-1/2-inch branch size or 1-1/2-inch x 1-1/2-inch wyes and 1-1/4-inch x 1-1/2-inch reducers (3) for each service connection.

H. Gate valves shall be iron body, bronze mounted and have solid wedges. The valves shall be designed for 150 psi working pressure.

I. Pipe and fittings utilized for gravity service connections shall be 6-inches in diameter and be manufactured of PVC. PVC pipe shall conform to ASTM D3034, with an SDR of 35 or ASTM F789. Joints for PVC pipe shall be push-on using elastomeric ring gaskets.

J. Caps for valves shall be Model SMARTPlug equipped with a 3M electronic disc marker system as manufactured by GPK Products, Inc. or equal.

K. Pipe and fittings using glued connections is not acceptable.

2.02 - CONCRETE

A. Concrete utilized for the encasement of chimneys or sewer pipes shall have a minimum compressive strength of 4,000 psi and conform to DIVISION 3, CONCRETE.

2.03 - UNDERGROUND TAPE AND TRACER WIRE

A. Underground tape shall be a 5 mil, 3-inch wide silver metal detectable tape which permanently identifies the underground force main. The tape shall meet APWA requirements and use brown colored stripes with black print indicating “CAUTION BURIED PRESSURE LINE BELOW”.

B. Tracer wire shall be in accordance with SECTION 02890, TRACER WIRE.

2.04 - ENGINEERED STAINLESS STEEL SERVICE LATERALS COMPONENTS – Not Used

PART 3 - EXECUTION

3.01 - GENERAL

A. Pressure sewer pipe shall be laid as shown on the drawings with a continuous slope between the high and low points as defined on the drawings.

B. Pressure sewer pipe and service connections shall be laid with a minimum cover of four feet.

C. The Contractor must adjust the installation depth of the low-pressure sewer to cross either over or under any existing utility while maintaining a minimum cover of four feet as well as meeting requirements set by MassDEP for separation of water mains and sewers and a minimum of 12-inch separation for other utilities, or as approved by utility Owner.

3.02 - LAYING PIPE

A. Excavations shall be made to accommodate the bedding material as specified in SECTION 02220, EARTH EXCAVATION, BACKFILL, FILL AND GRADING. All excavations shall be kept dry while pipe is being laid and until each joint and pipe has been viewed by the Engineer and approval given to commence backfilling operations. Any pipe which is not laid to grade and alignment shall be relaid to the satisfaction of the Engineer. No blocking shall be used. Pipe shall be installed in accordance with published recommendations of the pipe manufacturer.

B. All pressure sewer bends shall be 45 degrees or less.

C. Low-pressure pipe shall be laid as shown on the drawings with a continuous slope between the high and low points defined on the drawings.

D. Service Connections

1. Service connections shall be provided in accordance with the applicable paragraphs of this section of these specifications at a slope of 1/4-inch per foot unless otherwise directed by the Engineer. The extreme end of the service connection shall be capped unless it is to be connected to an existing service.

3. No service line shall be connected directly into a manhole unless otherwise directed by the Engineer.

4. All necessary adapters, reducers and the like shall be provided to connect to existing services.

5. Each service connection shall be provided with a gate value located at the Property Line.

6. An oak marker (1/2-inch in diameter by 2-foot long) shall be installed at the end of capped lines for all locations.

7. All services lines shall be tied into a minimum of three points including, if possible, the permanent corners of the building which is to be served. The depth of cover from the ground surface to the top of the pipe at the cap shall be recorded. The depth and tie information shall be made part of the Project Record Documents.

3.03 - THRUST BLOCKS

A. Concrete thrust blocks shall be placed at all pressure sewer bends 11-1/4 degrees and greater, at fittings and as designated by the Engineer, and shall conform to the details as shown herein.

3.04 - UNDERGROUND TAPE AND TRACER WIRE

A. Underground Tape shall be installed, centered, along the entire length of the low-pressure sewer and services at a maximum depth of 18-inches below finished grade.

B. Tracer Wire shall be installed, centered, along the entire length of the low-pressure sewer and services in accordance with SECTION 02890, TRACER WIRE.

3.05 - SERVICE CONNECTIONS

A. Pressure sewer service connections between the property line and the pressure sewer main in the street shall be 1-1/4-inch diameter PVC or HDPE pipe. Each service connection shall include a 1-1/4-inch ball valve with valve box at the property line as specified herein and as shown on the Drawings.

B. Any ledge encountered during installation of service pipe shall be removed to a point 4 feet beyond the end of the service pipe.

3.06 - TESTING

A. The low-pressure sewer pipe shall be tested in the presence of the Engineer, by water to a pressure equal to 2 times the total dynamic head of the Prefabricated Low-Pressure Sewage Pump Systems to which the low-pressure sewer pipe is attached, unless the test pressure is greater than the working pressure of the pipe. In that case the pipe shall be tested to the working pressure of the pipe. Testing shall conform to the requirements of the AWWA Standard C600. The Engineer shall provide the test pressure. This pressure shall be held for a period of at least 15 minutes, allowing a maximum pressure drop of 1 psi. Any defective work shown by this test shall be replaced at no additional cost to the Owner.

B. All equipment, labor, water, gauges, and the like for the testing of the low-pressure sewer pipe shall be supplied at no additional cost to the Owner.

C. The low-pressure sewer pipe shall be tested as part of the Sequence of Construction specified in SECTION 01030, SPECIAL REQUIREMENTS. Each section of low-pressure sewer pipe identified shall be pass the pressure test prior to moving onto the next section. Failure to comply with this requirement will result in no payment for work performed.

3.07 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 02631

POLYVINYL CHLORIDE SEWER FORCE MAIN

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PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes furnishing all labor, tools, equipment and materials, and performing all operations in connection with the construction of polyvinyl chloride (PVC) force main, complete with fittings, and other related items, as specified herein and as shown on the drawings.

B. The materials covered by this specification are intended to be standard materials of proven ability as manufactured by reputable concerns. Materials shall be designed and constructed in accordance with the best practice of the industry and shall be installed in accordance with the manufacturer's recommendations. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Manufacturer’s technical data containing information on new pipe and fittings.
2. Verifications from the pipe manufacturer of training in the proper method for handling and installing the new pipe.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit at no cost to the Owner.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

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

1.06 - DESIGN CRITERIA

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

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

PART 2 - PRODUCTS

2.01 - POLYVINYL CHLORIDE PIPE (PVC)

A. Polyvinyl Chloride Pipe, couplings and fittings shall conform to ASTM 2241, with an SDR of 21 unless otherwise shown on the drawings. The Owner has standardized on this pipe, couplings and fittings and therefore no substitutes are allowed.

B. Joints for PVC pipe shall be push-on joints using permanently bonded elastomeric ring joints conforming to ASTM F477. Such joints shall be installed in accordance with the pipe manufacturer's written instructions. Any joint which is not properly made, shows signs of leakage or is in the opinion of the Engineer, defective in any way shall be redone to the satisfaction of the Engineer.

2.02 - CONCRETE THRUST BLOCKS

A. Concrete shall have a minimum compressive strength of 4,000 psi and conform to the specifications in DIVISION 3, CONCRETE.

2.03 - UNDERGROUND TAPE AND TRACER WIRE

A. Underground tape shall be a 5 mil, 3-inch wide silver metal detectable tape which permanently identifies the underground force main. The tape shall meet APWA requirements and use brown colored stripes with black print indicating “CAUTION BURIED PRESSURE LINE BELOW”.

B. Tracer wire shall be in accordance with SECTION 02890, TRACER WIRE.

PART 3 - EXECUTION

3.01 - GENERAL

A. Force main shall be laid as shown on the drawings with a continuous slope between the high and low points defined on the drawings.

3.02 - LAYING PIPE

A. Excavations shall be made to accommodate the bedding material as specified in the DIVISION 2, SITE WORK. All excavations shall be kept dry while pipe is being laid and until each joint and pipe has been viewed by the Engineer and approval given to commence backfilling operations. Any pipe, which is not laid to grade and alignment, shall be relaid to the satisfaction of the Engineer. No blocking shall be used. Pipe shall be installed in accordance with published recommendations of the pipe manufacturer.

B. Force main shall be laid as shown on the drawings with a continuous slope between the high and low points defined on the drawings.

C. Allowable Deflection for PVC Pipe

1. Pipe installed under this specification shall have a maximum deflection of 5 percent at the time of testing. Such deflection is defined as the amount of vertical deformation (nominal inside diameter less the minimum vertical diameter when measured) multiplied by one hundred and divided by the nominal diameter of the pipe.

2. Upon completion of each force main, including the placement and compaction of backfill, and the cleaning of the force main, the Contractor shall measure the amount of deflection in all of the force mains. This testing shall be done by the use of a deflectometer, calibrated television or photography, or a properly sized "go, no go" mandrel or sewer ball. The method of deflection testing shall have the written approval of the Engineer.

3. All force main lines with a deflection angle of greater than 5 percent shall be repaired by re-bedding or replacement of the pipe.at no cost to the Owner.

3.03 - THRUST BLOCKS

A. Concrete thrust blocks shall be placed at all force main bends 11-1/4 degrees and greater, at fittings and as designated by the Engineer, and shall conform to the drawings.

3.04 - UNDERGROUND TAPE AND TRACER WIRE

A. Underground Tape shall be installed, centered, along the entire length of the force main at a maximum depth of 18-inches below finished grade.

B. Tracer Wire shall be installed, centered, along the entire length of the force main in accordance with SECTION 02890, TRACER WIRE.

3.05 - TESTING

A. The force main shall be tested in the presence of the Engineer, by water to a pressure equal to 2 times the total dynamic head of the pump (estimated at 110 feet) to which the force main is attached, unless the test pressure is greater than the working pressure of the pipe. In that case the pipe shall be tested to the working pressure of the pipe. The Engineer shall provide the test pressure. This pressure shall be held for a period of at least 15 minutes, allowing a maximum pressure drop of 5 psi. Any defective work shown by this test shall be replaced at no additional cost to the Owner.

B. All equipment, labor, water, gauges, and the like for the testing of the force main shall be supplied at no cost to the Owner.

3.06 - VISUAL INSPECTION

A. At the conclusion of the work, all pipelines shall be visually inspected by the Engineer to insure a straight and plumb alignment.

B. All pipelines which are not straight and plumb shall be removed and replaced at no cost to the Owner.

3.07 - CLEANING

A. At the conclusion of the work, the Contractor shall thoroughly clean the sewer lines by flushing with water or other means to remove dirt, stones, and other material. Prior to acceptance, all pipelines shall be inspected for cleanliness and to be sure no sandbags, broken pipe or other obstructions exist.

B. Cleaning and television inspection is as specified in SECTION 02702, CLEANING AND TELEVISION INSPECTION OF SEWER LINES.

3.08 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02675

HYDROSTATIC TESTING AND DISINFECTION

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes the furnishing of all labor, tools, materials and equipment and performing all operations necessary for the flushing, pressure testing, leakage testing and disinfection of potable water pipeline(s) as specified herein and as required to complete the Work.

B. The Work of this section shall be coordinated with the Owner. Use of water will only be as approved by the Owner. All work shall be in accordance with this specification, AWWA C600 and AWWA C651. Where conflicts appear between these specifications and AWWA C600 and AWWA C651 the more stringent requirement shall apply. All flushing, pressure and leakage testing and chlorinating shall be done by the Contractor in the presence of the Engineer.

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

1.02 - MEASUREMENT AND PAYMENT

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

B. In addition, the following conditions apply:

1. If sufficient manpower and equipment are not provided to prosecute this phase of the Work, the Owner reserves the right to engage an independent contractor to perform the flushing, testing, and disinfection Work. The cost for this Work will be deducted from payments due the Contractor, and it shall not place any claims against the Owner, Engineer or said independent contractor, for any leaks, damages to public or private property, production loss and/or profits, incurred by this Work.

2. If the leakage test is declared a failure by the Engineer, the Contractor shall at its own expense locate and make repairs as necessary, until the leakage is within the specified allowance. All costs associated with additional testing shall be borne by the Contractor.

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Sampling Procedure.
2. Certified Lab Documentation.
3. Analysis Results.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

1.06 - DESIGN CRITERIA

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

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

C. All products and materials shall conform to the applicable standards of ANSI and AWWA and/or as specified herein.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Each temporary blow-off, sample tap, and/or pressure tap shall consist of a corporation cock, Type K copper tubing and a curb stop, each of not less than one (1) inch diameter.

B. A pumping unit or proportionate feeder suitable for delivering a chlorine solution to the isolated pipeline(s) shall be provided. The unit used shall prevent chlorine solution from flowing back into the existing water system.

C. Chlorine solution for disinfecting pipeline(s) and appurtenances shall be made from either liquid sodium hypochlorite, or solid calcium hypochlorite, which shall conform to AWWA B300 Standard for Hypochlorites.

PART 3 - EXECUTION

3.01 - GENERAL

A. Flushing, testing and disinfection of pipeline(s) shall closely follow the pipe laying work. As the pipeline is installed, it shall be tested approximately every one thousand (1,000) feet, or between in-line isolation valves, whichever is less, as directed by the Engineer. Should a designated section of pipeline fail to be flushed, tested, and disinfected as specified, the pipe laying work shall be suspended until this Work is completed.

B. All flushing, testing and disinfection shall be done in the presence of the Engineer. The method of disinfection shall be the Continuous Feed Method of a chlorine solution as described hereinafter. Consult with the Owner and Engineer to identify acceptable location(s) for the discharge of the heavily chlorinated water that will result from the disinfection procedure.

C. Final acceptance of each segment of pipeline tested will be based on successful (negative) results of bacteriological testing. Location(s) for sampling shall be as directed by the Engineer.

D. The Contractor, with the assistance of the Owner, shall fill each new pipeline section as slowly as practicable so as not to cause dirty water and serious pressure drops within the existing water system. Vent air from the new pipeline(s) during the filling process.

E. Make taps on the new pipeline(s) where directed by the Engineer necessary to properly complete the hydrostatic and disinfection Work. After successful completion of the Work, with the authorization of the Owner, remove all temporary sampling tubing and blow-offs. The remaining corporation(s) shall be plugged and protected from damage by backfilling as approved by the Engineer.

3.02 - FLUSHING

A. All new pipeline(s), and existing pipeline(s) that have been drained and cut-into for making new connections, shall be thoroughly flushed prior to pressure and/or leakage testing and final disinfection.

B. Flushing shall be accomplished through partial opening and closing of valves, hydrants, and blow offs under expected line pressure as necessary to obtain the required scouring velocity. Flow velocities shall not be less than 2.5 feet per second in each pipeline section that is being flushed.

C. The size and number of hydrant outlets or pipeline taps to provide the required flow (at 40 psi residual pressure) is as follows. Minimum required flow and opening(s) diameter to flush pipeline segments based on 40-psi residual pressure in the pipeline.

Pipe Diameter (Inches)	**Flow to Produce 2.5 fps Minimum Velocity in Pipe (GPM)**	**Minimum Size of Taps on Pipe (Inches)**	**Outlet Openings**	
			Number	Size (Inch)
4	100	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
16	1,565	3-5/8	2	2-1/2

1. If less than a 40-psi residual pressure is available in the pipeline, with the size tap shown above, then a larger number of taps or hydrant outlets will be required, as directed by the Engineer.

2. The length of time for flushing, at or above the minimum allowable velocity shall be computed to allow a minimum of three (3) times the total volume of water stored in the pipeline segment being flushed to waste.

3.03 - PRESSURE TESTING

A. All new pipeline(s), or any valved section(s) thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure that will exist at the point of testing, or 150 psi, whichever is greater. Test pressures shall meet the following requirements.

1. Be of at least 2.5-hour duration.

2. Be not less than 1.25 times the expected system working pressure at the highest point along the test section.

3. Not exceed pipe or thrust-restraint design pressures.

4. Not vary by more than plus or minus 5-psi for the duration of the test.

5. Not exceed two (2) times the rated pressure of valves or hydrants when the pressure boundary includes closed butterfly valves, gate valves and/or hydrants. Valves shall not be operated in either direction at differential pressures greater than the rated pressures.

B. Air Removal. Following flushing, and before applying the specified test pressure, air shall be completely expelled from the pipeline segment being tested. After all air has been expelled, the air blowoffs shall be closed, and the test pressure applied.

C. Pressure Test. Each valved section of pipeline shall be slowly raised to the specified test pressure for two separate periods. The first period shall be for fifteen (15) minutes, after which the pressure in the test section shall be allowed to drop slowly back to system pressure. The pressure shall then be slowly raised again to the specified test pressure and maintained for 2-1/2 hours. The test pressure shall be based on the elevation of the lowest point of the pipeline in the test section and shall be corrected to the elevation of the test gauge, as directed by the Engineer. The test pressure shall be applied by means of a pump connected to the pipeline, in a manner satisfactory to the Engineer, and which will prevent any backflow into the existing water system.

D. Examination. Any exposed pipe, fittings, valves, hydrants and joints shall be carefully examined during the test. Any damaged or defective pipe, fittings, hydrants, or valves discovered following, or as a result of the pressure test shall be repaired or replaced with sound material. If faulty materials are removed and replaced, the pressure testing procedure shall be repeated until satisfactory to the Engineer.

3.04 - LEAKAGE TEST

A. Leakage testing shall be conducted concurrently with the pressure test.

B. Leakage Defined. Leakage shall be defined as the quantity of water that must be pumped into the new pipeline or any valved section thereof, to maintain pressure within plus or minus 5-psi of the specified test pressure, after the pipeline(s) have been filled with water and all air has been expelled. Leakage shall be recorded to the nearest one-tenth (0.10) of a gallon, by means of a calibrated test meter. Drawdown may be measured in a calibrated barrel, as approved by the Engineer. All records and charts shall become the property of the Engineer. Employ qualified personnel for all testing. Leakage testing shall not be measured as a drop in pressure over a specified period of time.

C. Allowable Leakage.

1. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$L = \frac{SD(P^{0.5})}{133{,}200}$ where: L = allowable gallons of leakage per hour (GPH)

S = the length of pipe tested (feet)

D = the nominal pipe diameter (inches)

P = the average test pressure during the test (psi)

2. The leakage formula is based on an allowable leakage of 11.65 gallons per day, per mile of pipe, per inch (nominal) of pipe diameter, at a pressure of 150-psi.

3. The allowable leakage in GPH per 1,000 feet of pipe at various pressures and pipe diameters are shown below:

Test Pressure (PSI)	Pipe Diameter (Inches)										
	6	8	10	12	16	20	24	30	36	42	48
450	0.95	1.27	1.59	1.91	2.55	3.18	3.82	4.78	5.73	6.69	7.64
400	0.90	1.20	1.50	1.80	2.40	3.00	3.60	4.50	5.41	6.31	7.21
350	0.84	1.12	1.40	1.69	2.25	2.81	3.37	4.21	5.06	5.90	6.74
300	0.78	1.04	1.30	1.56	2.08	2.60	3.12	3.90	4.68	5.46	6.24
275	0.75	1.00	1.24	1.49	1.99	2.49	2.99	3.73	4.48	5.23	5.98
250	0.71	0.95	1.19	1.42	1.90	2.37	2.85	3.56	4.27	4.99	5.70
225	0.68	0.90	1.13	1.35	1.80	2.25	2.70	3.38	4.05	4.73	5.41
200	0.64	0.85	1.06	1.28	1.70	2.12	2.55	3.19	3.82	4.46	5.09
175	0.59	0.80	0.99	1.19	1.59	1.98	2.38	2.98	3.58	4.17	4.77

Test Pressure (PSI)	Pipe Diameter (Inches)										
	6	8	10	12	16	20	24	30	36	42	48
150	0.55	0.74	0.92	1.10	1.47	1.84	2.21	2.76	3.31	3.86	4.41
l25	0.50	0.67	0.84	1.01	1.34	1.68	2.01	2.52	3.02	3.53	4.03
100	0.45	0.60	0.75	0.90	1.20	1.50	1.80	2.25	2.70	3.15	3.60

Notes: If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. When testing against closed metal-seated valves, an additional leakage shall be allowed per closed valve of 0.0078 gallons per hour per inch of nominal valve diameter. When hydrants are located in test sections they shall remain closed. Zero (0) leakage will be allowed on pipeline segments that cross bridges or carrier pipes located in jackings or borings.

D. Acceptance shall be determined on the basis of allowable leakage. If the test of any pipeline segment discloses leakage greater than that specified, the source of leakage shall be located and repaired as necessary to ensure that the allowable leakage is within the specified parameters.

1. All visible leaks are to be repaired regardless of the amount of leakage.

2. All pipeline segments shall be pressure and leakage tested in the presence of the Engineer, in order to qualify for acceptance.

3.05 - DISINFECTION

A. The method of disinfection shall be by the Continuous Feed Method of a chlorine solution as described hereinafter, and as approved by the Engineer.

B. Continuous Feed Method of Chlorine Solution. The continuous feed method consists of the following steps:

1. Upon completion of pipeline installation, fill pipeline(s) with potable water, and remove all air from high spots and/or pockets.

2. Flush the completed pipeline(s) in accordance with the requirements specified herein to remove particulates. Following the filling and flushing of the pipeline(s) and before chlorination, complete all hydrostatic testing as specified.

3. Fill the pipeline(s) with chlorinated potable water, having an initial concentration of 25-mg/L free chlorine residual. After a 24-hour period, there shall be a minimum of 10-mg/L free chlorine residual in the pipeline(s). Water from the existing distribution system or other approved source of supply shall be made to flow at a constant measured rate, into the new pipeline(s). In the absence of a meter, the rate may be approximated by methods such as placing a pilot gauge in the discharge or measuring the time to fill a container of known volume.

4. At a point not more than 10 feet downstream from the beginning of the new pipeline(s), water entering the new pipeline shall receive a dose of chlorine solution fed at a constant rate such that the water in the pipeline(s) will have not less than 25-mg/L free available chlorine. To assure that this concentration is achieved, measure chlorine concentration at regular intervals along the pipeline(s), using approved chlorine test kits, or as otherwise described in AWWA M12 - Simplified Procedures for Water Examination.

C. The amount of chlorine required to obtain a concentration of 25-mg/L per 100 feet of various diameter pipes is as follows:

1. Chlorine required to obtain a concentration of 25 mg/L per 100 feet.

	Sodium Hypochlorite Solution (Gallons per 100 feet)				Calcium Hypochlorite (Ounces)
Pipe Diameter (Inches)	**5% Available Chlorine**	**10% Available Chlorine**	**12-1/2% Available Chlorine**	**15% Available Chlorine**	**65% Available Chlorine**
4	0.03	0.02	0.02	0.01	0.32
6	0.08	0.04	0.03	0.03	0.75
8	0.13	0.07	0.06	0.05	1.30
10	0.20	0.10	0.09	0.07	2.10
12	0.28	0.15	0.12	0.10	2.95
16	0.50	0.25	0.22	0.17	5.30
20	0.80	0.40	0.34	0.28	8.40
24	1.15	0.60	0.50	0.40	12.00

2. Prior to injection of a chlorine solution into the section of pipeline being disinfected, the above quantities may be diluted into a known quantity of potable water in order to meet the requirements of the chemical feed equipment. The entire solution shall be injected into the section of pipeline being disinfected at a feed rate that ensures that the residual chlorine concentration is a minimum of 25 mg/L. The chlorine concentration within the pipeline being disinfected shall not exceed 50 mg/L without written approval of the Owner.

3. The quantities shown above are based on concentrations of available chlorine by volume. Extended or improper storage may have caused a loss of available chlorine.

4. For concentrations of 50 mg/L double the quantities listed.

D. During the application of chlorine, valves shall be closed to prevent strong chlorine solution in the new pipeline(s) from flowing into the existing system. Chlorine application shall continue until the entire pipeline(s) is filled with water having 25 mg/L of free available chlorine. The chlorinated water shall be retained in the pipeline(s) for at least 24 hours, during which time all valves and hydrants in the section(s) being treated shall be operated, in order to disinfect the appurtenances. At the end of this 24-hour period, all portions of the pipeline(s) being tested shall have a free available chlorine residual of at least 10 mg/L. If less that 10 mg/L free available chlorine residual is measured, the pipeline(s) shall be reflushed and the entire disinfection procedure repeated.

E. Chlorine solutions shall be applied to the pipeline(s) with chemical feed pump(s) designed for feeding chlorine solutions. Feed lines shall be of such material and strengths as to safely withstand corrosion caused by the concentrated chlorine solutions, and also the maximum pressures that may be created by the pump(s). All connections shall be checked for tightness before the solution is applied to the pipeline.

3.06 - FINAL FLUSHING

A. After the specified retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show the concentration in water leaving the pipeline is no higher than that generally prevailing in the water distribution system.

B. Arrangements shall be made with the Owner to flush the pipeline(s) of chlorinated water. Great care shall be exercised in the selection of the rate of flow and the discharge point(s), in order prevent damage to public or private property.

C. The Owner shall approve the environment to which the chlorinated water is to be discharged. If it is determined by the Owner that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to thoroughly neutralize the chlorine residual remaining in the water. If necessary, state, federal, and/or local regulatory agencies shall be contacted to ascertain if there are any special provisions for the disposal of the heavily chlorinated water. No chlorinated water shall be discharged directly into designated wetland areas or water bodies.

3.07 - PROCEDURES FOR DISINFECTING TAPPING SLEEVES

A. Before a tapping sleeve is installed, the exterior of the pipeline to be tapped shall be thoroughly cleaned, and the interior surface of the sleeve and valve shall be washed with a one (1) percent chlorine solution.

3.08 - BACTERIOLOGICAL TESTS

A. Standard Conditions. Twenty-four hours after final flushing and before a pipeline is placed in service, water samples shall be collected twice (24 hours apart) at each sampling point designated by the Engineer and tested for bacteriological quality in accordance with "Standard Methods for the Examination of Water and Wastewater". Water samples shall show the absence of coliform organisms and background bacteria. A standard heterotrophic plate count may be required at the option of the Engineer at no additional cost to the Owner. Water samples shall be taken at points at least every 1,000 feet along the pipeline, plus one (1) sample from the end of each test section and at least one (1) sample from each branch line.

B. Special Conditions. If, during construction, trench water has entered the pipeline, or if in the opinion of the Engineer excessive quantities of dirt or debris has entered the pipeline, bacteriological samples shall be taken at intervals of approximately 200 feet and shall be identified as to location. Samples shall be taken of water that has stood in the pipeline for at least 24 hours after final flushing has been completed.

C. Sampling Procedure. Samples for bacteriological analysis shall be collected, in the presence of the Engineer, in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in the collection of samples. A corporation cock shall be installed in the pipeline with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly shall be removed. The Contractor shall sample twice (24 hours apart) at each location designated by the Engineer.

D. The Owner shall deliver all samples to a State approved laboratory for bacterial analysis. Only after each consecutive sample is approved shall the pipeline(s) be incorporated into the water distribution system. In the event that positive reports of contamination are received, the pipeline(s) shall be flushed and disinfected as many times as may be necessary to obtain approved (negative) results at no additional cost to the Owner.

3.09 - RE-DISINFECTION

A. If the initial disinfection fails to produce satisfactory bacteriological samples, the pipeline(s) shall be reflushed and resampled. If check samples show the presence of coliform organisms, then the pipeline(s) shall be re-disinfected by the continuous feed method of chlorination, until satisfactory results are obtained.

B. High velocities in the existing system, resulting from flushing the new pipeline(s), may disturb sediment that has accumulated in the existing water system. When check samples are taken, the Contractor shall sample water entering the new pipeline(s).

3.10 - CHLORINATION PROCEDURES WHEN CUTTING INTO OR REPAIRING EXISTING PIPELINE(S)

A. The following procedures apply when pipeline(s) are wholly or partially dewatered. After the appropriate procedures have been completed, the pipeline(s) may be returned to service prior to completion of bacteriological testing, in order to minimize the time customers are out of service. Leaks or breaks that are repaired with clamping devices while the pipeline(s) are full of water under pressure present little danger of contamination and require no disinfection.

1. Trench Treatment. When an old pipeline is opened, either by accident or on purpose. Liberal quantities of hypochlorite tablets shall be applied to open trench areas to lessen the danger from pollution.

2. Swabbing with Hypochlorite Solution. The interior of all pipe and fittings used in making a repair (particularly couplings and sleeves) shall be swabbed or sprayed with a one (1) percent chlorine solution before they are installed.

3. Flushing. If valve and hydrant locations permit thorough flushing toward the work location from both directions, it shall be done. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated.

4. Slug Chlorination. Where practical in addition to the procedures above, a section of pipeline in which the break is located shall be isolated. All service connections shall be shut off, and the section flushed and chlorinated by the slug method, whereby the dose may be increased to as much as 300-mg/L, and the contact time reduced to as little as one (1) hour. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the water is free of noticeable chlorine odor.

5. Bacteriological samples shall be taken after repairs. If the direction of flow is unknown, samples shall be taken on each side of the pipeline break. If positive samples are recorded, daily sampling shall be continued until two (2) consecutive negative samples are recorded.

3.11 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 02702

CLEANING AND TELEVISION INSPECTION OF SEWER LINES

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PART 1 - GENERAL

1.01 - SCOPE

A. The work of this section includes the furnishing of all labor, materials and equipment required to clean, televise, and video tape the existing and/or new sewer lines during high groundwater conditions as determined by the Owner/Engineer, unless specified otherwise/directed by the Owner/Engineer.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

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

1. Contractor's description of all equipment to be used.
2. Contractor's description of its proposed methodology.
3. The Contractor shall submit a typed written report including television inspection logs for all work performed. These logs at a minimum should include: stationing, location of reference points, point of entry of service connections via a clock system, observed running leaks, observed continuously running service connections, bad joints, sags in pipes, and other evidence of potential problems.
4. Color DVDs and Inspection Logs.

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA

A. The work covered by this specification shall be in accordance with the best practice of the industry. The specifications call attention to certain features but do not purport to cover all details entering into the required work.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 - CLEANING

A. Cleaning shall be accomplished with high pressure hydraulic cleaning equipment or mechanical cleaning equipment followed by hydraulic cleaning.

1. "Light Cleaning" as used in these specifications, shall be equivalent to 1 to 2 passes of the hydraulic jet through the sewer lines.
2. “Moderate Cleaning” as used in these specifications shall be equivalent to 3 to 4 passes of the hydraulic jet through sewer lines.
3. “Heavy Cleaning” as used in these specifications shall be equivalent to more than 4 passes of the hydraulic jet through the sewer lines or use of mechanical equipment to remove debris, including substantial root mass, to render the line clean.

B. For existing sewer lines, each method shall be able to remove sufficient material to render the sewer line capable of handling 95 percent of its original design capacity. Each method shall also include root removal using equipment appropriate for the conditions.

C. For new sewer lines, each method shall be able to remove sufficient material to render the sewer line capable of handling 100 percent of its design capacity.

D. Equipment

1. Mechanical equipment shall be equipped with a belt booster clutch or overload clutch so that the pipe will not be damaged. No equipment of a direct drive type shall be permitted.
2. High pressure hydraulic equipment shall not operate under a "head of water" unless written approval is obtained from the Engineer.
3. High pressure hydraulic cleaning equipment shall be capable of producing flows from a fine spray to a solid stream and shall have a selection of two or more high pressure nozzles (approximately 2,000 pounds per square inch).
4. Satisfactory precautions shall be taken to protect the sewer lines at all times. All workmen shall be experienced and skilled in the use of the equipment used.

E. Disposal of Debris

1. All sludge, dirt, sand, gravel, roots, grease and other debris resulting from the cleaning operation shall be placed in a suitable container and legally disposed of by the Contractor.
2. No sewage or materials removed from the sewer shall be dumped or pumped into the streets or into water courses, ditches, catch basins or other drains or sewers.
3. The Contractor shall use suitable equipment to ensure that no solids are permitted to go downstream.

3.02 - COLOR TELEVISION INSPECTION

A. General

1. The television camera used for the inspection shall be a 360-degree pan and tilt camera specifically designed and constructed for inspection of sewer lines.
2. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. The camera shall be operative in 100 percent humidity conditions and have a minimum of 600 line-resolutions. Picture quality and definition shall be to the complete satisfaction of the Engineer and if unsatisfactory, the equipment shall be removed and replaced with equipment of satisfactory quality.

B. Sewer Lines

1. The inspection shall be done one section at a time and the section being inspected shall be suitably isolated from the remainder of the sewer system as required.
2. The camera shall be moved through the line in either direction at a uniform slow rate by means of cable winches located at manholes on each side of section being televised.
3. Means of communications shall be set up between the two winches and the monitor control. Photographic pictures shall be taken of the television monitor when directed by the Engineer.

C. Service Connections

1. Existing (If Applicable) - The Contractor shall video tape the entire length of each service connection in order to identify defects that may exist in the lines. This inspection shall occur after the connection has been made by adding a cleanout to each service connection located at the property line.
2. New - The Contractor shall video tape the entire length of each service connection from the main line to the cleanout to each service connection located at the property line.

3.03 - FLOW CONTROL – Not Used

3.04 - REPORTS

A. Television, inspection logs and cleaning logs cleaning logs shall be furnished to the Engineer.

B. Television inspection of the entire line shall be recorded on DVD. Where deficiencies and leaks are noted, the camera shall be stopped to observe the condition, information recorded and photographs taken as directed by the Engineer. Three copies of color video tapes shall be provided.

C. Television inspection logs shall be prepared and shall include identification of the section of pipe and pipe size. Records shall also include location of reference points, point of entry of service connections via a clock system, observed running leaks, observed continuously running service connections, bad joints, sags in pipes, and other evidence of potential problems. Three copies of inspection logs shall be provided.

D. Cleaning logs shall be prepared and shall include identification of the section of pipe and pipe size. Three copies of inspection logs shall be provided.

3.05 - CLEAN-UP

A. The Contractor shall be responsible for the legal disposal of removed materials and general clean-up of the work area as approved by the Engineer.

3.06 - FINAL ACCEPTANCE

A. Final acceptance of the sewer line cleaning shall be made upon completion of the television inspection as approved by the Engineer.

B. Final acceptance is based on the existing sewer's ability to carry 95 percent of its original design capacity and based on the new sewer's ability to carry 100 percent of its design capacity.

3.07 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02722

SPECIAL MANHOLES

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PART 1 - GENERAL

1.01 - SCOPE

A. The work under this section includes the furnishing of all labor, materials, tools and equipment necessary to construct precast concrete special manholes as follows:

1. Combination Air Valves
2. Air Release Stations (ARS)

Precast concrete special manholes shall include bases complete with steps, frames and covers, fittings, valves, piping and supports/restraints as specified herein and as shown on the drawings

B. Attention is directed to all sections within BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT; all sections within OTHER DOCUMENTS; DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Precast concrete manholes.
2. Frames and covers.
3. Horizontal joint sealing material.
4. Pipe connections.

6. Manhole Encapsulation System.
7. Valves, Piping and Fittings.

1.05 - PRODUCT HANDLING

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

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

1.06 - DESIGN CRITERIA

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

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

C. All Special Manholes shall be provided with: (a) Type 316 Stainless Steel pipe and valve supports; and (b) Type 316 Stainless Steel lateral and vertical Thrust Restraints. Supports shall be sized to withstand the weights of the pipes and valves. Thrust Restraints shall be sized to withstand the maximum working pressure of the pipelines. Supports and Thrust Restraints shall be designed and installed as to not interfere with the operation of the components located within the Special Manholes.

PART 2 - PRODUCTS

2.01 - PRECAST CONCRETE FOR SPECIAL MANHOLES

A. Precast reinforced concrete sections shall conform to the applicable requirements of ASTM C478. Sections and bases shall have a minimum wall thickness of the dimensions shown on the Contract Drawings. Unless otherwise detailed on the drawings all sections shall be of precast concrete.

B. Unless otherwise shown on the Contract Drawings manholes shall be five-foot in diameter feet and shall have a minimum inside height of seven feet.

C. The exterior of all manholes shall be factory coated with one coat of Tnemec Series 161 Fascure to prevent moisture migration.

D. All lifting holes and areas of the factory coating that have been compromised shall be filled and/or patched with mortar and coated with one coat of Tnemec Series 161 Fascure to prevent moisture migration.

E. The entire interior surfaces (walls, floor and ceiling) of precast manholes identified (see table) shall be coated with a high build epoxy.

Manhole Number	Location	Drawing Number	Remarks
F-06-37	Karen Way	04 C-137	LPS Air Release Station
F-07-30	Natural Drive	04 C-146	LPS Air Release Station
G-05-26	Uncle Vicks Way	04 C-102	LPS Air Release Station
G-06-06	Cheney Road	04 C-142	LPS Air Release Station
G-06-12	Loomis Lane	04 C-140	LPS Air Release Station

Manhole Number	Location	Drawing Number	Remarks
G-06-14	Loomis Lane	04 C-140	LPS Air Release Station
G-06-24	River Road	04 C-132	LPS Air Release Station
G-06-28	River Road	04 C-131	LPS Air Release Station
G-07-10	Pochet Road	04 C-118	LPS Air Release Station
G-07-13	Harvey's Lane	04 C-130	LPS Air Release Station
G-07-15	Windy Hill Lane	04 C-151	LPS Air Release Station
G-07-21	Cedar Way	04 C-148	LPS Air Release Station
H-04-01	Finlay Road	04 C-106	FM Air Release/Vacuum Valve Manhole
H-05-08	Lake Farm Lane	04 C-110	LPS Air Release Station
H-05-12	Finlay Road	04 C-106	FM Air Release/Vacuum Valve Manhole

Coating schedule to be as follows:

1. Surface Preparation: CIP Concrete to be prepared per SSPC SP #13 Standard with ICRI CSP #5 profile.
2. Lining System
   a. Concrete Surfacer: Tnemec Series 218 Mortar-Clad at 1/16-inch thickness.
   b. Finish: Series 434 PermaShield polyamine epoxy mortar at 125.0 mils dft.

2.02 - HORIZONTAL JOINTS

A. Horizontal joints between sections of manholes, unless otherwise specified herein, shall be sealed with a self-sealing butyl rubber based flexible joint sealant in rope form.

B. Sealant material shall be Kent-Seal No. 2 as manufactured by Hamilton-Kent Mfg. Co., Kent, Ohio; C-S146 as manufactured by Concrete Products Supply Co. Div., Press Seal Gasket Corp., Fort Wayne, Indiana; Ram-Nek as manufactured by K.T. Snyder Co., Inc., Houston, Texas, or equal. Sealant shall be installed in accordance with the manufacturers written instructions.

2.03 - MANHOLE STEPS

A. Manhole steps shall be of steel reinforced copolymer polypropylene conforming to ASTM C478, cast-in-place or installed utilizing inserts approved by the Engineer.

B. All steps shall be 12-inches on center with abrasive step surface and safety edge, drop front design, 1-inch diameter and 16-inches wide. Metal items embedded in concrete shall be painted with a zinc chromate primer.

2.04 - PIPE CONNECTIONS

A. Premolded elastomeric sealed joints shall be used at the joints between the pipe and sewer manhole sections. Premolded elastomeric sealed joints shall be A-Lok, Res-Seal, Press-Wedge II, Lock Joints Flexible Manhole Sleeve, Kor-N-Seal Joint Sleeve, or equal.

2.05 - MANHOLE COVERS AND FRAMES

A. Manhole frames and covers shall be self-level type by EJ Co. and in accordance with the detail shown on the drawings. The Owner has standardized on this manhole frame and cover and therefore no substitutes are allowed.

2.06 - BRICK

A. Brick shall conform to ASTM C32 and shall be new, water struck, first quality, whole, sound brick.

B. For tables and inverts, Type SS shall be used with cement mortar (no lime).

2.07 - MORTAR

A. Mortar shall be composed of one-part Portland cement to two parts sand with 20 percent hydrated lime.

B. Portland cement shall conform to the requirements of ASTM C150. Sand shall conform to the requirements of ASTM C144. Hydrated lime shall conform to the requirements of ASTM C207.

2.08 - WATER

A. Water shall be clean, fresh and free from organic matter, oil, acid, alkali or deleterious substances.

2.09 - BEDDING MATERIAL

A. Bedding material under manholes shall conform to the requirements of pipe bedding material as specified in SECTION 02220, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

2.10 - CONCRETE

A. Concrete for floor fillings, encasements, and similar items shall be as specified in DIVISION 3, CONCRETE.

2.11 - COMBINATION AIR VALVES

A. Wastewater Combination Air Valves shall be single body type, suitable for pressures up to 150 psig with automatic float operated valves designed to: (a) exhaust large quantities of air during the filling of the force main and close upon liquid entry; (b) release accumulated air from the force main while the system is in operation and under pressure; and (c) open during draining and/or if a negative pressure occurs.

B. Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512.

C. The manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

D. The single body valves shall have full size NPT inlets and outlets equal to the nominal 2-inch valve size. The body inlet connections shall be hexagonal for a wrench connection. The body shall have 2-inch NPT cleanout and 1-inch NPT drain connection on the side of the casting. The valve shall have three additional NPT connections for the addition of backwash accessories.

E. The valve body and cover shall be constructed of ASTM A351 Grade CF8M stainless steel. The float, plug, guide shafts, and bushings shall be constructed of Type 316 stainless steel. Non-metallic guides and bushings are not acceptable. Resilient seats shall be Buna-N.

F. Backwash accessories shall consist of an inlet shut-off valve, a blow-off valve, a clean water inlet valve, rubber supply hose, and quick disconnect couplings. Accessory valves shall be quarter-turn, full ported bronze ball valves.

G. Wastewater Combination Air Valves shall be Series 800AS as manufactured by Val-Matic Valve and Manufacturing Corporation, Elmhurst, Il, USA or approved equal.

2.12 - AIR RELEASE STATIONS

A. Air Release Stations (ARS) shall be complete factory-built and tested Combination Air Release Valve Stations, each consisting of a stainless-steel manifold for mounting a factory provided 2-inch Male NPT Combination Air Valve suitably mounted in an HDPE Tank. The tank and manifold shall feature a quick disconnect feature that enables the valve to be removed from the top of the tank (at grade level) without entering the tank, conforming to OSHA Confined Space Standards.

B. Air Release Valve Stations shall be Model ARS as manufactured by Environment One Corporation, 2773 Balltown Road, Niskayuna, NY, USA or approved equal.

2.13 - IN-LINE FLUSHING / FORCE MAIN DRAIN MANHOLES – NOT USED

2.14 - VALVES

A. Gate valves shall be iron body, bronze mounted and have solid wedges. The valves shall be designed for 150 psi working pressure.

B. Exterior surfaces of all valves shall be coated with a minimum of three applications of an approved bituminous solution, on a rust-casting, prior to shipment. Body ring shall be free of any bitumastic solution. Valve interiors shall have a two-part thermoset for fusion bonded epoxy protective coating system and meet all requirements of AWWA C550.

2.15 - CARBON ODOR CONTROL UNIT

A. Manholes identified (see table) shall be provided with a compact, modular canister designed granular catalytic activated carbon odor control unit. Unit shall be designed to use the positive pressure generated inside the manholes to push the contaminated air up through the unit. The contaminated air shall be absorbed by the carbon, allowing clean air to vent through the manhole cover into the atmosphere.

Manhole Number	Location	Drawing Number	Remarks
F-06-37	Karen Way	04 C-137	LPS Air Release Station
F-07-30	Natural Drive	04 C-146	LPS Air Release Station
G-05-26	Uncle Vicks Way	04 C-102	LPS Air Release Station
G-06-06	Cheney Road	04 C-142	LPS Air Release Station
G-06-12	Loomis Lane	04 C-140	LPS Air Release Station
G-06-14	Loomis Lane	04 C-140	LPS Air Release Station
G-06-24	River Road	04 C-132	LPS Air Release Station
G-06-28	River Road	04 C-131	LPS Air Release Station
G-07-10	Pochet Road	04 C-118	LPS Air Release Station
G-07-13	Harvey's Lane	04 C-130	LPS Air Release Station
G-07-15	Windy Hill Lane	04 C-151	LPS Air Release Station
G-07-21	Cedar Way	04 C-148	LPS Air Release Station
H-04-01	Finlay Road	04 C-106	FM Air Release/Vacuum Valve Manhole
H-05-08	Lake Farm Lane	04 C-110	LPS Air Release Station
H-05-12	Finlay Road	04 C-106	FM Air Release/Vacuum Valve Manhole

B. One carbon spare odor control unit shall be provided for each manhole identified. Three spare carbon canisters/bags shall be provided for each manhole identified.

C. Carbon odor control units shall be Sweet Street as manufactured by Continental Carbon Group, Odoreater CC Manhole Insert as manufactured by Parson Environmental Products, Inc. or equal.

2.16 - MANHOLE ADJUSTING RINGS – NOT USED

2.17 - MANHOLE ENCAPSULATION SYSTEM

A. All manholes shall be installed with an external manhole encapsulation system that seals: (1) the interface between the precast concrete manhole and the frame and cover and (2) all manhole joints which are located below groundwater.

B. The manhole encapsulation system shall be designed to prevent leakage of water into the manhole and shall be either one of the following:

1. The manhole encapsulation system shall be a heat shrinkable wraparound sleeve system and shall have an overall thickness of 0.100-inches with a minimum width of 12-inches. The manhole encapsulation shall be "Wrapid Seal Manhole Encapsulation System" as manufactured by Canusa, A Division of Shaw Pipe Resources or equal.

2. The manhole encapsulation system shall be a rubber sleeve made of EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 65 mils with a minimum width of 12-inches. Each unit shall have a 2-inch wide mastic strip on the top and bottom edge of the rubber wrap. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of ¼-inch. The manhole encapsulation shall be "Infi-Shield Seal Wrap" as manufactured by Sealing System, Inc. or equal.

PART 3 - EXECUTION

3.01 - PRECAST REINFORCED CONCRETE

A. Precast reinforced concrete structures shall be installed as shown on the drawings. Precast sections shall be installed so that entire structure is vertically plumb and the steps are in a true line. All erection holes shall be filled solid with non-shrinking grout. The top uppermost precast section shall be set at a grade that will allow for the installation of a minimum of two courses and a maximum of five courses of brick and mortar prior to setting the cast iron frame and cover. The Contractor shall furnish and use suitable slings, hooks and cables for the proper handling of the sections.

B. Surfaces of sewer pipe to be bonded to cast in place concrete bases shall be cleaned of all dust, dirt, grease, laitance, and loose or spalling concrete and given, where applicable, a coat of bonding compound in conformance with the sealant or gasket manufacturer's recommendations.

3.02 - MANHOLE COVERS AND FRAMES

A. If overlay pavement is required by the Owner, the covers and frames shall be set 1/4-inch below the finish grade of the roadway utilizing cement mortar to hold the frame in place, as detailed.

B. The temporary roadway surface elevation shall be maintained and the frames and covers shall be set 3/4-inch above the grade of the temporary resurfacing utilizing either cement mortar or bituminous concrete to hold the frame in place. A slope, constructed of bituminous concrete pavement, shall be placed around the entire grate, frame and cover for a distance of 6-inches from the grate, frame and cover.

C. Any voids created in the road gravel or pavement when raising the grate, frame and cover from its temporary elevation to its permanent elevation shall be filled with concrete.

3.03 - VACUUM TEST

A. Vacuum tests shall be made and observed by the Engineer on each manhole.

B. Preparation for Testing

1. The test shall be made after the manhole had been assembled in place, all lifting holes and horizontal joints shall be filled and pointed with an approved non-shrinking mortar, but prior to filling and pointing the horizontal joints.

2. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test. All pipes and other openings into the manhole shall be suitably plugged and plugs braced to prevent blow out.

3. The test may be conducted before backfilling around the manhole.

C. Test Procedures

1. The Contractor shall take any and all steps necessary to assure the Engineer that the water table is below the invert of the manhole throughout the test. Any and all measures necessary by the Contractor to lower the ground water table below the invert of the manhole will be at the Contractor's cost. The vacuum test shall be based on the following criteria:

   a. Manhole test pressures and time shall be as follows:

      (1) Initial test pressure, 10-inches Hg (i.e., 20-inch absolute).

      (2) Test time, 1-inch Hg drop to 9-inch Hg in 2 minutes minimum allowable, for 0 to 10 foot deep manholes; 2-1/2 minutes minimum allowable for 10 foot to 15 foot deep manholes; 3 minutes minimum allowable for manholes greater than 15 foot in depth.

2. If the pressure drop exceeds 1-inch Hg in 2 minutes the manhole shall be repaired on the outside and retested.

3. If a manhole fails to meet a 1-inch Hg drop in 1 minute after repair, the manhole shall be water exfiltration tested and repaired as necessary.

D. Testing using either air or water shall be done whenever possible prior to backfilling to assist in locating leaks. Joint repairs by parging are to be done on the outside of the manhole. Vacuum testing draws together the joint and applies high pressure to the elastomeric joint material. Properly placed and sized elastomeric joint material must be used to avoid leakage or to enable sections to be separated if necessary to affect a repair.

3.04 - MANHOLE ADJUSTING RINGS – NOT USED

3.05 - MANHOLE ENCAPSULATION SYSTEM

A. The external manhole encapsulation system shall be installed in accordance with the manufacturer’s instructions. All surfaces shall be free of dirt, sharp points and preheated to remove moisture.

B. The Contractor’s personnel shall be trained by the manufacturer in the proper method of application of the external manhole encapsulation system. The Contractor shall have the manufacturer’s field service representative present during the application of external manhole encapsulation system on the first two manholes installed.

3.06 - VISUAL INSPECTION

A. At the conclusion of the work, all manholes shall be visually inspected by the Engineer to insure a straight and plumb alignment.

B. All manholes that are not straight and plumb shall be removed and replaced.

3.07 - CLEANUP

A. Upon completion, of all construction and testing, and prior to final acceptance all debris shall be removed from manholes and the tables cleaned.

3.08 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02725

MANHOLES, CATCH BASINS, HANDHOLES, AND PULL BOXES

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to construct precast concrete manholes, catch basins, handholes, and pull boxes including bases complete with inverts, tables, steps, frames, grates and covers, mancatchers, fittings, piping and concrete encasements for drop manholes as specified herein and as shown on the Contract Drawings

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Precast concrete manholes, catch basins, handholes and pull boxes.
2. Frames, covers, and grates.
3. Horizontal joint sealing material.
4. Pipe connections.
5. Manhole steps.
6. Manhole Encapsulation System.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

1.06 - DESIGN CRITERIA

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

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

PART 2 - PRODUCTS

2.01 - PRECAST SECTIONS FOR MANHOLES

A. Precast reinforced concrete sections for drain manholes, sewer manholes, valve manholes, chemical or process manholes, (hereinafter referred to as "manholes") and catch basins, shall conform to the applicable requirements of ASTM C478. Sections and bases shall have a minimum wall thickness of the dimensions shown on the Contract Drawings. Unless otherwise detailed on the Contract Drawings all sections shall be of precast concrete. Flat top sections to be substituted for conical sections of manholes and catch basins in areas of low cover shall be indicated in submittals and shall conform to the requirements for precast concrete sections for handholes.

B. Unless otherwise shown on the Contract Drawings manholes shall be 4-foot in diameter for pipe up to 24-inches in diameter unless the angle between two 24-inch pipes is less than 120 degrees. In such cases and when the size of the pipe is less than 36-inches a 5-foot inside diameter manhole shall be used. Where the pipe is 36-inches in diameter or greater, the diameter of the structure shall be as shown on the Contract Drawings.

C. Exterior surfaces of all precast manholes shall be given one shop coat of bituminous waterproofing.

D. All lifting holes and areas of the factory coating that have been compromised shall be filled and/or patched with mortar and coated with one coat of bituminous waterproofing.

E. Interior surfaces (walls, floor and ceiling of manholes) precast manholes (See table) shall be coated from the bottom to the top with a high build epoxy.

Manhole Number	Location	Drawing Number
F-06-09	Lewis Road	04 C-143
F-06-10	Main Street	04 C-114
F-06-12	Cheney Road	04 C-142
F-06-13	Main Street	04 C-114
F-06-26	Main Street	04 C-113
F-06-27	Main Street	04 C-113
F-06-28	Main Street	04 C-113
F-06-29	Main Street	04 C-112
F-06-30	Main Street	04 C-112
F-06-31	Main Street	04 C-112
F-06-32	Main Street	04 C-112

F-07-01	Larboard Lane	04 C-147
F-07-02	Larboard Lane	04 C-147
F-07-04	Natural Drive	04 C-146
F-07-05	Pochet Road	04 C-117
F-07-15	Grist Road	04 C-144
F-07-20	Beach Road	04 C-125
F-07-21	Beach Road	04 C-124
F-07-27	Great Oak Road	04 C-122
F-07-28	Great Oak Road	04 C-122
G-05-07	River Road	04 C-131
G-05-15	Monument Road	04 C-101
G-05-16	Monument Road	04 C-101
G-06-02	River Road	04 C-131
G-07-01	Pochet Road	04 C-117
G-07-02	Pochet Road	04 C-117
G-07-03	Barley Neck Road	04 C-127
G-07-04	Barley Neck Road	04 C-127
G-07-08	Grist Road	04 C-144
H-05-02	Pond Road	04 C-105
H-05-03	Pond Road	04 C-105

Coating schedule to be as follows:

1. Surface Preparation: CIP Concrete to be prepared per SSPC SP #13 Standard with ICRI CSP #5 profile.
2. Lining System
    a. Concrete Surfacer: Tnemec Series 218 Mortar-Clad at 1/16-inch thickness.
    b. Finish: Series 434 PermaShield polyamine epoxy mortar at 125.0 mils dft.

2.02 - HORIZONTAL JOINTS

A. Horizontal joints between sections of manholes, unless otherwise specified herein, shall be sealed with a self-sealing butyl rubber based flexible joint sealant in rope form. Sealant material shall be Kent-Seal No. 2 as manufactured by Hamilton-Kent Mfg. Co., Kent, Ohio; C-S146 as manufactured by Concrete Products Supply Co. Div., Press Seal Gasket Corp., Fort Wayne, Indiana; Ram-Nek as manufactured by K.T. Snyder Co., Inc., Houston, Texas. Sealant shall be installed in accordance with the manufacturers written instructions.

B. Horizontal joints between sections of precast concrete drain manholes and catch basins shall be mortared with mix specified herein.

2.03 - MANHOLE STEPS

A. Manhole steps shall be of steel reinforced copolymer polypropylene conforming to ASTM C478, cast-in-place or installed utilizing inserts approved by the Engineer.

B. All steps shall be 12-inches on center with abrasive step surface and safety edge, drop front design, 1-inch diameter and 16-inches wide. Metal items embedded in concrete shall be painted with a zinc chromate primer.

2.04 - PRECAST SECTIONS FOR ELECTRICAL MANHOLES, HANDHOLES, AND PULL BOXES

A. Refer to DIVISION 16, ELECTRICAL.

2.05 - PIPE CONNECTIONS

A. Premolded elastomeric sealed joints shall be used at the joints between the pipe and sewer manhole sections. Premolded elastomeric sealed joints shall be A-Lok, Res-Seal, Press-Wedge II, Lock Joints Flexible Manhole Sleeve, or Kor-N-Seal Joint Sleeve.

B. Mortar shall be used between pipe and structure in the storm drainage systems. Mortar mix shall be as specified herein.

C. Manholes shall be manufactured with knockout panels for future pipe connections/ extensions at the locations shown on the Contract Drawings.

2.06 - MANHOLE FRAMES AND COVERS

A. Manhole frames and covers shall be self-level type by EJ Co. and in accordance with the detail shown on the drawings. The Owner has standardized on this manhole frame and cover and therefore no substitutes are allowed.

B. Bolted and gasketed manhole frames and covers shall be in accordance with the detail shown on the drawings. The Owner has standardized on this manhole frame and cover and therefore no substitutes are allowed. The following manholes shall be furnished with bolted and gasketed manhole frames and covers.

Manhole Number	Location	Drawing Number
F-06-06	Barley Neck Road	04 C-124
F-06-01	Cole Place	04 C-126
F-06-02	Cole Place	04 C-126
F-06-03	Cole Place	04 C-126
F-06-04	Cole Place	04 C-126
F-07-26	Cole Place	04 C-126
G-05-16	Monument Road	04 C-101
G-05-22	Pond Road	04 C-104
G-05-23	Pond Road	04 C-104
G-05-24	Pond Road	04 C-105
F-06-29	Main Street	04 C-113
F-06-28	Main Street	04 C-113
F-06-05	Beach Road	04 C-124
F-07-20	Beach Road	04 C-125
G-07-07	Barley Neck Road	04 C-127
G-07-06	Barley Neck Road	04 C-127

2.07 - BRICK

A. Brick shall conform to ASTM C32 and shall be new, water struck, first quality, whole, sound brick.

B. For tables and inverts, Type SS shall be used with cement mortar (no lime).

2.08 - MORTAR

A. Mortar shall be composed of one-part Portland cement to two parts sand with 20 percent hydrated lime.

B. Portland cement shall conform to the requirements of ASTM C150. Sand shall conform to the requirements of ASTM C144. Hydrated lime shall conform to the requirements of ASTM C207.

2.09 - WATER

A. Water shall be clean, fresh and free from organic matter, oil, acid, alkali, or deleterious substances.

2.10 - BEDDING MATERIAL

A. Bedding material under structures herein shall be as detailed and as specified in SECTION 02220, EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

2.11 - CONCRETE

A. Concrete for tables, inverts, paved invert fillings, encasements, floor fillings and similar items shall be as specified in DIVISION 3, CONCRETE.

2.12 - POLYVINYL CHLORIDE PIPE

A. Polyvinyl Chloride pipe for drop manhole connections shall conform to ASTM D3034 and shall be SDR35.

2.13 - MID LEVEL PLATFORM

A. All manholes with a depth of 20-feet or greater from rim to invert shall have installed at the midpoint of the manhole a mid-level platform. The mid-level platform shall be installed in accordance with the details on the Contract Drawings.

2.14 - MANHOLE ADJUSTING RINGS – Not Used

2.15 - MANHOLE ENCAPSULATION SYSTEM

A. All manholes shall be installed with an external manhole encapsulation system that seals: (1) the interface between the precast concrete manhole and the frame and cover and (2) all manhole joints which are located below groundwater.

B. The manhole encapsulation system shall be designed to prevent leakage of water into the manhole and shall be either one of the following:

1. The manhole encapsulation system shall be a heat shrinkable wraparound sleeve system and shall have an overall thickness of 0.100-inches with a minimum width of 12-inches. The manhole encapsulation shall be "Wrapid Seal Manhole Encapsulation System" as manufactured by Canusa, A Division of Shaw Pipe Resources, Riser-Wrap as manufactured by Pipeline Seal and Insulator, Inc. or equal.

2. The manhole encapsulation system shall be a rubber sleeve made of EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 65 mils with a minimum width of 12-inches. Each unit shall have a 2-inch wide mastic strip on the top and bottom edge of the rubber wrap. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of ¼-inch. The manhole encapsulation shall be "Infi-Shield Seal Wrap" as manufactured by Sealing System, Inc. or equal.

2.16 - CARBON ODOR CONTROL UNIT

A. Manholes identified (see table) shall be provided with a compact, modular canister designed granular activated catalytic carbon odor control unit. Unit shall be designed to use the positive pressure generated inside the manholes to push the contaminated air up through the unit. The contaminated air shall be absorbed by the carbon, allowing clean air to vent through the manhole cover into the atmosphere.

Manhole Number	Location	Drawing Number
F-06-09	Lewis Road	04 C-143
F-06-10	Main Street	04 C-114
F-06-12	Cheney Road	04 C-142
F-06-13	Main Street	04 C-114

F-06-26	Main Street	04 C-113
F-06-27	Main Street	04 C-113
F-06-28	Main Street	04 C-113
F-06-29	Main Street	04 C-112
F-06-30	Main Street	04 C-112
F-06-31	Main Street	04 C-112
F-06-32	Main Street	04 C-112
F-07-01	Larboard Lane	04 C-147
F-07-02	Larboard Lane	04 C-147
F-07-04	Natural Drive	04 C-146
F-07-05	Pochet Road	04 C-117
F-07-15	Grist Road	04 C-144
F-07-20	Beach Road	04 C-125
F-07-21	Beach Road	04 C-124
F-07-27	Great Oak Road	04 C-122
F-07-28	Great Oak Road	04 C-122
G-05-07	River Road	04 C-131
G-05-15	Monument Road	04 C-101
G-05-16	Monument Road	04 C-101
G-06-02	River Road	04 C-131
G-07-01	Pochet Road	04 C-117
G-07-02	Pochet Road	04 C-117
G-07-03	Barley Neck Road	04 C-127
G-07-04	Barley Neck Road	04 C-127
G-07-08	Grist Road	04 C-144
H-05-02	Pond Road	04 C-105
H-05-03	Pond Road	04 C-105

B. One carbon spare odor control unit shall be provided for each manhole identified. Three spare carbon canisters/bags shall be provided for each manhole identified.

C. Carbon odor control units shall be Sweet Street as manufactured by Continental Carbon Group, Odoreater CC Manhole Insert as manufactured by Parson Environmental Products, Inc. or equal.

PART 3 - EXECUTION

3.01 - PRECAST REINFORCED CONCRETE STRUCTURES

A. Precast Reinforced Concrete Structures shall be installed as shown on the Contract Drawings and at a maximum spacing of 300 linear-feet. Precast sections shall be installed so that the entire structure is vertically plumb and the steps are in a true line. All erection holes and horizontal joists shall be filled solid with non-shrinking grout. The top uppermost precast section shall be set at a grade that will allow for the installation of a minimum of two courses and a maximum of five courses of manhole adjusting rings prior to setting the cast iron frame and cover. Furnish and use suitable slings, hooks and cables for the proper handling of the sections.

B. Surfaces of sewer pipe to be bonded to cast-in-place concrete bases shall be cleaned of all dust, dirt, grease, laitance, and loose or spalling concrete and given, where applicable, a coat of bonding compound in conformance with the sealant or gasket manufacturer's recommendations.

C. Tables and inverts shall be constructed of brick and concrete for sewer manholes, and of concrete for drain manholes as shown on the Contract Drawings. The size and shape of the invert shall accurately conform to the adjoining sewer or drains pipes. Any change in size or direction shall be even and as gradual as possible. Concrete floor filling for chemical or process pullbox sumps shall be as shown on the details.

D. Knockout panels for future sewer extensions shall be manufactured into precast manhole, as specified above, at the locations shown on the Contract Drawings. Stubs shall not be used.

3.02 - MANHOLE COVERS AND FRAMES

A. In paved surfaces, grates, covers and frames shall be set 1/4-inch below the finish grade of the roadway utilizing cement mortar to hold the frame in place, as shown of the Contract Drawings.

B. The temporary roadway surface elevation shall be maintained and the grates, frames, and covers shall be set 3/4-inch above the grade of the temporary resurfacing utilizing either cement mortar or bituminous concrete to hold the frame in place. A slope, constructed of bituminous concrete pavement, shall be placed around the entire grate, frame and cover for a distance of 6-inches from the grate, frame and cover.

C. Any voids created in the road gravel or pavement when raising the grate, frame and cover from its temporary elevation to its permanent elevation shall be filled with concrete.

3.03 - DROP CONNECTIONS

A. Drop connections shall be installed for manholes, which have invert elevation differences greater than 3-feet. No exterior drop connections are allowed.

B. Drop connections for manholes shall be constructed utilizing polyvinyl chloride pipe, elastomeric sealed joints, and Type 316 stainless steel mounting hardware and materials. Drops shall be constructed in accordance with the Contract Drawings.

C. The size of the drop piping shall be 8-inches when the size of the sewer main is less than 24-inches. When the sewer main is equal to or larger than 24-inches, the drop piping shall be 12-inches in diameter.

3.04 - LEAKAGE TESTS

A. Leakage tests shall be made and observed by the Engineer on each sewer manhole. The test shall be an exfiltration, infiltration test or vacuum test made as described below:

1. Preparation for Testing

    a. After the manhole has been assembled in place, all lifting holes and horizontal joints shall be filled and pointed with a non-shrinking mortar. The test shall be made prior to placing the tables and invert and before filling and pointing the horizontal joints.

    b. If the groundwater table has been allowed to rise above the bottom of the manhole, it shall be lowered for the duration of the test. All pipes and other openings into the manhole shall be suitably plugged and plugs braced to prevent blow out.

2. Backfilling

   a. The test may be conducted before backfilling around the manhole.

   b. There will be adjustment in the leakage allowance for unknown causes including, but limited to, leaking plugs and absorption. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

3. The Contractor has the option of test method depending upon the actual field conditions. The following are acceptable test methods:

   a. If the measured ground water table is above the highest joint in the manhole, and if there is not leakage into the manhole as determined by the Engineer, the Contractor may perform an infiltration or vacuum test as described herein.

   b. If the measured ground water table height is lower than the invert of the manhole, the Contractor may perform an exfiltration or a vacuum test.

3.05 - TEST PROCEDURES

A. Infiltration Test

1. The manhole interior shall be visually inspected. The manhole shall be considered acceptable for use when no infiltration of ground water is observed on the interior surfaces of the manhole.

B. Exfiltration Test

1. The manhole shall be filled with water to the top of the cone section. If the excavation has not been backfilled and observation indicates no visible leakage, that is, no water visibly moving down the surface of the manhole, the manhole shall be considered satisfactorily watertight.

2. If the test as described above is unsatisfactory as determined by the Engineer or if the manhole excavation has been backfilled the test shall be continued. A period of time may be permitted, if the Contractor so wishes, to allow for absorption.

3. At the end of this period, the manhole shall be refilled to the top of the cone, if necessary, and the measuring time of at least 8 hours shall begin. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage determined on the basis of depth. The leakage for each manhole shall not exceed 1 gallon per vertical foot for a 24-hour period.

4. If the test fails, but the leakage does not exceed 3 gallons per vertical foot per day, repairs shall be made in accordance with industry standard repair methods as to bring the leakage within the allowable rate of 1 gallon per vertical foot per day. If the leakage exceeds 3 gallons per vertical foot per day, it shall be the Contractor's responsibility to uncover the manhole as necessary and to disassemble, reconstruct or replace it as required, at no cost to the Owner. The manhole shall then be retested.

C. Vacuum Test

1. If the vacuum test is performed in lieu of the infiltration or exfiltration test the Contractor shall take any and all steps necessary to assure the Engineer that the water table is below the invert of the manhole throughout the test. Any and all measures necessary by the Contractor to lower the ground water table below the invert of the manhole will be at the Contractor's expense. The vacuum test shall be based on the following criteria:

   a. Manhole test pressures and time shall be as follows:

      (1) Initial test pressure, 10-inches Hg (i.e., 20-inch absolute).

      (2) Test time, 1-inch Hg drop to 9-inch Hg in 2 minutes minimum allowable, for 0 to 10-foot-deep manholes; 2-1/2 minutes minimum allowable for 10 foot to 15 foot deep manholes; 3 minutes minimum allowable for manholes greater than 15 foot in depth.

   b. If the pressure drop exceeds 1-inch Hg in 2 minutes the manhole shall be repaired and retested.

c. If a manhole fails to meet a 1-inch Hg drop in 1 minute after repair, the manhole shall be water exfiltration tested and repaired as necessary.

d. Testing using either air or water shall be done whenever possible prior to backfilling to assist in locating leaks. Joint repairs by parging are to be done on both outside and inside of the joint to ensure a permanent seal. Vacuum testing draws together the joint and applies high pressure to the elastomeric joint material. Properly placed and sized elastomeric joint material must be used to avoid leakage or to enable sections to be separated if necessary to affect a repair.

3.06 - MANHOLE ADJUSTING RINGS – Not Used

3.07 - MANHOLE ENCAPSULATION SYSTEM

A. The external manhole encapsulation system shall be installed in accordance with the manufacturer's written instructions. All surfaces shall be free of dirt, sharp points and preheated to remove moisture.

B. The Contractor's personnel shall be trained by the manufacturer in the proper method of application of the external manhole encapsulation system. The Contractor shall have the manufacturer's field service representative present during the application of external manhole encapsulation system on the first two manholes encapsulated.

3.08 - VISUAL INSPECTION

A. At the conclusion of the work, all manholes, catch basins, handholes and pull boxes shall be visually inspected by the Engineer to insure a straight and plumb alignment.

B. All manholes, catch basins, handholes and pull boxes that are not straight and plumb shall be removed and replaced.

3.09 - CLEANUP

A. Upon completion, of all construction and testing, and prior to final acceptance all debris shall be removed from manholes and the tables cleaned.

3.10 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02735

FLOW CONTROL OF SEWER LINES

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
PART 2 - PRODUCTS - Not Used 2
PART 3 - EXECUTION 2
3.01 - GENERAL 2
3.02 - CLEAN-UP 3
3.03 - CONTRACT CLOSEOUT 3

PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to control the flow of wastewater in the sewer lines as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to all sections within BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT; all sections within OTHER DOCUMENTS; DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Contractor's description of all equipment to be used.
2. Contractor's description of his proposed methodology.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

1.06 - DESIGN CRITERIA

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

B. Contractor shall use by-pass pumps and power sources with sound proofing for minimal disturbance (less than 85 db).

C. Contractor shall provide secondary containment for any type of fuel used for power sources. Secondary containment shall be sized for at least 150 percent of the total fuel supply.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.01 - GENERAL

A. When the depth of flow in the sewer line is above the maximum allowable set forth for the type of work being performed in the applicable section(s) of these specifications, one or more of the following methods of flow control shall be used:

1. Plugging or Blocking
    a. A sewer line plug shall be inserted into the sewer line(s) at a manhole upstream from the section in which the work is to be performed.
    b. The plug shall be so designed that all or any portion of the sewage flow can be released.

2. Pumping and Bypassing

   a. When pumping/bypassing is required, the Contractor shall supply the necessary pumps, conduits and other equipment to divert the flow of sewage around the section in which work is to be performed. The Contractor shall be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system.

   b. Bypass pumping shall only be performed during working hours. The gravity sewers shall be reconnected at the end of each work day.

B. The Contractor shall conduct its work so as to not cause excessive surcharging of the sewerage system and shall not cause damage to the sewerage system, its connections and/or apparatus. Any damage caused by the Contractor's operations shall be repaired to the complete satisfaction of the Engineer and at no additional cost to the Owner.

3.02 - CLEAN-UP

A. The Contractor shall be responsible for the legal disposal of removed materials and general clean-up of the work area as approved by the Engineer.

3.03 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 02736

TEMPORARY CONNECTIONS

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 2
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
PART 2 - PRODUCTS 3
2.01 - MATERIALS 3
PART 3 - EXECUTION 3
3.01 - PIPE LAYING 3
3.02 - TEMPORARY BYPASS 3
3.03 - TEMPORARY SERVICE CONNECTIONS 4
3.04 - CONTRACT CLOSEOUT 4

PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment and performing all operations in connection with the temporary connections, as specified herein and as shown on the drawings.

B. Provide, disinfect, and maintain temporary potable water bypass pipe, connections, and services as indicated and as specified and later remove temporary facilities.

C. Have readily available sufficient additional quantity of bypass pipe, connections of suitable sizes to replace or supplement the temporary facilities in event these prove inadequate in any way.

D. Perform all appurtenant work including but not limited to excavation and backfilling, constructing ramps at driveways and other access ways, replacement of temporary and permanent pavement, restoration of public and private property.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

B. Submittals shall include shop drawings showing complete fabrication and construction details, materials, weights, dimensions, clearances, anchorage details, piping and utility requirements. Submittals shall include at least the following:

1. Before commencing work, submit for Engineer's review and approval, proposed layout plan and operations schedule for installing and removing temporary bypasses, connections and services.

2. Submit for Engineer's review and approval, a list of materials with sizes for temporary bypass, connect-ions and services.

3. Quality Assurance documents.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

1.06 - DESIGN CRITERIA

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

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

C. Quality Assurance

1. Use only materials that are suitable for potable water transmission and distribution.
2. Provide temporary connections capable of withstanding service pressure of 150 psi.
3. Take water for temporary connections from Owner's nearest available hydrants remaining in service.

D. Safety Requirements

1. Prevent contamination of contiguous potable water distribution system and services.
2. Coordinate and cooperate with Owner's water utility and fire department to maintain water distribution and fire protection capability.
3. Take all necessary precautions for public safety.
4. See SECTION 01500, TEMPORARY FACILITIES regarding water supply for Contractor's operations.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Provide pipe, fittings, hoses, connections, valves suitable for potable water service at 250 psi and as approved by Engineer.

PART 3 - EXECUTION

3.01 - PIPE LAYING

A. Furnish, install, maintain and later remove devices necessary to ensure public safety as required and as approved.

B. Install, operate, maintain, test, disinfect and remove temporary facilities including bypass, connections, laterals, customer services and customer connections and temporary fire hydrants as indicated on drawings, as specified and as approved by Engineer.

C. Make installation suitable for temporary potable water service pressures to 150 psi without leakage.

D. Do not operate Owner's or user's valves, stops and hydrants without Engineer's permission for specific valves, stops and hydrants.

E. Test temporary facilities in presence of Engineer before taking Owner's water main out of service.

F. Disinfect temporary facilities to meet Engineer's approval and in accordance with SECTION 02675, HYDROSTATIC TESTING AND DISINFECTION prior to placing such temporary facilities in service.

G. Make attachments and connections to fire hydrants and fire protection systems in a manner which can be easily and quickly removed to permit use of fire hydrants and fire protection systems for fire fighting purposes.

H. Notify in writing the Owner and the Owner's water utility and fire department 48 hours in advance of connect-ing and disconnecting temporary and permanent facilities so that representatives of Owner's water utility and fire department may be present at installation or removal of permanent and temporary connections and to permit Owner to inform customers and users as Owner deems necessary.

I. Do not install temporary bypass, connections and customer services across streets except as permitted by Engineer.

J. Connect to the temporary bypass water mains that are to remain in service as indicated and approved by Engineer.

K. After water mains are returned to service, remove temporary facilities not required for remaining work and restore and clean up affected areas to the approval of the Engineer.

3.02 - TEMPORARY BYPASS

A. Provide bypass not less than sizes indicated on drawings and in any case not less than 2-in. diameter.

B. Lay bypass out of traveled way in manner to protect the bypass from damage.

C. Where bypass is approved to cross streets and street intersections, lay in trench and place temporary pavement over bypass except as permitted otherwise in writing by the Engineer.

D. Where bypass crosses driveways and similar access ways to properties, construct suitable ramp to allow driving and passing over pipe except where Engineer requires bypass be laid in trench with temporary pavement over bypass.

E. Keep existing fire hydrants in service by making appropriate connections to bypass or by installing and maintaining temporary fire hydrants adjacent to each existing fire hydrant affected by work until restored to service.

F. Provide each temporary fire hydrant with individual valve control.

G. Provide temporary fire hydrants with fire hose connections compatible with existing fire hydrant hose connections as approved by the Engineer.

H. Satisfactorily flush existing hydrants, to which bypass is connected for water supply, prior to making connections to prevent stagnant or discolored water from entering bypass.

I. If bypass proves inadequate for temporary service, replace or supplement bypass as appropriate to provide adequate temporary service, including replacement with larger diameter bypass, as approved by the Engineer.

3.03 - TEMPORARY SERVICE CONNECTIONS

A. Furnish, install, maintain and later remove temporary service connections from the bypass to each building and service supplied by water main to be removed from service.

B. Lay temporary connections out of traveled and access ways where possible.

C. Temporary service connections ramped or in trench where directed and approved by the Engineer.

D. Provide temporary service connections equal to or larger size than permanent service connections.

E. Install and maintain pressure regulators for temporary services where necessary.

F. Install and remove temporary service connections and back clean permanent services at times when work can be observed by the Engineer and other representatives of the Owner.

G. Coordinate and cooperate with service user, Owner's water utility and fire department, to assure minimum disturbance to fire protection system and other special and automated uses.

H. Make temporary service connections to user service line, sill cock, or other convenient and reasonable points and acceptable to the Engineer.

3.04 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 02890

TRACER WIRE

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
1.03 - DEFINITIONS 1
1.04 - SUBMITTALS 2
1.05 - PRODUCT HANDLING 2
1.06 - DESIGN CRITERIA 2
PART 2 - PRODUCTS 2
2.01 - GENERAL 2
2.02 - TRACER WIRE 2
2.03 - CONNECTORS 3
2.04 - TERMINATION/ACCESS 3
2.05 - GROUNDING 3
PART 3 - EXECUTION 4
3.01 - INSTALLATION 4
3.02 - PROHIBITED PRODUCTS AND METHODS 4
3.03 - TESTING 5
3.04 - CONTRACT CLOSEOUT 5

PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide tracer wire as specified and/or as shown on the drawings.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT C-700, GENERAL CONDITIONS.

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

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

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

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

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT C-700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

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

1. Brochures and/or Catalogue Cuts including materials of construction, dimensions, minimum submergence requirements, etc.
2. Shop Drawings, including all equipment and components
3. Installation instructions
4. Manufacturer's Data

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

PART 2 - PRODUCTS

2.01 - GENERAL

A. All trace wire and trace wire products shall be domestically manufactured in the U.S.A.

B. All trace wire shall have HDPE insulation intended for direct bury, green color coated per APWA standard for a sewer utility being marked.

2.02 - TRACER WIRE

A. Open Trench - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.

B. Directional Drilling/Jacking/Boring - Trace wire shall be #12 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.

2.03 - CONNECTORS

A. All mainline trace wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At Crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.

B. Direct bury wire connectors shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall be installed in a manner so as to prevent any uninsulated wire exposure.

C. Non locking friction fit, twist on or taped connectors are prohibited.

2.04 - TERMINATION/ACCESS

A. All trace wire termination points must utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.

B. All grade level/in-ground access boxes shall be appropriately identified with “sewer” cast into the cap and be color coded.

C. A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.

D. All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.

E. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

F. Gravity Sewers and Force Mains - Trace wire must terminate at grade level/in- ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway as approved by the Engineer.

G. Long-runs of Force Main, in excess of 500 linear feet. Trace wire access must be provided with a grade level/in-ground trace wire access box, located at the edge of the road right-of- way, and out of the roadway as approved by the Engineer. The grade level/in-ground trace wire access box shall be delineated using a minimum 48-inch polyethylene marker post, color coded green per APWA standard for the specific utility being marked.

2.05 - GROUNDING

A. Trace wire must be properly grounded at all dead ends/stubs

B. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum

C. 1.5 lb.) specifically manufactured for this purpose and buried at the same elevation as the utility.

D. When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.

E. When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.

F. Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. All materials and equipment shall be installed in a neat, workmanlike manner. The Contractor shall unpack all items and dispose of all unwanted packing materials.

B. Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.

C. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.

D. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

E. Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5’ intervals.

F. Trace wire must be properly grounded as specified.

G. Trace wire on all service laterals/stubs must terminate at an approved trace wire access box located directly above the utility, at the edge of the road right-of-way, but out of the roadway. (See Trace wire Termination/Access)

H. At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire. (See Grounding)

I. Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead- end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.

J. All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.

K. In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors and shall be properly grounded at the splice location as specified.

L. A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.

M. Lay mainline trace wire continuously, by-passing around the outside of manholes/structures on the North or East side.

N. Trace wire on all sanitary service laterals must terminate at an approved trace wire access box color coded green and located directly above the service lateral at the edge of road right of way.

3.02 - PROHIBITED PRODUCTS AND METHODS

A. The following products and methods are:

1. Uninsulated trace wire;
2. Trace wire insulations other than HDPE;
3. Trace wires not domestically manufactured;
4. Non locking, friction fit, twist on or taped connectors;
5. Brass or copper ground rods;
6. Wire connections utilizing taping or spray-on waterproofing;
7. Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another;

8. Trace wire wrapped around the corresponding utility;
9. Brass fittings with trace wire connection lugs;
10. Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.; and
11. Connecting trace wire to existing conductive utilities.

3.03 - TESTING

A. All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.

B. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

C. Continuity testing in lieu of actual line tracing shall not be accepted.

3.04 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 03100

CONCRETE FORMWORK

PART 1 – GENERAL 2
1.01 - SCOPE 2
1.02 - MEASUREMENT AND PAYMENT 2
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1.05 - PRODUCT HANDLING 3
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1.07 - REFERENCES 4
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2.04 - FORM MATERIAL LOCATIONS 4
2.05 - FORM TIES 5
2.06 - BOND BREAKER 5
2.07 - FORM LINERS 5
2.08 - RUSTICATIONS 6
2.09 - FORM CAULKING 6
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PART 1 – GENERAL

1.01 - SCOPE

A. Provide design and furnish materials for fabricating, erecting and removing formwork, false work and shoring for cast-in-place concrete as shown on the contract drawings and specified herein for a complete installation. The use of stay-in-place forms is expressly prohibited.

B. Use formwork to cast all cast-in-place concrete structures.

C. Provide and remove all formwork for architectural, civil, mechanical, and electrical work as shown on the drawings or specified under specified under those disciplines.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification section number and title and Drawing numbers and titles.

1. Layout of panel joints and tie hole pattern for architectural formwork.
2. Form Ties: Submit data sheets for form ties proposed for use.
3. Form Ties-Tapered Through-Bolts: Proposed method of sealing and patching form tie holes.
4. ANSI/NSF 61 Certification that form release agents proposed for use in structures to contain potable water are non-toxic and have no adverse effect on the quality or appearance of potable water.

1.05 - PRODUCT HANDLING

A. Comply with the requirements of SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Contractor shall arrange deliveries of materials and equipment in accordance with construction Progress Schedule, coordinate to avoid conflict with Work and conditions at Project site.

C. Materials shall be delivered to the site in an undamaged condition and at such intervals as will avoid delay in the work.

D. Material shall be stored and protected in a clean, properly drained location. Material shall be kept off the ground under a weather-tight covering permitting good air circulation. Formwork materials shall be stored on dry wood sleepers, pallets, platforms or other appropriate supports which have slope for positive drainage. Materials shall be protected from distortion, excessive stresses, corrosion and other damage. Materials shall not be stored on the structure in a manner that might cause distortion or damage to the supporting structure.

1.06 - DESIGN CRITERIA

A. Design formwork in conformance with methodology of ACI 347R for anticipated loads, lateral pressures, depth of concrete placement and rate of concrete placement. Design shall consider any special requirements due to the use of self consolidating, plasticized and/or retarded set concrete. All forms and shoring shall be designed at the contractor's expense.

B. Qualifications

1. Formwork Designer: Formwork, false work, and shoring design shall be by an engineer licensed in the state where the Project is located.

C. Quality Assurance

1. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.

2. Design of Formwork

a. The Contractor shall assume responsibility for the design, engineering and construction of formwork. Forms shall be designed to produce concrete members identical in shape, lines and dimensions to members shown on the Contract Documents.

b. When high range water reducer (superplasticizer) is used in concrete mix or when self consolidated concrete is specified, forms shall be designed for full hydrostatic pressure per ACI 347.

c. The formwork shall be designed for the loads and lateral pressures in accordance with ACI 347 and wind loads as specified by the local building code.

d. Construction and contraction joints, openings, offsets, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, waterstops, anchorages, inserts, and other features shall be provided.

e. Formwork shall be designed to be readily removable without impact, shock, or damage to 'green' concrete surfaces and adjacent materials.

f. The maximum panel deflection shall be L/360 of the span between structural members.

3. Unless otherwise specified herein, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits as given in ACI 117.

4. Materials, fabrications and workmanship found defective shall be promptly removed and replaced and new acceptable work shall be provided in accordance with Contract requirements at no additional cost to the owner.

1.07 - REFERENCES

A. American Concrete Institute (ACI):

1. 117/117R: Standard Tolerances for Concrete Construction and Materials.
2. 309.2R: Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces.
3. 318/318R: Building Code Requirements for Structural Concrete and Commentary.
4. 347: Guide to Formwork for Concrete.
5. 350/350R: Code Requirements for Environmental Concrete Structures and Commentary.

B. Engineered Wood Association (APA)

C. National Institute of. Product Standards and Technology

1. Voluntary Product Standard PS 1 Structural Plywood

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

PART 2 - PRODUCTS

2.01 - LUMBER

A. Lumber used in form construction shall be Douglas fir, No. 2 grade, S4S, Standard Grading and Dressing Rules No. 16, West Coast Lumber Inspection Bureau; or Southern Yellow Pine, No. 2, S4S, Standard Grade Rules Southern Pine Inspection Bureau. Boards shall be 6 inches or more in width.

2.02 - PLYWOOD

A. Only grade-marked plywood conforming to APA shall be provided.

B. Plywood used in form construction shall be Grade B-B, Class 1 plyform, mill-oiled, and sanded on both sides in conformance with U.S. Product Standard PS 1 Structural Plywood.

C. Thickness shall be sized to maintain alignment and surface smoothness, but not less than 5/8-inch thick.

2.03 - STEEL FORMS

A. Commercial grade sheets not less than 16 gage shall be provided.

B. Stock material that is free from warps, bends, kinks, cracks, and rust or other matter that could stain the concrete shall be provided.

2.04 - FORM MATERIAL LOCATIONS

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.

B. Column Forms:

1. Rectangular Columns: As specified for walls.
2. Circular Columns: Fabricated steel or fiber reinforced plastic with bolted together sections or spirally wound laminated fiber form internally treated with release agent for height of column.

C. All Other Forms: Materials as specified for wall forms.

D. Rustication Grooves and Chamfer Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

2.05 - FORM TIES

A. Locate form ties on exposed surfaces in a uniform pattern. Place form ties so they remain embedded in the concrete except for a removable portion at each end. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch. Construct form ties so that no metal is within 1 1/2 inches of the concrete surface when the forms, inserts, and tie ends are removed. Do not use wire ties. Ties shall withstand all pressures and maintain forms within acceptable deflection limits.

B. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1 1/2 inches and sufficient dimensions to permit patching of the tie hole.

C. Tapered form ties shall be tapered through-bolts or through-bolts that utilize a removable tapered sleeve.

D. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:

1. Integral steel water stop 0.103-inch thick and 0.625 inch in diameter tightly and continuously welded to tie.

2. Neoprene water stop 3/16-inch thick and 15/16 inch in diameter whose center hole is one-half diameter of tie, or molded plastic water stop of comparable size.

E. Elastic Vinyl Plug:

1. Design and size of plug shall allow insertion with tool to enable plug to elongate and return to original length and diameter upon removal forming watertight seal.

2. Manufacturer:

a. Dayton Superior; A58 Sure Plug.

b. Or equal.

F. Mechanical EPDM Rubber Plug:

1. Mechanical plug for taper tie

2. Manufacturers:

a. Sika Greenstreak, St. Louis, MO; X-Plug

b. Or equal.

3. Friction fit plugs will not be allowed.

2.06 - BOND BREAKER

A. Bond breaker shall be a V.O.C.-compliant nonstaining type that will provide positive bond prevention.

B. Manufacturers:

1. Edoco Burke; Clean Lift 90 W.B..

2. Nox-Crete, Inc.; Silcoseal 97EC.

3. Or equal.

2.07 - FORM LINERS

A. Form liners shall be provided as shown on documents.

B. Products:

1. Dura-Tex; Symons Corporation.

2. Or equal.

2.08 - RUSTICATIONS

A. Rustications shall be provided as shown on documents.

B. Products:

1. Rustications; Symons Corporation.

2. Or equal.

2.09 - FORM CAULKING

A. Form caulking shall be a one-component, gun-grade silicone sealant that is capable of producing flush, watertight and non-absorbent surfaces and joints. Sealant shall be compatible with the type of forming material and concrete ingredients used.

B. Products:

1. Series 1200 Construction Caulking; GE Silicones.

2. Dow Corning 999-A; Dow Corning Co..

3. Or equal.

2.10 - CHAMFER STRIPS

A. Provide 3/4-inch by 3/4-inch chamfer strips milled from clear, straight-grain pine, surfaced each side or extruded vinyl type with or without nailing flange unless otherwise shown on the Contract Documents.

2.11 - INSERTS

A. Provide galvanized cast steel or galvanized welded steel inserts, complete with anchors to concrete and fittings such as bolts, wedges and straps.

2.12 - DOVETAIL ANCHOR SLOTS

A. Provide dovetail anchor slots manufactured from 22 gage, galvanized steel with removable felt or polyurethane.

2.13 - FORM RELEASE AGENT

A. Form release agent shall not bond with, stain, or adversely affect concrete surfaces and shall not impair subsequent treatments of concrete surfaces. Form release agent shall be a ready-to-use water-based material formulated to reduce or eliminate surface imperfections and containing no mineral oil or organic solvents.

B. Certified as meeting the requirement of ANSI/NSF 61 for contact with potable water.

C. Manufacturers and Products:

1. BASF; MBT, Rheofinish 211.

2. Cresset Chemical Company; Crete-Lease 20-VOC.

3. Unitex Chemicals; Farm Fresh.

4. Symons Corporation: Magic Kote

5. Or equal.

PART 3 - EXECUTION

3.01 - FORM TOLERANCES

A. Comply with the requirements of ACI 117 for tolerances for formed surfaces except as specified in Table 03100-1.

TABLE 03100-1	
Vertical alignment (plumbness)	1/4 inch in any 10 feet and 1 inch maximum for entire length
Variation in the lines and surfaces of foundation mats, base slabs and walls	1/4 inch in any 10 feet and 1 inch max. for entire length
Variation from the level or from the grades indicated on the drawings	1/4 inch in any 10 feet
Variation of the linear building lines from established position in plan	1/2 inch in any 20 feet and 1 inch maximum for entire length
Variation of distance between walls	1/4 inch in any 10 feet and 1 inch maximum for entire length and height
Variation in the sizes and locations of sleeves, floor openings and wall openings	Minus 1/4 inch Plus 1/2 inch
Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus 1/4 inch Plus 1/2 inch
Offset between adjacent panels of formwork facing material	1/2 inch (ACI 117 Class C finish).
Offset between adjacent panels of formwork facing material for exposed surfaces where appearance is of importance	1/8 inch (ACI 117 Class A finish).

B. Tolerances are not cumulative

C. Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

D. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.

3.02 - PREPARATION

A. Clean form surfaces to be in contact with concrete of foreign material prior to installation. Tape, gasket, plug, and/or caulk joints, gaps, and apertures in forms so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.

B. Coat form surfaces in contact with concrete with a form release agent prior to form installation.

C. Keep form coatings off steel reinforcement, items to be embedded, and previously placed concrete.

D. Steel Forms: Apply form release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

E. Form liners for architectural concrete finish shall be installed in accordance with the manufacturer’s recommendations.

3.03 - ERECTION AND INSTALLATION

A. Forms shall be constructed in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight. Forms shall be substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subject. Unless otherwise indicated on the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits in ACI 117 and herein specified.

B. Provide means for holding adjacent edges and ends of form panels tight and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.

C. Provide one cleanout and inspection opening 12 inches wide by 18 inches high every 7 feet at the bottom of each lift of forms.

D. Provide exterior corners of concrete members with chamfers as specified.

E. Provide means for removing forms without injury to the surface of finished concrete.

F. Do not embed any form-tying device or part thereof other than metal in the concrete.

G. Locate large end of taper tie on the "wet" side of the wall.

H. Use only form or form-tying methods that do not cause spalling of the concrete upon form stripping or tie removal.

I. Form surfaces of concrete members except where placement of the concrete against the ground is shown in the drawings or as indicated below. The dimensions of concrete members shown in the drawings apply to formed surfaces, except where otherwise indicated. Add 2 inches of concrete where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement of concrete against the ground shall be limited to footings and other nonexposed concrete and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.

J. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with additional reinforcement as shown in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

K. Set anchor bolts and other embedded items accurately before placing concrete and hold securely in position until the concrete is placed and set. Check special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after placing concrete. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to placing concrete.

3.04 - PROTECTION

A. During installation, the forms shall not be used as a storage platform nor as a working platform until the forms have been permanently fastened in position.

3.05 - PIPES AND WALL CASTINGS CAST IN CONCRETE

A. Install wall castings, wall flanges, and wall anchors before placing concrete. Do not weld, tie, or otherwise connect the wall castings or anchors to the reinforcing steel.

B. Pipes or wall castings located below operating water level shall have water stop ring collars and shall be cast in place. Do not block out such piping and grout after the concrete section is cast unless permitted, authorized or directed by the Engineer. Pipes fitted with thrust rings shall be cast in place.

3.06 - REMOVAL OF FORMS

A. Forms shall be removed in accordance with ACI 347 recommendations without damage to concrete and in a manner to ensure complete safety to the structure. Forms, form ties and bracing shall not be removed without specific permission of the Contractor's Registered Professional Engineer.

B. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed; during which the air surrounding the concrete is above 50 degrees F.

TABLE 03100-2	
Sides of footings and encasements; Walls; Vertical sides of slabs, beams, girders; Columns; Similar members not supporting loads.	24 hours
Bottom forms of slabs, beams, and girders; and shoring for slabs, beams, and girders with immediate reshoring.	Until concrete strength reaches 70 percent specified 28-day strength
Bottom forms of slabs, beams, and girders; and shoring for slabs, beams, and girders without reshoring	Until concrete strength reaches specified 28-day design strength

C. Removal times will be increased if the concrete temperature following placement is permitted to drop below 50 degrees F.

D. Do not remove supports and reshore.

3.07 - PATCHING OF TAPERED TIE HOLES

A. Clear tie hole of all loose debris with a taper tie void brush and flush debris from tie hole with air or water.

B. Install plug from larger tie hole end in accordance with manufacturer’s instructions using an insertion tool as recommended by the manufacturer.

C. Fill each side of hole with mortar. Apply mortar to the "wet" side of the wall first. Consolidate mortar solidly into the hole.

3.08 - CLOSEOUT ACTIVITIES

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

END OF SECTION

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SECTION 03200

CONCRETE REINFORCEMENT

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PART 1 – GENERAL

1.01 - SCOPE

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

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

C. Provide concrete reinforcement as indicated and specified including:

1. Reinforcement bars.
2. Welded wire reinforcement.
3. Reinforcement accessories.

D. Provide concrete reinforcement for architectural, civil, mechanical, and electrical work as shown on the drawings or specified under those disciplines.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Submit bar lists and placing drawings for all reinforced concrete and masonry structures in accordance with SECTION 01300, SUBMITTALS.
2. Detail reinforcement in conformance with ACI 315.
3. Clearly indicate bar sizes, spacing, locations, quantities and total weight of reinforcement steel and wire reinforcement, bending schedules, and supporting and spacing devices. Show joints, with applicable joint reinforcement and waterstops.
4. Coordinate bar splicing and placement with Contractor’s concrete placing schedule and joint locations. Do not add or delete joints without permission from the Engineer.
5. Show wall reinforcement in elevation. Show entire elevation of wall from top to bottom and end to end. Do not show partial elevations. Show all dowels, joints and pockets in walls.
6. Show slab reinforcement in plan view. Show all dowels, joints, openings and recesses in slabs.
7. Show location and size of all penetrations greater than 12-inches in diameter or least dimension of the opening with the corresponding added reinforcement around the penetrations.
8. Clearly show marking for each reinforcement item.
9. Indicate locations of reinforcement bar cut-offs, splices and development lengths.

C. Submit certified copies of mill test reports of reinforcement analysis dated within the last three months for each shipment of reinforcement with specific lots in shipments identified.

D. Chemical composition of reinforcement steel: Ladle analysis indicating percentage of carbon, phosphorous, manganese and sulfur present in steel.

E. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, submit Manufacturer's literature that contains instructions and recommendations for installation for each type of coupler used; certified test reports that verify the load capacity of each type and size of coupler used; and Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

F. Unless otherwise acceptable to the Engineer, each submittal shall include reinforcement only for a single structure or part thereof. Shop drawings depicting multiple structures on the same sheet are not acceptable.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. Keep reinforcement steel free from mill scale, rust, dirt, grease or other foreign matter.

C. Ship and store reinforcement steel with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placing drawings.

D. Store reinforcement steel off the ground, protected from moisture and kept free from dirt, oil or other injurious contaminants.

1.06 - DESIGN CRITERIA

A. Do not fabricate reinforcement until shop and placement drawings have been reviewed and accepted by the Engineer.

B. Perform concrete reinforcement work in accordance with CRSI Manual of Practice and ACI 315**.**

C. An independent testing agency accepted by Engineer shall visually inspect and test reinforcing steel welds in accordance with AWS D1.4/D1.4M.

D. An independent testing agency accepted by Engineer shall inspect each mechanical coupler and verify each component is installed in accordance with Manufacturer's instructions and ICC Evaluation Services Report or equivalent code agency report.

1.07 - REFERENCES

A. ASTM International (ASTM)

1. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM A616 - Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
4. ASTM A617 - Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.
5. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
6. ASTM A1064/A1064M - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

B. American Concrete Institute (ACI)

1. ACI 301 - Standard Specification for Structural Concrete.
2. ACI 315 - Details and Detailing of Concrete Reinforcement.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 350 - Building Code Requirements for Environmental Engineering Concrete Structures

C. Concrete Reinforcing Steel Institute (CRSI)

1. CRSI Manual of Standard Practice.

2. CRSI Placing Reinforcing Bars.

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

1.08 - INSPECTION AND TESTING

A. In no case shall any reinforcement steel be covered with concrete until the installation of the reinforcement has been observed by the Engineer and the Engineer's authorization to proceed with the concreting has been obtained. The Engineer shall be given a minimum of 48 hours prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished observations of the reinforcement steel.

B. Provide Engineer with access to fabrication plant to facilitate inspection of reinforcement. Notify Engineer of commencement and duration of shop fabrication, in sufficient time to allow for proper inspection.

PART 2 - PRODUCTS

2.01 -REINFORCEMENT STEEL

A. Reinforcement Steel: ASTM A615/A615M, 60 ksi yield grade; deformed billet steel bars.

B. Reinforcement Steel to be Welded: ASTM A706/A706M, 60 ksi yield strength; deformed low-alloy steel bars.

C. Reinforcement Steel Plain Bar and Rod Mats: ASTM A704/A704M, ASTM A1064, Grade 60; steel bars or rods, unfinished.

D. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A1064.

E. Reinforcement shall be clean and free from loose mill scale, dirt, grease, oil, form release agent, dried concrete or any material reducing bond with concrete.

F. Welded Wire Reinforcement:

1. Provide welded wire reinforcement conforming to ASTM A1064 in flat sheets.

2. Provide deformed welded wire reinforcement conforming to ASTM A1064 in flat sheets.

3. Provide support bars and reinforcement bar supports as specified herein to obtain the concrete cover indicated.

2.02 - ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, and Spacers: sized and shaped for strength and support of reinforcement during concrete placement including load bearing pad on bottom of base slabs and slabs on grade to prevent puncturing the vapor retarder.

C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather Exposed Concrete Surfaces: plastic coated steel, stainless steel or plastic type; size and shape as required.

D. Provide 3-inch by 3-inch plain precast concrete blocks, precast concrete doweled blocks or concrete brick for support of bottom reinforcement in foundation mats, base slabs, footings, pile caps, grade beams and slabs on grade. Provide block thickness to produce concrete cover of reinforcement as indicated.

E. Mechanical Couplers

1. Reinforcement Tension Bar Splicers:

a. Cadweld or Lenton rebar splicers by Erico Products, Inc. and Dayton Barsplice, Inc., or equal.

b. DB-SAE splicer system by Richmond Screw Anchor Company, Inc., C2D rebar flange coupler by Williams Form Engineering Corporation and Lenton Form Saver by Erico Products, Inc., or equal.

c. Develop minimum 125 percent of yield capacity of bars spliced in tension when tested as assembly in accordance with ASTM A370 and A615.

F. Reinforcement Compression Bar Splicers:

1. Manufacturers: G-Loc splicers by Gateway Building Products Division

2. Speed-Sleeve by Erico Products, Inc.

G. Provide epoxy for grouting reinforcement bars specifically formulated for such application for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements in SECTION 03600, GROUT.

2.03 - FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Standard Practice, ACI 315 and ASTM A184/A184M.

B. Weld reinforcement in accordance with AWS D1.4 only when permitted by the Engineer.

C. Locate reinforcement splices not indicated on Drawings, at point of minimum stress.

D. Cold bend bars. Do not straighten or rebend bars.

E. Do not heat reinforcement steel to bend or straighten.

F. Bend bars around a revolving collar having a diameter of not less than that recommended by ACI 318.

G. Cut bar ends that are to be butt spliced, or threaded by saw cutting. Terminate such ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Place, support and secure reinforcement against displacement. Do not deviate from required position. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

B. Do not displace or damage vapor retarder.

C. Position dowels accurately. Rigidly support, align and securely tie dowels normal to the concrete surface before concrete placement. Setting dowels into wet concrete is prohibited.

D. Position wall dowels projecting from base slabs on grade with templates or guides held in place above the concrete placement line. Position the templates to obtain the required clearance between the dowels and the face of the walls.

E. Bars additional to those indicated that may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at no additional cost to the Owner.

F. Do not extend continuous reinforcement or other fixed metal items through expansion joints. Provide 2 inches clearance from each face of expansion joint.

G. Provide additional reinforcement bars to support top reinforcement in slabs. Do not shift reinforcement bars from positions in upper layers to positions in lower layers as a substitute for additional support bars.

H. Support reinforcement steel in accordance with CRSI “Placing Reinforcement Bars” with maximum spacing of 4-feet-0-inches.

I. Tie reinforcement steel at intersections in accordance with CRSI “Placing Reinforcement Bars”:

1. Maximum tie spacing for footings, walls and columns: every third intersection or 3 feet.

2. Maximum spacing for slabs and other work: every fourth intersection or 3 feet.

3. Tie a minimum of 25 percent of all intersecting bars in foundation mats, base slabs, footings, pile caps, slabs on grade and elevated slabs.

4. Secure all dowels in place before placing concrete.

5. Tie wires shall be bent away from the forms and from finished concrete surfaces in order to provide the required concrete coverage.

J. Locate reinforcement to avoid interference with items drilled in later, such as concrete anchors.

K. Extend welded wire reinforcement to within 2 inches of edges of slab or section. Lap sheets at least 12 inches or two wire spaces, whichever is greater, at ends and edges and wire tightly together. Stagger end laps.

L. Unless shown otherwise on Drawings, place welded wire reinforcement in slabs on grade between the upper third point and mid-point of slab. Placing welded wire reinforcement on the subgrade and pulling it up during concrete placement is not permitted.

M. Support welded wire reinforcement placed over the ground on wired concrete blocks spaced not more than 3 feet on centers in any direction.

N. Support welded wire reinforcement placed over horizontal forms on slab bolsters spaced not more than 30 inches on center.

O. Mechanical coupler systems may be substituted for dowels at Contractor's option when permitted by Engineer.

P. Provide additional reinforcement bars to support ties and stirrups in beams where top reinforcement is not continuous.

Q. Securely support and tie reinforcement steel to prevent movement during concrete placement.

R. Unless otherwise shown on the Drawings or permitted by the Engineer, do not bend reinforcement bars that project from in-place concrete.

S. Do not weld reinforcement steel bars (including tack welded) either during fabrication or erection. Immediately remove bars that have been welded, including tack welds, without such permission from the work.

T. Reinforcement steel interfering with the location of other reinforcement steel, conduits or embedded items may be moved up to 3 inches. Make greater displacement of bars to avoid interference only with the permission of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior permission from the Engineer.

U. Setting bars and welded wire reinforcement on layers of fresh concrete as the work progresses or adjusting reinforcement during the placement of concrete is prohibited.

V. Provide and place safety caps on all exposed ends of vertical reinforcement that pose a danger to injury or life safety.

3.02 - REINFORCEMENT AROUND OPENINGS AND PENETRATIONS

A. Accommodate placement of formed openings and penetrations.

B. Unless specific additional reinforcement around openings and penetrations is shown on the Drawings, provide additional reinforcement steel on each side of opening or penetration equivalent to one half of the cross-sectional area of the reinforcement steel interrupted by an opening or penetration. The bars shall have sufficient length to be fully developed at each end beyond the opening or penetration.

C. Refer to details on Drawings for additional diagonal bars around openings or penetrations and bar extension length on each side of openings or penetrations.

3.03 - SPLICING OF REINFORCEMENT

A. Splices may be used to provide continuity due to bar length limitations. Do not splice reinforcement that is detailed to be continuous in the Drawings.

B. Provide tension lap splices at all laps in compliance with ACI 318. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Use Class B splices at all other locations.

C. Except as otherwise indicated on the Drawings, stagger splices in circumferential reinforcement in circular walls using Class B tension splices. Do not splice adjacent bars within the required lap length.

D. Make splices for reinforcement in tension tie members, with a full mechanical splice and staggered at least 30 inches.

E. Make splices in column spiral reinforcement, when necessary, by a lap of 1-1/2 turns.

F. Reinforcement shall be continuous through construction joints.

G. Reinforcement may be spliced at construction joints provided that entire lap is placed within only one concrete placement.

3.04 - ACCESSORIES

A. Provide accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcement steel is to be supported over soil.

C. Provide stainless steel bar supports or steel chairs with plastic tips where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity or liquid (including bottom of slabs over liquid containing areas) unless otherwise noted on contract documents.

D. Do not use metal chairs, ferrous clips, nails, etc. that extend to the surfaces of the concrete. Do not use stones, brick or wood block supports.

E. Do not use alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcement steel fastened to the bottom and top mats unless permitted by the Engineer.

F. Mechanical Couplers:

1. Couplers that are located at a joint face can be a type that can be set either flush or recessed from the face as indicated.

2. Seal couplers during concrete placement to completely eliminate concrete or cement paste from entering.

3. Recess couplers intended for future connections a minimum of 1/2 inch from the concrete surface. After the concrete is placed, plug the coupler with plastic plugs that have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials.

4. Unless indicated otherwise, provide mechanical coupler spacing and size to match the spacing and size of the reinforcement indicated for the adjacent section.

3.05 - FIELD QUALITY CONTROL

A. Remove reinforcement with kinks or bends not shown on shop or placement drawings. Remove such reinforcement from job site and replace with new fabricated steel. Do not field bend of reinforcement unless reinforcement is indicated or specified to be field bent.

B. Protect reinforcement from rusting, deforming, bending, kinking and other injury. Clean in-place reinforcement that has rusted, or been splattered with concrete using sand or water blasting prior to incorporation into the Work.

3.06 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 03250

CONCRETE JOINTS AND ACCESSORIES

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PART 1 - GENERAL

1.01 - SCOPE

A. This section describes materials, testing, and installation of concrete joints and accessories as specified and as shown on contract drawings.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification section number and title and Drawing numbers and titles.

1. Manufacturer's printed data and application instructions for specified materials and locations where materials are to be used.
2. Submit one sample of each type of water stop.
3. Submit layouts for joints.
4. Certification that materials used within the joint system are compatible with each other.

1.05 - PRODUCT HANDLING

A. Comply with the requirements of SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Transport, handle and deliver materials to the job site in the manufacturer's sealed bags, unopened containers or banded pallets.

C. Store materials off the ground on a platform or skids and protect with covers from snow, rain and ground splatter.

D. Store expansion joint compounds in a dry location where they cannot freeze.

E. Store plastic products under cover in a dry location, out of direct sunlight.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. Quality Assurance

1. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.
2. Do not add, relocate or omit joints without written permission from the Engineer.
3. Reject material exceeding expiration date for use.
4. Clean concrete surfaces to receive expansion joint compound in accordance with the printed instructions of the joint compound manufacturer.
5. In structures to contain potable water, use joint materials that are ANSI/NSF 61 approved for contact with potable water.

1.07 - REFERENCES

A. ASTM International (ASTM):

1. A276: Standard Specification for Stainless Steel Bars and Shapes.
2. C920: Specification for Elastomeric Joint Sealants
3. C1193: Guide for Use of Joint Sealants
4. D1752: Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. Environmental Protection Agency (EPA):

1. 40 CFR 59: National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.

C. Corps of Engineers:

1. CRD-C 572: Specifications for Polyvinylchloride Waterstop.

D. Federal Specifications:

1. TT-S-00230C: Sealing Compound: Elastomeric Type, Single Component

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

1.08 - MANUFACTURER'S SERVICES

A. Prior to joint preparation for joints receiving sealant materials, require joint manufacturer's technical representative to demonstrate, on site, joint preparation, priming, and sealant materials application for the Contractor's personnel performing joint work.

PART 2 - PRODUCTS

2.01 - ELASTOMERIC JOINT SEALANT

A. Federal Specification TT-S-00230C Type 1, Class A, single component, cold applied, pourable, polyurethane.

1. Products:
   a. Euclid Chemical Corp; Eucolastic 1
   b. Mameco ; Vulkem 45
   c. Or equal.

2.02 - JOINT SEALANT FOR CONCRETE STRUCTURES

A. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, gun grade polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25 for horizontal joints and Grade NS, Class 25 for vertical joints and be recommended by the manufacturer for continuous immersion in water. Troweling of sealants into joints will not be permitted. Sealant shall meet requirements in Table 03250-1.

TABLE 03250-1

Characteristic or Parameter	Technical Requirements
Pot life	1 to 3 hours
Hardness	35 Shore A, +/- 5
Elongation	650 percent, ASTM D412
Tensile strength	200 psi, ASTM D412
Peel strength on concrete	No adhesion loss at 25 pounds
Temperature service range	40 to 167 degrees F
Immersion in water	Continuous

B. Products:

1. Tremco; Vulkem 227 or Vulkem 245 (for Type M, Grade P, Class 25)
2. Sika Corporation; Sikaflex-2CNS (for Grade NS, Class 25), Sikaflex-2CSL
3. Or equal.

C. For applications on walls and surfaces inclined more than 30 degrees from the horizontal, use multi-component chemical resistant polysulfide sealant conforming to ASTM C920, Type M, Grade NS, Class 25.

1. Sonneborn ; Sonolastic Two-part
2. Tamms; Hornflex-L
3. DuPont; Cormax PSC
4. Or equal.

2.03 - EPOXY JOINT SEALANT

A. 100 percent solids per ASTM D1259, two-part epoxy with an instantaneous Shore D hardness of 50 to 65 per ASTM D2240.

1. Metzger-McGuire Co.; MM80 or Edge Pro50
2. Euclid Chemical Corp. ; Euco700
3. Or equal.

2.04 - BACKING ROD FOR EXPANSION JOINTS

A. Provide an extruded closed-cell polyethylene foam rod. The rod shall be 1/4-inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices.

1. Industrial Systems Department; Minicel backer rod
2. Hercules, Inc.; Plastic Products Group
3. Or equal.

2.05 - BOND BREAKER TAPE

A. Provide an adhesive-backed glazed butyl or polyethylene tape that will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

2.06 - PREFORMED CONTROL JOINT

A. One-piece, flexible, PVC joint former.

1. Vinylex Corp.; Kold-Seal Zip-Per Strip KSF-150-50-50

2. Or equal.

B. One-piece steel strip with preformed groove

1. Burke Concrete Accessories, Inc.; Keyed Kold Retained Kap

2. Or equal.

C. Provide the preformed control joint material in full-length unspliced pieces.

2.07 - PREMOLDED JOINT FILLER FOR PAVEMENTS AND SLABS

A. Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D1752, Type I

B. Bituminous-type preformed expansion joint filler conforming to ASTM D994.

2.08 - PREMOLDED JOINT FILLER FOR LIQUID CONTAINMENT STRUCTURES

A. Self-expanding cork per ASTM D1752, Type III.

B. Sponge Rubber per ASTM D1752, Type I. Preformed, nonextruded type constructed of closed-cell neoprene.

2.09 - EXPANSION JOINT DOWELS

A. Stainless steel bar dowels conforming to ASTM A276, Type 316.

B. Thoroughly grease expansion joint dowels prior to placing adjoining (2^{nd} placement) wall or slab concrete.

2.10 - STYROFOAM FILLER BLOCK

A. Styrofoam filler blocks for future construction and expansion joints.

1. Products:

a. Dow Chemical Company; Styrofoam SM brand

b. Or equal.

2.11 - VOC LIMITS FOR SEALANTS, AND SEALANT PRIMERS

A. VOC limits for sealants, and sealant primers to comply with content limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24), or applicable state and local codes containing more stringent requirements.

2.12 - BOND BREAKER FOR JOINT COMPOUNDS

A. Provide polyethylene tape.

PART 3 - EXECUTION

3.01 - JOINTS

A. Make joints only at locations shown on the contract drawings or as permitted by the Engineer. Any addition or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written permission.

B. Relocate additional joints where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. If a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footing or floor slabs.

C. Cast slabs and beams monolithically without horizontal joints unless specifically indicated on the drawings.

D. Do not use horizontal joints within foundation mats, base slabs, footings, pile caps, slabs on grade or elevated beams and slabs.

E. Provide joints in concrete fills and toppings at the same location as the joints in the supporting concrete.

F. Provide waterstops in all wall and slab joints in liquid containment structures and at locations shown on the contract Drawings. Do not provide metal waterstops unless permitted by Engineer.

G. Construction Joints

1. Provide flat ribbed waterstops at construction joints where shown on contract drawings and specified herein.

2. Allow 72 hours between placements of adjacent slabs.

3. Where joint key ways are shown on contract drawings form keyways by beveled strips or boards placed at right angles to the formed face. Except where otherwise shown on contract drawings or specified, keyways shall be at least 1-1/2 inches in depth over at least 25 percent of the width of the section.

4. After the placement has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose concrete, foreign material, and expose clean aggregate by sandblasting or waterblasting the surface of construction joints before placing the new concrete. Cover horizontal construction joints with mortar. Spread uniformly and work thoroughly into irregularities of the surface. The water-cement ratio of the mortar in place shall not exceed that of the concrete to be placed, and the consistency of the mortar shall be suitable for placing and working.

5. In case of emergency, place additional construction joints. (An interval of 45 minutes between two consecutive batches of concrete shall constitute cause for an emergency construction joint.)

H. Contraction Joints:

1. Do not use of control joints in liquid contain structures.

2. Provide 6-inch, center-bulb waterstop at contraction joints where shown on contract drawings and specified herein.

3. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker prior to placing new concrete against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.

4. Full contraction joints

a. Do not extend reinforcement or other embedded items bonded to the concrete (except stainless steel dowels bonded on only one side of joint) continuously through any expansion joint.

b. Where shown on contract drawings provide stainless steel expansion joint dowels. Secure stainless steel dowels tightly in forms with rigid ties. Orient dowels to permit joint movement.

5. Partial contraction Joints

a. Extend every other bar of reinforcement steel through partial contraction joints or as indicated on the drawings.

I. Control Joints:

1. Do not use of control joints in liquid containment structures.
2. Locate control joints as shown on the Contract Drawings.
3. Form control joints with control joint inserts or sawcuts.
4. For sawcutting:
   a. Using early entry saws, saw joints in slabs before the formation of uncontrolled cracking (i.e., cracking that occurs at locations other than construction, control, or contraction joints) and as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing.
   b. Fill saw cut to full depth with elastomeric joint sealant for joints not exposed to vehicular traffic. Fill joints to full depth with epoxy joint sealant for joints exposed to vehicular traffic.
5. Unless noted otherwise on the Contract Drawings, total reduction in concrete member thickness shall be at least 1/4 the member thickness.

J. Expansion Joints:

1. Size and location of expansion joints shall be as shown on the Contract Drawings.
2. Provide 9 inch, center-bulb waterstop at expansion joints where shown on contract drawings and specified herein.
3. Do not extend reinforcement or other embedded items bonded to the concrete (except stainless steel dowels bonded on only one side of joint) continuously through any expansion joint.
4. Install stainless steel expansion joint dowels parallel to wall or slab face, perpendicular to the joint face, and in true horizontal position. Secure stainless steel expansion joint dowels tightly in forms with rigid ties. Orient dowels to permit joint movement.

3.02 - INSTALLATION OF JOINT SEALANTS

A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.

B. Apply masking tape along the edges of the exposed surface of the exposed joints.

C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.

D. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.

E. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.

F. After the sealant has been applied, remove the masking tape and any sealant spillage.

G. Sealants used in water retaining structures shall achieve final cure at least seven days before the structure is filled with water.

3.03 - LEAKAGE TESTING

A. Test hydraulic structures in accordance with SECTION 03800, LEAKAGE TESTING OF CONTAINMENT STRUCTURES.

3.04 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 03300

CAST-IN-PLACE CONCRETE

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, equipment and incidentals required for the furnishing and installation of all materials required to provide Cast-in-Place Concrete as specified herein and/or as shown on the Contract Drawings.

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

C. Provide cast-in-place concrete for architectural, civil, mechanical, and electrical work as shown on the drawings or specified under specified under those disciplines.

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Product Data
    a. Manufacturer's specifications and instructions for all admixtures and curing materials. Manufacturer’s certification of compatibility of all admixtures.
2. Shop Drawings
    a. Provide certification that cement used complies with ASTM C150 and these specifications.
    b. Provide certification that aggregates comply with ASTM C33. Submit gradation analysis with concrete mix designs.

c. Provide certification of compliance with these specifications from the manufacturer of the concrete admixtures.

d. Prepare mix designs in accordance with ACI 318, except as modified herein.

1) Submit concrete mix designs, laboratory 7-day and 28-day compressive test results and laboratory shrinkage test results for review and approval by the Engineer.

2) Alternatively, submit test reports of 7- and 28-day compressive tests and shrinkage test results of the proposed mix where that same mix has been used on two previous projects in the past twelve months.

3) Do not use any concrete mixes in the work that have not been approved by the Engineer.

e. Plant Qualification Submit certification from the National Ready Mixed Concrete Association indicating compliance with the specified qualification requirements.

3. Test and Evaluation Reports

a. Provide results of drying shrinkage tests from trial concrete mixes by the Contractor's testing laboratory firm.

4. Manufacturers' Instructions

a. Provide epoxy bonding compound manufacturer's specific instructions for use. Provide manufacturer's certifications as to suitability of product to meet job requirements with regard to surface, pot life, set time, vertical or horizontal application, and forming restrictions.

5. Field Quality Control Submittals

a. Provide delivery tickets for ready-mix concrete or weigh masters certificate per ASTM C94, including weights of cement and each size aggregate and amount of water added at the plant and record of placements. Record the amount of water added on the job on the delivery ticket. Water added at the plant shall account for moisture in both coarse and fine aggregate and liquid admixtures.

b. Batch tickets shall include the following information

1) Load number, truck number and driver's name

2) Strength of concrete (compression strength)

3) Amount of concrete (cu. yds.)

4) Time truck was charged with cement

5) Revolution counter reading at first addition of water

6) Type, brand and amount of cement

7) Type, brand and amount of admixtures

8) Amount of water withheld at the plant (if any)

9) Information necessary to calculate total mixing water

10) Maximum size of aggregate

11) Weights of fine and coarse aggregates

12) Signature of ready-mix representative

13) Concrete temperature at batching plant

14) Type and amount of fly ash, other pozzolan or slag cement.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance.

B. Deliver concrete to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water- cementitious materials ratio, slump, air entrainment, temperature and homogeneity.

C. Reject concrete not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket.

1.06 - DESIGN CRITERIA

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE.

B. Concrete not meeting the minimum specified 28-day design strength shall be cause for rejection and removal from the work.

C. Perform concrete work in conformance with ACI 301 unless otherwise specified.

D. Do not use calcium chloride or admixtures containing calcium chloride.

E. Do not place concrete until design mix, material tests and trial concrete batch mix compression and shrinkage test results are approved by the Engineer. Approvals shall be obtained at least 30-days prior to the need for use on the job site.

F. The Contractor shall employ an independent testing laboratory, acceptable to the Engineer, to develop concrete mix designs and testing.

G. The Contractor shall employ an independent testing laboratory, acceptable to the Engineer, to test the conformity of materials proposed for use in the concrete mixes to the project specifications and to design and test concrete mixes proposed for use. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent. The Contractor shall allow free access to obtain test samples.

H. The Owner shall employ an independent testing laboratory, acceptable to the Engineer, to test conformity of materials placed into the work during construction. Concrete testing shall be performed by an ACI Concrete Field Technician, Grade I or equivalent. The Contractor shall allow free access to obtain test samples.

I. Methods of Sampling and Testing

1. Fresh Concrete Sampling - ASTM C 172
2. Specimen Preparation - ASTM C 31
3. Compressive Strength ASTM C 39
4. Air Content ASTM C 231
5. Slump ASTM C 143
6. Temperature ASTM C 1064
7. Unit Weight ASTM C 138
8. Obtaining Drilled Cores ASTM C 42
9. Drying Shrinkage ASTM C 157

J. Acceptance of Structure Acceptance of completed concrete work requires conformance with dimensional tolerances, appearance and strength as indicated or specified.

K. Hot weather concrete to conform to ACI 305 and as specified herein.

L. Cold weather concrete to conform to ACI 306 and as specified herein.

M. Reject concrete delivered to job site that exceeds the time limit specified.

N. Reject concrete delivered to job site that exceeds the concrete temperature limitations specified.

O. Do not place concrete in water or on frozen or uncompacted ground.

1.07 - REFERENCES

A. American Concrete Institute (ACI)

1. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
2. ACI 301 Specifications for Structural Concrete
3. ACI 304R Guide for Measuring, Mixing, Transporting and Placing Concrete
4. ACI 304.2R Placing Concrete by Pumping Methods
5. ACI 305.1 Specification for Hot Weather Concreting
6. ACI 306.1 Standard Specification for Cold Weather Concreting
7. ACI 308.1 Specification for Curing Concrete
8. ACI 318 Building Code Requirements for Structural Concrete
9. ACI 350 Code Requirements for Environmental Engineering Concrete Structures

B. ASTM International (ASTM) Publications

1. A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3. C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
4. C 33 Standard Specification for Concrete Aggregates
5. C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
6. C 40 Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
7. C 42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
8. C 87 Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
9. C 88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
10. C 94 Standard Specification for Ready-Mixed Concrete
11. C 109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or (50-mm) Cube Specimens)
12. C 123 Standard Test Method for Lightweight Particles in Aggregate
13. C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
14. C 138 Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
15. C 143 Standard Test Method for Slump of Hydraulic Cement Concrete
16. C 150 Standard Specification for Portland Cement
17. C 157 Standard Test Method for Length Change of Hardened Hydraulic Cement, Mortar and Concrete
18. C 171 Standard Specification for Sheet Materials for Curing Concrete
19. C 172 Standard Practice for Sampling Freshly Mixed Concrete
20. C 192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
21. C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
22. C 260 Standard Specification for Air-Entraining Admixtures for Concrete
23. C 289 Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)

24. C 295 Standard Guide for Petrographic Examination of Aggregates for Concrete
25. C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
26. C 311 Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
27. C 494 Standard Specification for Chemical Admixtures for Concrete
28. C 595 Standard Specification for Blended Hydraulic Cements
29. C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
30. C 881 Standard Test Method for Epoxy Resin Base Bonding Systems for Concrete
31. C 882 Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear
32. C 989 Standard Specification for Slag Cement for Use in Concrete and Mortars
33. C 1017 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
34. C 1064 Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
35. C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
36. C 1116 Standard Specification for Fiber Reinforced Concrete
37. C 1240 Standard Specification for Silica Fume Used in Cementitious Mixtures
38. C 1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
39. D 75 Standard Practice for Sampling Aggregates
40. E 154 Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
41. E 329 Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials used in Construction

C. American Association of State Highway and Transportation Officials (AASHTO)

1. M182 Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.

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

1.08 - SHRINKAGE TESTS

A. The testing laboratory shall perform drying shrinkage tests for the trial batches as specified herein. Shrinkage limitations apply only to concrete for liquid containing structures.

B. Fabricate, cure, dry, and measure specimens in accordance with ASTM C157 modified as follows

1. Remove specimens from molds at an age of 23 hours +/- 1 hour after trial batching, place immediately in water at 70 degrees F +/- 3 degrees F for at least 30 minutes, measure within 30 minutes thereafter to determine original length, and then submerge in saturated lime water at 73 degrees F +/- 3 degrees F.
2. At age seven-days, take measurements to determine expansion, expressed as a percentage of original length. This length at age seven-days shall be the base length for drying shrinkage calculations (zero-days' drying age).
3. Immediately place specimens in a humidity-controlled room maintained at 73 degrees F +/- 3 degrees F and 50 percent +/- 4 percent relative humidity for the remainder of the test.
4. Report measurements to determine shrinkage expressed as percentage of the base length separately for 7, 14, 21, and 28-days of drying after 7-days of moist curing.

C. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at zero-days' drying age) and the length after drying at each test age.

1. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001-inch at each test age.

2. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004-inch, disregard the results obtained from that specimen.

3. Report results of the shrinkage test to the nearest 0.001 percent of shrinkage.

D. Take compression test specimens in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project.

E. Acceptance of Test Results The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.028 percent or 0.032 percent, respectively.

1. Use only mix designs for construction that have first met the trial batch shrinkage and compression requirements.

2. If the trial batch specimens do not meet both the strength and shrinkage requirements, revise the mix designs and/or materials and retest.

1.09 - WORKABILITY

A. Concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.

1.10 - SITE CONDITIONS

A. Do not place concrete until conditions and facilities for making and curing control test specimens are in compliance with ASTM C 31 and as specified herein.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Cement

1. Portland cement, ASTM C150, Type II; or blended hydraulic cement, ASTM C595, Type IP (MS).

2. Type IP (MS) shall not be used for concrete to come in contact with potable water.

3. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.

4. Maximum tricalcium aluminate shall not exceed 8 percent. The maximum percent alkalis shall not exceed 0.6 percent.

B. Fly Ash

1. Provide fly ash conforming to the following requirements

a. Class F fly ash conforming to ASTM C 618 for chemical and physical properties.

b. Supplemental requirements in percent

(1) Maximum carbon content 3%

(2) Maximum sulfur trioxide (SO3) content 4%

(3) Maximum loss on ignition 3%

(4) Maximum water requirement (as a percent of control) 100%

(5) Fineness, maximum retained on No. 325 sieve 25%

C. Slag Cement

1. Slag cement, when used, shall meet the requirements of ASTM C989, Grade 100 or better.

D. Silica Fume

1. Silica fume, when used, shall meet the requirements of ASTM C1240.

a. Products

(1) BASF Corporation; MasterLife SF 100.

(2) Sika Corporation; Sikacrete 950DP

(3) Euclid Chemical Company; Eucoshot MSA

(4) Or equal.

E. Fine Aggregates

1. Clean, sharp, natural sand conforming to requirements of ASTM C33 with a fineness modulus between 2.50 and 3.0.

2. Aggregates sourced from locations known to contain Pyrrhotite or other deleterious materials shall not be acceptable.

F. Coarse Aggregate

1. Well graded crushed stone, natural rock conforming to requirements of ASTM C33.

2. Limit deleterious substances in accordance with ASTM C33, Table 3, Severe Weathering Regions, limit clay lumps not to exceed 1.0 percent by weight, and limit loss when tested for soundness using magnesium sulfate to 12 percent.

3. Test conformity of aggregate and confirm that aggregates intended for use in concrete are potentially non-reactive when tested in conformance with ASTM C 289.

4. Aggregates sourced from locations known to contain Pyrrhotite or other deleterious materials shall not be acceptable.

G. Water and Ice

1. Use water and ice free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances and conforms to requirements of ASTM C1602.

2. Water shall not contain more than 500 mg/L of chlorides or more than 500 mg/L of sulfate.

3. Heat or cool water to obtain concrete temperatures specified, and in conformance with ACI 305.1 and ACI 306.1.

H. Color Additive for Exterior Electrical Duct Encasement

1. For exterior electrical duct concrete encasements, use a color additive for identification purposes.

I. Concrete Admixtures

1. Maintain compressive strength and maximum water-cementitious materials ratios specified in Table 03300-1 when using admixtures. Include all admixtures in solution form in the water-cementitious materials ratio calculations. Do not use any admixture that contains intentionally-added chlorides or other corrosive elements. Admixtures shall be used in compliance with the manufacturer's printed instructions. The manufacturer shall certify the compatibility of multiple admixtures used in the same mix. Do not use admixtures in greater dosages than recommended by manufacturer.

2. Air Entrainment

a. Air-entraining admixture shall conform to ASTM C260.

b. Products

(1) BASF Corporation – MasterAir AE 90, MasterAir VR 10, or MasterAir AE 200

(2) Sika Corporation, AER.

(3) WR Grace & Co.; Darex II-AEA

(4) Or equal.

c. Adjust the admixture content to accommodate fly ash or other pozzolan requirements, and other admixtures when used, in order to obtain the specified air content.

3. Water Reducing

a. Water-reducing admixture shall conform to ASTM C494, Type A and be compatible with the air-entraining admixture.

b. Products

(1) BASF Corporation; MasterPozzolith Series or MasterPolyHeed Series

(2) Sika Corporation, Plastocrete 161

(3) WR Grace & Co.; Daracem 65

(4) Euclid Chemical Company; Eucon NW

(5) Or equal.

4. Water Reducing and Retarding

a. Water-reducing and retarding admixture shall conform to ASTM C494, Type D and compatible with the air-entraining admixture.

b. Products

(1) BASF Corporation; MasterPozzolith Series

(2) Sika Corporation; Plastiment

(3) WR Grace & Co.; WRDA 64

(4) Or equal.

5. Accelerating

a. The use of accelerating admixtures is not permitted.

6. High-Range Water-Reducing Admixture (Superplasticizer)
    a. High-Range water-reducing admixture shall conform to ASTM C494, Type F or ASTM C1017, Type I.
    b. Products
        (1) BASF Corporation; MasterRheobuild 1000 or MasterGlenium Series
        (2) WR Grace & Co.; Daracem 100
        (3) Euclid Chemical company; Eucon SPC
        (4) Or equal.
7. Workability-Retaining Admixture
    a. Workability-enhancing admixture shall conform to ASTM C 494, Type S.
    b. Products
        (1) BASF Corporation – MasterSure Z 60
        (2) WR Grace & Co.; Adva XT2
        (3) Or equal.
8. Shrinkage Reducing Admixture
    a. Shrinkage-reducing admixture is permitted to be used in the mix to meet shrinkage limitations provided that specified strength are met and there is no reduction in sulfate resistance and no increase in permeability. Quantity of shrinkage-reducing admixture used in the mix shall be added to the quantity of water for purposes of determining the water/cementitous materials ratio.
    b. Products
        (1) BASF Corporation; MasterLIFE SRA 20
        (2) WR Grace & Co.; Eclipse 4500
        (3) Euclid Chemical company; Eucon SRA
        (4) Or equal.

K. Fiber Reinforcement
1. Fiber reinforcing shall conform to ASTM C 1116, Type III.
2. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement
3. Dosage Rate Volume of fibers shall be a minimum of 3 pounds per cubic yard.
4. Physical Characteristics
    a. Specific gravity 0.91
    b. Tensile strength 40,000 to 110,000 psi
    c. Minimum Fiber length 1/2-inch

5. Fibrous concrete reinforcement materials provided in this section shall produce concrete conforming to the requirements for strength of concrete specified.
    a. Products
        (1) BASF Corporation “MasterFiber MAC” Series
        (2) WR Grace & Co. STRUX 90/40
        (3) Propex Operating Company,LLC Enduro 600
        (4) Or equal.

L. Epoxy Bonding Agent
1. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures.
2. Products
    a. Sika Corp.; Sikadur 32 Hi-Mod
    b. Euclid Chemical Company; Duralcrete
    c. BASF Corporation; MasterEmaco ADH 326
    d. Or equal

M. Vapor Retarder 10 mil polyethylene sheet conforming to ASTM E 154

N. Curing Compound
1. Liquid form, which will form impervious membrane over, exposed surface of concrete when applied to fresh concrete by means of spray gun. Compound shall not inhibit future bond of floor covering or concrete floor treatment. Use Type I-D compound with red fugitive dye, Class B, having 18 percent minimum solids conforming to ASTM C 309.
2. Products
    a. BASF Corporation; MasterKure EC 1315
    b. Euclid Chemical Company; Super Diamond Clear VOX
    c. W. R. Meadows, Inc.; VOCOMP-30
    d. Dayton Superior Corp; Safe Cure and Seal 30% J23UV
    e. Or equal.

O. Burlap Mats
1. Conform to AASHTO M182.

P. Sisal-Kraft Paper and Polyethylene Sheets for Curing
1. Conform to ASTM C171.

2.02 - MIXES

A. Conform to ASTM C94, except as modified by these specifications.

B. Air content as determined by ASTM C231

5 ± 1 1/2 percent for concrete using 1 1/2-inch maximum aggregate size.

6 ± 1 1/2 percent for concrete using 3/4-inch maximum aggregate size.

C. Provide concrete with the following compressive strengths at 28-days and proportion it for strength and quality requirements in accordance with ACI 318. The resulting mix shall not conflict with limiting values specified in Table 03300-1.

Table 03300-1

Type of Work	28-Day Minimum Compressive Strength (in psi)	Maximum Water/Cement Ratio
Concrete for liquid containing	4,500	0.42
Precast concrete	5,000	0.40
Prestressed concrete	6,000	0.40
Concrete (fiber reinforced) fill, topping and miscellaneous unreinforced concrete	4,000	0.54
Pavement	3,000	0.54
Mud mats and concrete under foundations	1,500	0.76
Concrete not otherwise specified	4,000	0.44

D. Measure slump in accordance with ASTM C143

1. Proportion and produce the concrete to have a maximum slump of 4-inches. A tolerance of up to 1-inch above the indicated maximum is allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.
2. Mixes containing water reducers shall have a maximum slump of 6-inches after the addition of a mid-range water reducer and maximum slump of 8-inches after the addition of a high range water reducer.

E. Pozzolan Content

1. Fly ash shall not exceed 20 percent of the total cementitious content.
2. Slag cement will be permitted as a substitute for fly ash at no additional cost to the Owner, in the event that Class F Fly Ash is not available. The slag substitution shall be in the same proportions and percentages of the total cementitious material as shown for fly ash.
3. Use silica fume concrete where indicated on the drawings. Silica fume not to exceed 10 percent of the total weight of the silica fume plus cement.

F. Aggregate Size

1. The maximum aggregate size shall be
   a. 1 1/2-inches for walls greater than 18-inches in thickness, grade beams, footings, foundation mats, and base slabs.
   b. 3/8-inches for floor fill in clarifiers, in congested areas where approved by the engineer, for fireproofing around structural steel beams and columns and to fill cored holes.
   c. 3/4-inches for all other concrete.
2. Combined aggregate grading shall be as specified in Table 03300-2.

Table 03300-2

Maximum Aggregate Size	1 1/2-inch	1-inch	3/4-inch	3/8-inch
Aggregate Grade per ASTM C33	467	57	67	8

PART 3 - EXECUTION

3.01 - INSPECTION

A. Contractor shall examine the substrate and the conditions under which work is to be performed and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions are corrected in a manner acceptable to the engineer.

3.02 - MIXING AND TRANSPORTING CONCRETE

A. General. Conform to concreting procedures set forth in ASTM C 94, ACI 304R and as specified herein.

1. Transport concrete to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

2. Discharge concrete into forms within 1-1/2 hours after cement has entered mixing drum or before the drum has revolved 300 revolutions after the addition of water, whichever occurs first.

3. Do not add water at the jobsite unless permitted by the engineer. If it is necessary to add water to obtain the specified slump, add water per ASTM C 94, but do not exceed the amount of water that has been held back at the plant. Added water shall be incorporated by additional mixing of at least 35 revolutions. Quality control sampling shall be done after the water has been added and the batch thoroughly mixed.

4. Do not add water to concrete containing high range water reducing admixture.

5. Keep a record showing time and place of each placement of concrete, together with transit-mix delivery slips certifying the contents of the placement.

6. Discharge of concrete shall be completed within the limits set out in Table 03300-3.

Table 03300-3

MAXIMUM TIME TO CONCRETE DISCHARGE

Concrete Temperature	Limit
Over 90 Degrees F	Remove concrete from jobsite and discard concrete
86 to 90 Degrees F	45 minutes
81 to 85 Degrees F	60 minutes
70 to 80 Degrees F	75 minutes
Below 70 Degrees F	90 minutes

B. Conveying. Convey concrete from agitator or mixer truck to place of final deposit in forms by one of the following methods

1. Buckets or hoppers with discharge gates having a clear opening equal to not less than one-third the maximum interior horizontal area or five times the maximum aggregate size being used, whichever is greater, and side slopes of not less than 60 degrees to horizontal.

2. Buggies or wheelbarrows equipped with pneumatic tires.

3. Round bottom, metal or metal-lined chutes with inclined slope of between two to three feet horizontally to one foot vertically and of sufficient capacity to avoid overflow.

4. Circular drop pipes with a top diameter of at least eight times the maximum aggregate size, but not less than 6-inches, or tapered to not less than six times maximum aggregate size.

3.03 - CONCRETE ACCEPTANCE

A. The Contractor shall accept or reject each batch of concrete delivered to the point of agitator or mixer truck discharge. The signature of a Contractor's authorized representative on the delivery batch ticket shall indicate concrete acceptance.

B. The Contractor shall reject concrete delivered without a complete concrete delivery batch ticket as specified herein. The concrete supplier will furnish copies of the signed batch ticket to the Contractor and Engineer.

C. The testing agency shall perform field tests at the point of agitator or mixer truck discharge. Accept or reject concrete on the basis of conformity with slump, air content and temperature specified.

D. The testing agency shall inspect concrete transit truck's barrel revolution counter and gauge for measuring water added to the concrete. Reject concrete which exceeds the maximum barrel revolution of 300, the limits in Table 03300-3 or concrete that has water content exceeding the specified water-cement ratio.

E. The Contractor shall reject concrete not conforming to specification before discharging into the forms.

3.04 - PREPARATION AND COORDINATION

A. Contractor shall notify the Engineer or the Engineer's Representative of readiness to place concrete in any portion of the work a minimum of 48 hours prior to concrete placement. Failure to provide this notification will be cause for delay in placing until inspections can be completed and arrangements for testing established.

B. All reinforcement, installation of waterstop, positioning of embedded items, and condition of formwork shall be inspected by the Engineer or the Engineer's representative prior to concrete placement.

C. Coordinate the sequence of placement to assure that construction joints will occur only where indicated on the drawings.

D. Schedule sufficient equipment for continuous concrete placement. Provide for backup equipment and procedures to be implemented in case of an interruption in placement.

E. Compact the subbase and/or bedding. The subbase and/or bedding shall be uniformly moist at the time of concrete placement. Spraying water on the subbase and/or bedding may be necessary prior to placement of concrete. Concrete shall not be placed on standing water, mud, and foreign matter.

F. Provide mud slabs to obtain a dry and stable working platform for placement of slabs on grade and foundation mats as indicated on the drawings or as may be required.

G. Install a granular base beneath slabs on ground where shown on contract drawings, Place granular material on a compacted subgrade and compact the granular base.

H. Place vapor retarder under structural slabs and buildings and where shown on contract drawings. Install material with 6-inch lap at joints and seal joints with tape as recommended by the vapor retarder manufacturer. Tape material cut for slab penetrations to the pipe, conduit or other items passing through the slab. Use tape recommended by the vapor retarder manufacturer.

I. Install vapor retarder without punctures or tears and protect against punctures and breaks.

J. Where concrete is required to be placed and bonded to existing concrete, coat the contact surfaces with epoxy bonding agent. The method of preparation and application of the bonding agent shall conform to the manufacturer's recommendations.

3.05 - JOINTS AND EMBEDDED ITEMS

A. Provide construction and expansion joints as specified in SECTION 03250, CONCRETE JOINTS AND ACCESSORIES.

1. Clean all construction joints to remove loose concrete and laitance before placing adjoining concrete. Do not damage exposed concrete edges, key grooves, waterstops or reinforcement.

2. Intentionally roughen surfaces of set concrete to receive new concrete to 1/4-inch amplitude in a manner to expose bonded aggregate uniformly at joints.

3. Do not place concrete against construction joints for at least 72 hours after initial concrete set.

B. Embedded Items

1. Secure castings, inserts, conduits and other metalwork encased in concrete to prevent them from being displaced or deformed during concrete work. Use templates to secure items in place.

2. Clean embedded items of oil and all foreign matter.

3. Install inserts, anchors, sleeves and other items into formwork where indicated or specified under other sections of these specifications.

4. Build dovetail anchor slots into new concrete against which facing brick, concrete masonry units, tile, stone or any type ashlar is to be installed. Provide vertically at 16-in. centers where facing brick, etc., passes by concrete. Provide one continuous anchor slot where facing brick, etc., abuts the concrete work.

5. Aluminum embedded in concrete shall be coated to prevent galvanic corrosion with a zinc chromate primer and one of the following products

a. Bitumastic Super Service Black by Koppers Co., Inc.

b. Tarmastic 100 by Porter Coatings Division, Porter Paint Co.

c. 450 Heavy Tnemecol by Tnemec Company.

d. Or equal.

6. Check location and support of piping, electrical conduits and other embedded items before depositing concrete. Correct locations as required and secure in place.

7. Complete required tests on embedded piping before starting concrete placement.

C. Embedded Pipes and Conduit

1. Embedded pipes and conduit in concrete shall conform to the requirements and limitations of ACI 318, ACI 350 and these specifications and shall be as approved by the engineer.

2. Conduits, pipes, and sleeves of any material not harmful to concrete and within the limitations specified herein shall be permitted to be embedded in concrete with the approval of the Engineer.

3. Conduits and pipes of aluminum shall not be embedded in concrete.

4. Pipes passing through walls of a liquid-containing structure shall include an integral waterstop.

5. Conduits, pipes, and sleeves passing through a slab, wall, or beam shall not impair significantly the strength of the construction.

6. Conduits and pipes, with their fittings, embedded within a column shall not displace more than 4 percent of the area of cross section.

7. Except when drawings for conduits and pipes are approved by the structural engineer, conduits and pipes embedded within a slab, wall, or beam (other than those merely passing through) shall satisfy the following:
    a. Conduits and pipes shall not be larger in outside dimension than 1/3 the overall thickness of the slab, wall, or beam in which they are embedded.
    b. Conduits and pipes shall not be spaced closer than 3 times the outside diameters on center.
    c. Conduits and pipes shall be placed within the middle third of the element and between reinforcement layers. Do not install runs of piping or conduit between formwork and reinforcement.
    d. Avoid crossing pipes and conduit in concrete.
8. Pipes and fittings shall be designed to resist the effects of the material, pressure, and temperature to which they will be subjected.
9. No liquid, gas, or vapor, except water not exceeding 90 degrees F or 50 psi pressure, shall be placed in the pipes until the concrete has attained its design strength.
10. Reinforcement with an area not less than 0.002 times area of concrete section shall be provided perpendicular to piping or conduit at a maximum spacing of 12-inches.
11. Piping and conduit shall be so fabricated and installed that cutting, bending, or displacement of reinforcement from its proper location will not be required.
12. Close ends of conduits, piping and sleeves embedded in concrete with caps or plugs prior to concrete placement.

3.06 - CONCRETE PLACEMENT

A. Placement shall conform to ACI 304R as modified by these specifications.

B. Intentionally roughen surfaces of set concrete to receive new concrete to ¼" amplitude in a manner to expose bonded aggregate uniformly at joints.

C. Do not place adjacent sections of walls and slabs until seven-days after placement of the previously placed concrete.

D. Do not place concrete until all free water has been removed from the forms, clear of the work. Do not permit free or storm water to flow over surfaces of concrete so as to injure the quality or surface finish.

E. Do not place concrete during inclement weather. Protect concrete placed from inclement weather. Keep sufficient protective covering ready at all times for this purpose.

F. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing. Do not deposit concrete in large quantities in one place to be worked along the forms with a vibrator.

G. Deposit concrete continuously and in level layers 1 to 2 feet thick. Avoid inclined layers and cold joints. Place concrete at lower portion of slope first on sloping surfaces.

H. Do not deposit partially hardened concrete in forms. Retempering of partially hardened concrete is not permitted. Remove all partially hardened concrete from site at no additional compensation.

I. Do not allow concrete to fall freely in forms to cause segregation (separation of coarse aggregate from mortar). Limit maximum free fall of concrete to 4 feet. Do not move concrete horizontally more than four feet from point of discharge. Space points of deposit not more than eight feet apart.

J. At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise shown on contract drawings.

K. Consolidate concrete using mechanical vibrators operated within the mass of concrete and/or on the forms conforming to procedures set forth in ACI 309R and as specified herein.

L. Conduct vibration to produce concrete of uniform texture and appearance, free of honeycombing, streaking, cold joints or visible lift lines.

M. Conduct vibration in a systematic manner with regularly maintained vibrators. Furnish sufficient backup units at job site. Use vibrators having minimum frequency of 8,000 vibrations per minute and of sufficient amplitude to consolidate concrete. Use not less than one vibrator with crew for each 35 to 40 cubic yards of concrete placed per hour.

N. Insert and withdraw vibrator vertically at a uniform spacing over the entire area of placement. Space distances between insertions such that spheres of influence of each insertion overlap.

O. Use additional vibration with pencil vibrators on vertical surfaces and on all exposed concrete to bring full surface of mortar against the forms so as to eliminate air voids, bug holes and other surface defects. Employ the following additional procedures for vibrating concrete as necessary to maintain proper consolidation of concrete

1. Reduce distance between internal vibration insertions and increase time for each insertion.
2. Insert vibrator as close to face of form as possible without contacting form or reinforcement.
3. Thoroughly vibrate area immediately adjacent to waterstops without damaging the waterstop.
4. Use spading as a supplement to vibration where particularly difficult conditions exist.

P. Pumping Concrete

1. Conform to the recommendations of ACI 304.2R except as modified herein.
2. Use equipment and procedures and schedule deliveries to maintain steady flow of concrete at the discharge end of pipe.
3. Maintain concrete properties of slump, air content and temperature. Make adjustments in concrete proportions as necessary to provide concrete properties in accordance with the approved concrete design mix and as specified herein.
4. Use pipe with inside diameter of at least three times the maximum coarse aggregate size, but not less than 4-inches.
5. Do not use aluminum pipes for delivery of concrete to the forms.
6. Take samples at the point of agitator or mixer truck discharge.
7. Furnish labor and assistance as required by the testing laboratory in obtaining and handling test specimens.

3.07 - CURING AND PROTECTION

A. General

1. Protect concrete from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.
2. Comply with curing procedures set forth in ACI 301, ACI 308.1 and as specified herein.
3. Perform hot weather concreting in conformance with ACI 305.1 and as specified herein when the ambient atmospheric temperature is 80 degrees F or above.
4. Perform cold weather concreting in conformance with ACI 306.1 and as specified herein when the ambient atmospheric temperature is 40 degrees F or below.
5. Concrete required to be moist cured shall remain moist for the entire duration of the cure. Repeated wetting and drying cycles of the curing process will not be allowed.

B. Curing Duration

1. Start initial curing after placing and finishing concrete as soon as free moisture has disappeared from unformed concrete surfaces. Initial curing starts as soon as concrete achieves final set. Forms left tightly in place are considered as part of the curing system, provided that wooden forms are kept continuously moist. Keep continuously moist for not less than 72 hours.

2. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7-days and in accordance with ACI 301 procedures for a total curing period, initial plus final, of at least 10-days.

3. Avoid rapid drying at the end of the final curing period

C. Curing Requirements

1. Unformed Surfaces Cover and cure entire surface of newly placed concrete immediately after completing finishing operations and water film has evaporated from surface or as soon as marring of concrete will not occur. Protect finished slabs from direct rays of the sun to prevent checking, crazing and plastic shrinkage.

2. Formed Surfaces. Minimize moisture loss for formed surfaces exposed to heating by the sun by keeping forms wet until safely removed. Keep surface continuously wet by warm water spray or warm water saturated fabric immediately following form removal.

3. Liquid containing and below grade structures. Moist cure by the application of water to maintain the surface in a continually wet condition. Use water that is free of impurities that could etch or discolor exposed concrete surfaces.

4. Other concrete Moist cure by moisture-retaining cover curing, or by the use of curing compound.

D. Curing Methods

1. Water Curing Use water curing for unformed surfaces. Continuously water cure all exposed concrete for the entire curing period. Provide moisture curing by any of the following methods

   a. Keeping the surface of the concrete continuously wet by ponding or immersion.

   b. Continuous water-fog spray or sprinkling.

   c. Covering the concrete surface with curing mats, thoroughly saturating the mats with water, and keeping the mats continuously wet with sprinklers or porous hoses. Place curing mats so as to provide coverage of the concrete surfaces and edges, with a 4-inch lap over adjacent mats. Weight down the curing cover to maintain contact with the concrete surface, as necessary.

2. Sealing Materials

   a. Use common sealing materials such as plastic film or waterproofing (kraft) paper when permitted by the Engineer.

   b. Lap adjacent sheets a minimum of 12-inches. Seal edges with waterproof tape or adhesive. Use sheets of sufficient length to cover sides of concrete member.

   c. Place sheet materials only on moist concrete surfaces. Wet concrete surface with fine water spray if the surface appears dry before placing sheet material.

   d. The presence of moisture on concrete surfaces at all times during the prescribed curing period is proof of acceptable curing using sheet material.

3. Membrane Curing Compound

   a. Apply membrane-curing compound uniformly over concrete surface by means of roller or spray at a rate recommended by the curing compound manufacturer, but not less than 1 gallon per 150 sq. ft. of surface area. Agitate curing material in supply container immediately before transfer to distributor and thoroughly agitate it during application for uniform consistency and dispersion of pigment

   b. Do not use curing compounds on construction and expansion joints or on surfaces to receive liquid hardener, dustproofer/sealer, concrete paint, tile, concrete fills and toppings or other applications requiring positive bond.

   c. Reapply membrane-curing compound to concrete surfaces that have been subjected to wetting within 3 hours after curing compound has been applied by method for initial application.

E. Protection from environmental conditions. Maintain the concrete temperature above 50 degrees F continuously throughout the curing period. Make arrangements before concrete placing for heating, covering, insulation or housing as required to maintain the specified temperature and moisture conditions continuously for the curing period.

1. When the atmospheric temperature is 80 degrees F and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture-retaining covering.

2. Protect the concrete continuously for the entire curing period.

3. Maintain concrete temperature as uniformly as possible and protect from rapid atmospheric temperature changes.

4. Avoid temperature changes in concrete that exceed 5 degrees F in any one hour and 50 degrees F in any 24-hour period.

F. Protection from physical injury Protect concrete from physical disturbances such as shock and vibration during curing period. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water. Do not load concrete in such a manner as to overstress concrete.

G. Protection from Deicing Agents Do not apply deicing chemicals to concrete.

3.08 - FIELD QUALITY CONTROL

A. Hot Weather Requirements

1. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305.1 and the following.

2. When the weather is such that the temperature of the concrete as placed would exceed 90 degrees F, use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 90 degrees F.

3. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the-day, and the proper and timely application of specified curing methods.

4. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

B. Cold Weather Requirements

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306.1 and the following.

2. When the temperature of the surrounding atmosphere is 40 degrees F or is likely to fall below this temperature, use heated mixing water not to exceed 140 degrees F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

3. When placed in the forms during cold weather, maintain concrete temperature at not less than 55 degrees F. All materials shall be free from ice, snow, and frozen lumps before entering the mixer.

4. Maintain the air and the forms in contact with the concrete at temperatures above 40 degrees F for the first five-days after placing, and above 35 degrees F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature.

5. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

C. Backfill Against Walls

1. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.

2. Do not backfill the walls of structures that will be laterally restrained or supported by suspended slabs or slabs on grade until the slab is placed and the concrete has reached the specified compressive strength.

D. Concrete Testing

1. Concrete Quality Test Specimen

a. Perform sampling and curing of test specimen in accordance with ASTM C31.

b. Testing agency personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content and temperature.

c. For each 50 cu. yd. of each mix design of concrete but not less than once a-day nor less than once for each 5,000 sq. ft. of surface area of foundation mats, base slabs, footings, pile caps, slabs on grade, grade beams, walls, or elevated slabs, the testing agency will cast a minimum of

(1) One set of four (4) 6”x12” test specimens or

(2) One set of seven (7) 4”x8” test specimens

d. Once a cylinder size has been selected, the size and number of specimens representing a strength test for each concrete mix shall remain constant.

e. For 6”x12” test cylinders

(1) The testing agency will compression test one (1) of each set of four 6”x12” specimens at 7-days.

(2) Test two (2) of the remaining cylinders at 28-days for concrete strength acceptance.

(3) The fourth cylinder shall be held for testing at 56-days only if the 28-day cylinder strengths are deficient. The fourth cylinder of each set shall be discarded if the 28-day strengths meet or exceed the specified minimum strength.

f. For 4”x8” test cylinders

(1) The testing agency will compression test two (2) of each set of seven 4”x8” specimens at 7-days.

(2) Test three (3) of the remaining cylinders at 28-days for concrete strength acceptance.

(3) The last two cylinders shall be held for testing at 56-days only if the 28-day cylinder strengths are deficient. The 6^{th} and 7^{th} cylinders of each set shall be discarded if the 28-day strengths meet or exceed the specified minimum strength.

2. The laboratory firm shall immediately notify the Contractor and the Engineer if the seven-day strength is deficient.

3. The acceptance test result is the average of the strengths of the two specimens tested at 28-days.

4. The laboratory firm shall submit compression test results to both the Contractor and the Engineer. Concrete acceptance shall be based on the requirements of ACI 318 and ACI 350.

5. Field cured cylinders conforming to ASTM C31 will be required to determine field compressive strength of concrete. Laboratory cured cylinders for concrete quality testing shall not be used for determining field compressive strength.

E. Concrete Coring

a. When the concrete quality test specimen compression tests fail to be in compliance with the Contract Documents or when the Engineer detects deficiencies in the concrete, the Contractor will take concrete cores at least 4-inches in diameter from the structure in conformance with ASTM C 42 at locations determined by the Engineer.

b. Obtain at least three representative cores from each member or area of concrete that is considered potentially deficient.

c. Obtain additional cores to replace cores that show evidence of having been damaged subsequent to or during removal from the structure.

d. The testing agency shall compression test the cores taken from the structure in conformance with ASTM C 39 and submit test strength test results of cores specified above to the Contractor and to the Engineer.

e. All costs associated with coring and testing of cores will be borne by the Contractor at no additional cost to the Owner.

3.09 - REPAIRS

A. Provide in accordance with SECTION 03730, CONCRETE REPAIR.

3.10 - CONCRETE FINISHES

A. Do not use curing compound where epoxy, urethane, mortar bed, grout, additional concrete or other toppings or adhesive will be applied.

B. Do not sprinkle with dry cement or add water when finishing concrete surfaces.

C. Finish concrete surfaces in accordance with the following schedule

Table 03300-4	
Finish Designation	**Area Applied**
F-1	Beams, columns, and exterior walls not exposed to liquids or view.
F-2	Walls, beams, and columns exposed to liquids. EXCEPTION surfaces that are to be coated.
F-3	Walls, beams, and columns exposed to view and to 1 foot below liquid level or finished grade. Underside of formed floors or slabs. EXCEPTION surfaces that are to be coated.
F-4	Exterior and interior surfaces to be coated.
S-1	Slabs and floors to be covered with concrete or grout.
S-2	Slabs and floors not liquid containing.
S-3	Slab surfaces on which mechanical equipment moves. Slab surfaces to receive sealer or hardener shall be prepared in accordance with product manufacturer's requirements.
S-4	Slabs and floors exposed to view, which are liquid containing, or are to receive crystalline waterproofing.
S-5	Slabs and floors at slopes greater than 10% and stairs.
E-1	Exposed edges.
E-2	Top of walls, beams, and similar unformed surfaces.

1. Finish F-1 Repair defective concrete, fill depressions deeper than 1/2-inch, and fill tie holes.
2. Finish F-2 Repair defective concrete, remove fins, fill depressions 1/4-inch or deeper, and fill tie holes.
3. Finish F-3 In addition to Finish F-2, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume, over the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.
4. Finish F-4 Repair defective concrete, remove fins, fill depressions 1/16-inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16-inch.
5. Finish S-1 Screed to grade without special finish unless otherwise shown on contract documents. Roughen and/or apply bonding agent where shown on contract drawings.
6. Finish S-2 Smooth steel trowel finish.
7. Finish S-3 Steel trowel finish free from trowel marks and all irregularities.
8. Finish S-4 Steel trowel finish without local depressions or high points. For liquid containing slabs apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.
9. Finish S-5 Steel trowel finish without local depressions or high points. Apply a stiff bristle broom finish. Leave broom lines parallel to the direction of slope drainage.
10. Finish E-1 Provide 3/4-inch chamfer on external corners of exposed concrete walls, beams columns, equipment pads and exposed edges of construction joints. Do not chamfer columns flush with concrete block walls.
11. Finish E-2 Strike smooth and float to an F-3 or F-4 finish.

D. Protect finished concrete surfaces from damage by construction equipment, materials, curing procedures and rain or running water.

3.11 - FINISHING OF FORMED SURFACES

A. Cure surfaces until finishing and repairing are completed.

B. Perform finish work in accordance with the schedule in the section herein, Table 03300-4, as soon as possible after forms are removed.

C. Conform to the requirements specified in SECTION 03100, CONCRETE FORM WORK.

3.12 - FINISHING OF UNFORMED SURFACES

A. Perform finish work in accordance with the schedule in SECTION 03350, CONTROLLED LOW STRENGTH MATERIAL Table 03350-1.

B. Provide S-3 steel-trowel finish to all top, horizontal and inclined surfaces not otherwise specified or indicated. This includes concrete fills and toppings and floors. Provide hand steel-trowel finish to all surfaces such as weirs or walls over which liquids will flow.

C. Provide S-5 broom finish to exterior walkways, exterior stairs, entrance platforms and loading docks.

3.13 - CLOSEOUT ACTIVITIES

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

END OF SECTION

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SECTION 03350

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

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PART 1 - GENERAL

1.01 - SCOPE

A. Provide and install controlled low strength material as indicated and specified.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification section number and title and Drawing numbers and titles.

1. CLSM mix design and results of strength tests from trial mixes by the Contractor's testing laboratory firm.
2. Submit manufacturer’s Stable-Air Generator Admixture product data, installation instructions and recommendations for material use.
3. Test and Performance - Submit the following data:
    a. Any required deviations from prescribed tests and special handling instructions for test specimens.
    b. Controlled Low Strength Material shall have a maximum strength of 200 psi according to ASTM C39 at 56 days after placement.
    c. Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a final bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4” per foot of depth) as measured in Section 10 of ASTM C940.
    d. Controlled Low Strength Material shall have a unit weight of 90 - 110 lbs./ft^3 measured at the point of placement.

1.05 - PRODUCT HANDLING

A. Comply with the requirements of SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Order CLSM from batching plant so that trucks arrive at discharge locations when material is required.

C. Deliver CLSM to discharge locations in watertight agitator or mixer trucks without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

D. Reject CLSM not conforming to specification, unsuitable for placement, exceeding the time or temperature limitations or not having a complete delivery batch ticket

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. Quality Assurance

1. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.
2. Sustainability Standards Certifications.
3. Do not place CLSM until design mix, material tests and trial batch mix compression test results are approved by the Engineer. Approvals are required at least 30 days before placing any production CLSM.
4. Employ an independent testing laboratory, acceptable to the Engineer to test conformity of materials to specifications and to design CLSM mixes.
5. Furnish, pay for and deliver representative samples of sufficient quantity of cement, aggregates and admixtures required for trial batch mixes to the testing laboratory. Obtain materials from the batching plant that will be supplying production CLSM in conformance with ASTM D75.
6. Measure all materials for CLSM, including water, with equipment and facilities suitable for accurate measurement and capable of being adjusted in conformance with ASTM C94. Use scales certified by local Sealer of Weights and Measures within one year of use and accurate when static load tested to plus or minus 0.4 percent of total capacity of scale. Batch all materials by weight except admixtures that may be batched by volume.
7. The testing laboratory will take control test specimens; conduct slump tests and measure air content and temperature in the field.
8. Methods of Sampling and Testing:
    a. Fresh Concrete Sampling: ASTM C172.
    b. Specimen Preparation: ASTM C31.
    c. Compressive Strength: ASTM C39.
    d. Air Content: ASTM C231.
    e. Slump: ASTM C143.
    f. Temperature: ASTM C1064.
    g. Unit Weight: ASTM C138.

D. Project/Site Conditions

1. Do not place CLSM until conditions and facilities for making and curing control test specimens are in compliance with ASTM C31 and as specified herein.

1.07 - REFERENCES

A. American Concrete Institute (ACI):

1. 229R: Controlled Low-Strength Materials
2. 301: Specifications for Structural Concrete
3. 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete
4. 305R: Hot Water Concreting.
5. 306R: Cold Water Concreting
6. 308: Standard Practice for Curing Concrete
7. 318: Building Code Requirements for Structural Concrete and Commentary

B. ASTM International (ASTM):

1. C31: Practice for Making and Curing Concrete Test Specimens in the Field
2. C33: Specification for Concrete Aggregates
3. C39: Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. C94: Standard Specification for Ready-Mixed Concrete
5. C138: Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
6. C143: Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. C150: Standard Specification for Portland Cement.
8. C172: Practice for Sampling Freshly Mixed Concrete
9. C231: Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
10. C494: Standard Specification for Chemical Admixtures for Concrete.
11. C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
12. C940: Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
13. C1064: Test Method for Temperature of Freshly Mixed Portland Cement Concrete
14. D75: Practice for Sampling Aggregates

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

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Furnish Portland cement conforming to ASTM C150. Use one approved brand from one mill throughout the contract term unless otherwise approved by the Engineer. Use Type II for all work, unless otherwise specified.

B. Water

1. Use water that is potable and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances, and conforms to the requirements for water in ASTM C94, and as specified herein.
2. The maximum water-soluble chloride ion in the water shall not exceed 0.060 percent by weight of cement.

C. Aggregates:

1. Use aggregates for CLSM conforming to ASTM C33 and to the following requirements.

D. Admixtures:

1. General Requirements: ASTM C494.

E. Fly Ash: Provide fly ash conforming to the following requirements:

1. Class F fly ash conforming to ASTM C618 for chemical and physical properties.
2. Supplemental requirements in percent:

a.	Maximum carbon content	3 percent
b.	Maximum sulfur trioxide (SO_3) content	4 percent
c.	Maximum loss on ignition	3 percent
d.	Maximum water requirement (as a percent of control)	100 percent
e.	Fineness, maximum retained on No. 325 sieve	25 percent

2.02 - MIXES

A. Mix design shall produce a consistency that will result in a flowable product at the time of placement that does not require manual means to move it into place.

B. Provide mix with compressive strength of maximum 200 psi when measured 56 days after placement

C. Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a Final Bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4-inch per foot of depth) as measured in Section 10 of ASTM C940 "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory".

D. The fresh unit weight shall be 90 - 110 lbs./ft^3, except where specified, and in the absence of strength data the cementitious content shall be a maximum of 150 lbs./cy.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Batch, mix and deliver CLSM in conformance with ASTM C94. Batch all constituents at a central batching or mixing plant.

B. Seasonal Conditions:

1. Conform to ACI 305R and as specified herein for hot weather concreting. Do not add retarder admixture to any concrete.

2. Conform to ACI 306R and as specified herein for cold weather concreting. Do not add accelerator admixture to any concrete.

3.02 - TRANSPORTING AND MIXING

A. Conform to concreting procedures set forth in ACI 304R and as specified herein.

B. Transport CLSM to discharge locations without altering the specified properties of water-cement ratio, slump, air entrainment, temperature and homogeneity.

3.03 - FIELD TESTING

A. General:

1. The testing laboratory will use concrete samples taken at the point of agitator or mixer truck discharge to perform slump, air content, and temperature tests and for field control test specimens.

B. Notification of Delivery:

1. Notify the Engineer of concrete deliveries a minimum of 48 hours in advance of the scheduled placement. Include within this notification, the mix design and quantity of concrete, method and location of placement, frequency of trucks, ordered slump and time of initial delivery.

2. Furnish delivery batch ticket to the representative from the owner's testing laboratory or to the Engineer representative in the field with each batch delivered to the discharge locations in conformance with ASTM C94.

C. Test Measurements at Discharge:

1. The testing laboratory firm will take measurement of concrete slump, air content and temperature for each 50 cubic yards of each mix design but not less than once a day. The laboratory will conduct the slump, air content and temperature test measurements in conformance with ASTM C143, ASTM C231, and ASTM C1064, respectively.

2. The testing laboratory will submit test reports of field measurements specified above to the Contractor and to the Engineer.

D. Control Test Specimens:

1. The testing laboratory will cast a minimum of one set of three field control test specimens in conformance with ASTM C31 for each 150 cubic yards of each mix design of concrete but not less than once a day.

2. Laboratory personnel will record truck and load number from the delivery batch ticket, the concrete placement location of each specimen, the date, concrete strength, slump, air content, temperature and truck driver's name.

3. Furnish tightly constructed nonabsorbent test cylinder molds. Use molds of same type and manufacture for all test specimens. Leave molds on cylinders until received in testing laboratory.

4. Furnish boxes for initial curing of test cylinders in conformance with ASTM C31 from time of fabrication until they are transported to the testing laboratory.

5. The testing laboratory will compression test one of each set of three specimens at seven days. Immediately notify the Contractor and the Engineer if the seven-day strength is deficient. Test the two remaining cylinders at 65 days for concrete strength acceptance. The acceptance test result is the average of the strengths of the two specimens tested at 56 days. The laboratory firm will submit compression test results of the control test specimens to both the Contractor and the Engineer. Evaluation and acceptance of concrete shall conform to ACI 301 and ACI 318.

3.04 - CURING AND PROTECTION

A. Protect CLSM from premature drying, hot or cold temperatures, and mechanical injury, beginning immediately after placement and maintain concrete with minimal moisture loss at relatively constant temperature.

B. Comply with curing procedures set forth in ACI 301, applicable portions of ACI 308 and as specified herein.

C. Perform hot weather concreting in conformance with ACI 305R and as specified herein when the ambient atmospheric temperature is 80 degrees F or above.

D. Perform cold weather concreting in conformance with ACI 306R and as specified herein when the ambient atmospheric temperature is 40 degrees F or below.

E. Protect Controlled Low Strength Material from traffic until sufficient strength has been achieved for further construction operations

3.05 - CLOSEOUT ACTIVITIES

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT

END OF SECTION

SECTION 03420

PRECAST REINFORCED CONCRETE VAULTS

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PART 1 - GENERAL

1.01 - SCOPE

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

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

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

1. Manufacturer’s technical data containing information on new pipe and fittings.
2. Verifications from the pipe manufacturer of training in the proper method for handling and installing the new pipe.
    a. Completely detailed shop drawings for precast concrete vaults. Indicate all dimensions, details, reinforcing steel, inserts, connections, openings and lifting devices. Mark each component for identification. Show mark on erection plan and place legibly on unit at time of manufacture.
    b. Submit manufacturer’s specification and product data for all items specified.
    c. Drawings of modifications or changes in features or details, which are necessitated by design requirements. Make such modifications without additional compensation.
    d. Do not fabricate precast concrete vaults before shop drawings are accepted by the Engineer.
    e. Certification, signed and sealed by a Professional Structural Engineer registered in the jurisdiction where the vaults will be installed and employed by the vault manufacturer and stating:
        1) Elements and connections are designed to withstand required loads and forces
        2) Structure is not affected by buoyant forces.
        3) Codes and specifications to which structural design conforms.
        4) Do not submit calculations.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance.

B. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

C. Comply with precast concrete manufacturer's instructions for unloading, storing and moving vault components.

D. Store vaults on clean blocking, off the ground and protected from rain and ground splatter.

E. Coordinate the delivery, storage, handling and installation of precast concrete vaults.

1.06 - DESIGN CRITERIA

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

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

C. Vault design and construction comply with the specified design load conditions, ASTM C858 and as specified herein.

1.07 - REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. HB: Standard Specifications for Highway Bridges.
2. M198: Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

B. American Concrete Institute (ACI):

1. ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
2. ACI 301: Standard Specifications for Structural Concrete
3. ACI 304R: Guide for Measuring, Mixing, Transporting and Placing Concrete
4. ACI 305R: Hot Weather Concreting
5. ACI 306R: Cold Weather Concreting
6. ACI 308: Standard Practice for Curing Concrete
7. ACI 309R: Guide for Consolidation of Concrete
8. 318: Building Code Requirements for Structural Concrete and Commentary

C. ASTM International (ASTM):

1. A48: Standard Specification for Gray Iron Castings.
2. C31: Practice for Making and Curing Concrete Test Specimens in the Field
3. C33: Specification for Concrete Aggregates
4. C39: Test Method for Compressive Strength of Cylindrical Concrete Specimens
5. C143: Test method for Slump of Hydraulic Cement Concrete
6. C150: Specification for Portland Cement
7. C172: Practice for Sampling Freshly Mixed Concrete
8. C192: Practice for Making and Curing Concrete Test Specimens in the Laboratory

9. C231: Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
10. C260: Specification for Air-Entraining Admixtures for Concrete
11. C494: Specification for Chemical Admixtures for Concrete
12. C857: Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
13. C858: Specification for Underground Precast Utility Chambers
14. C1064: Test Method for Temperature of Freshly Mixed Portland Cement Concrete
15. D75: Practice for Sampling Aggregates
16. D4101: Standard Specification for Polypropylene Injection and Extrusion Materials

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

PART 2 - PRODUCTS

2.01 - PRECAST REINFORCED CONCRETE VAULTS

A. Manufacturers:

1. Oldcastle Precast, Inc.
2. Shea Concrete Products Inc.
3. Or equal.

B. Materials:

1. Minimum concrete compressive strength of 5,000 psi at 28 days conforming to SECTION 03300, CAST-IN-PLACE CONCRETE.
2. Portland cement: ASTM C150, Type II.
3. Coarse Aggregate and sand conforming to SECTION 03300, CAST-IN-PLACE CONCRETE.
4. Steel reinforcement conforming to ASTM A615, Grade 60.
5. Water: Potable.
6. Provide air entraining and water reducing concrete admixtures as specified in SECTION 03300, CAST-IN-PLACE CONCRETE.
7. Butyl rubber-based sealants conforming to AASHTO M198, Type B but with no bitumen content.
8. Non-Shrink Grout:
    a. BASF Chemical Company; Masterflow 713 Plus
    b. The Euclid Chemical Co.; Euco NS Grout
    c. Sika Corporation; SikaGrout 212
    d. Or equal.

C. Design Criteria. Use design loads according to ASTM C857 or as indicated below, whichever produces the more severe conditions:

1. Design precast reinforced concrete vault to withstand earth and groundwater loads. Assume groundwater elevation to be at the top of the vault. Provide design based on an equivalent fluid pressure equal to a minimum of 95 pounds per cubic foot.
2. Design precast reinforced concrete vault to withstand internal hydrostatic and seismic loading. Assume internal fluid level to be at the top of the vault. Provide design based upon an equivalent fluid pressure of 65 pounds per cubic foot.

3. Design precast reinforced concrete vault to withstand an H20 vehicle loading with an impact factor as prescribed in ASTM C857 with a minimum surcharge of 250 psf. Account for vehicle positions both above and alongside vault including directly on each manhole cover.
4. Design precast reinforced concrete vault ceiling to withstand additional concentrated loads from lifting hooks located directly above each valve, meter or other equipment. Provide lifting hook capable of supporting the load, but not less than 2,500 pounds each hook.
5. Design and install vaults to withstand hydrostatic uplift caused by a groundwater elevation at grade level or equal to the top of the vault, whichever produces the most severe condition. Use only the weight of the vault and hold-down slab to resist hydrostatic uplift with a minimum safety factor of 1.3. Do not include side friction of soil on walls.
6. Walls and floor slab: minimum of 6 inches in thickness. Cast lower wall section and floor slab monolithically.
7. Precast reinforced concrete vault roof: minimum of 8 inches in thickness.
8. Design vault to withstand the load condition where the vault roof is removed while the structure is backfilled to grade and subject to live and dead loads.
9. Provide precast reinforced concrete vault as indicated on the drawings. Provide a watertight vault enclosure including sumps and entrance tubes as indicated**.**
10. Fabricate precast reinforced concrete vault in sections for as required for handling and installation.
11. Provide pipe sleeves with water stops, rubber pipe boots or other devices at pipe penetrations.
12. Provide reinforced concrete vertical entrance tube with inside dimensions as indicated.

2.02 - MANHOLE FRAMES AND COVERS

A. Refer to SECTION 02725, MANHOLES, CATCH BASINS, HAND HOLES AND PULL BOXES.

2.03 - BITUMINOUS WATERPROOFING MATERIAL

A. Manufacturers:

1. Tnemec Company, Inc.; Series 46-465 H.B. Tnemecol
2. PPG Industries; Amercoat 78HB.
3. Carboline; Bitumastic 300M
4. Or equal.

2.04 - ENTRANCE HATCHES

A. Manufacturers:

5. Bilco Co.
6. Halliday
7. Babcock-Davis Associates, Inc.
8. Or equal.

B. Provide aluminum hatches of the type and size indicated and as follows:

1. Fabricate hatch and frame with 1/4-inch extruded aluminum frame and 1/4- inch diamond checkered aluminum plate covers.

2. Reinforce cover, with aluminum bars and angles welded to underside of covers, to withstand AASHTO H-20 wheel loading.

3. Provide hatch with hinges, hold-open safety-lock bars and flush lift handles, factory assembled, and shipped complete for installation.

4. Provide stainless steel hardware throughout. Hinge covers to frames with heavy duty stainless steel concealed hinges and stainless steel pins. Attach hinges to covers and frames with countersunk/flathead stainless steel machine screws. Fit covers flush to frame.

5. Provide slam latch, flush mounted grip handle, and removable plug and key wrench.

6. Fabricate gutter type hatches with 1-1/2-inch drainage coupling in one corner of the channel frame.

7. Provide frost proof inner hatch.

8. Provide ladder-up safety post.

9. Provide drain PVC drain piping to location required by the Contract Drawings or as recommended by the Engineer.

2.05 - LIFTING HOOKS

A. Provide lifting hooks in the ceiling above pumps, valves and meters.

1. Lifting hooks shall have adequate capacity to lift the equipment, but not less than 2,500 pounds.

2.06 - ACCESS LADDERS

A. Provide aluminum access ladders as follows:

2. Ladders conforming to OSHA Standards 29 CFR Chapter 1926.1053.

3. Fabricate from 1-1/2-inch IPS, Schedule 80 aluminum pipe upright and 1 inch solid round aluminum rod rungs, mortised and welded to uprights. Ground welds smooth. Close, seal and ground smooth top of uprights.

4. Space aluminum rungs 12 inches on centers.

5. Securely fasten ladder to entrance tube and precast reinforced concrete vaults with aluminum brackets and 1/2-inch diameter stainless steel expansion bolts.

6. Ladders conforming to OSHA Standards 29 CFR Chapter 1926.1053.

2.07 - MANHOLE STEPS

A. Aluminum Steps

1. Stock No. 12653B made by Aluminum Company of America, Pittsburgh, PA.

2. Stock No. F-14-2-B made by New Jersey Aluminum Co., New Brunswick, NJ.

3. Or equal.

4. Stock numbers are for embedded steps, for steps to be attached after casting, shape of exposed parts to be like stock numbers, but other ends shaped to suit inserts.

B. Plastic Coated Steel Steps

1. Provide steps 13 inches minimum width projecting 5 inches minimum from the wall surface. Steps to be driven into preformed holes.

2. Provide steps with copolymer polypropylene coating conforming to ASTM D4101 and 1/2-inch diameter steel reinforcing rod conforming to ASTM A615.

C. Test steps to resist a pull out load of 1,500 pounds 750 pounds per leg without loosening or being damaged.

1. Manufacturers

a. American Step Company, Inc., Griffin, Ga.

b. Parson Environmental Products, Inc., Reading, Pa.

c. Bowco Industries, Inc., Canby, Or.

d. Or equal.

PART 3 - EXECUTION

3.01 - PROTECTION

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

B. Before coating application, clean contact surfaces, remove dirt, grease, oil, foreign substances.

3.02 - FINISHES

A. Finishes: Aluminum ladders and entrance hatches shall receive and Aluminum Association clear anodic finish, designation C22A31.

3.03 - INSTALLATION

A. Install precast reinforced concrete vault, and related appurtenances in accordance with manufacturer's instructions.

B. Place precast reinforced concrete vault onto level prepared bedding as indicated. Provide uniform bearing over entire base of vault.

C. Seal all joints inside and out with specified sealant to ensure joints are waterproof.

D. Repair or replace damaged waterproofing.

E. Backfill vault excavation uniformly and in such a manner so as not to damage the waterproofing.

3.04 - PROTECTIVE COATING

A. Apply two coats of protective coating material (minimum 10 mils dry film thickness per coat) to exterior of walls, floor and ceiling by brush or spray according to manufacturer’s printed instructions.

B. Repair or replace damaged protective coating as determined by the Engineer at no additional cost to the owner.

C. Backfill vault excavation uniformly and in such a manner so as not to damage the waterproofing.

3.05 - CLOSEOUT ACTIVITIES

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

END OF SECTION

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SECTION 03600

GROUT

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PART 1 - GENERAL

1.01 - SCOPE

A. Furnish all labor, materials, equipment, and incidentals required, and install grout complete as shown on the Drawings and as specified herein.

B. Summary

1. Material for grouting reinforcing bars, anchor bolts into existing or newly placed concrete.
2. Material for grouting under bearing plates for columns or beams.
3. Materials for grouting under equipment.
4. Materials for grouting under and around steel tanks.
5. Materials for miscellaneous grouting including but not limited to railing posts, equipment guides, bollards, precast concrete joints and supports etc.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification section number and title and Drawing numbers and titles.

1. Manufacturer's printed data and application instructions for specified materials and locations where materials are to be used.

2. Product Data

a. Commercially manufactured non-shrink, non-metallic cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM standards, and Material Safety Data Sheet.

b. Commercially manufactured non-shrink epoxy grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM Standards and Material Safety Data Sheet.

c. Cement grout. Include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures, and the proposed mix of the grout.

d. Concrete grout. Include data for concrete as delineated in SECTION 03300, CAST-IN-PLACE CONCRETE. This includes the mix design, constituent quantities per cubic yard, and the water/cement ratio.

e. Bonding Agent. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM standards, and Material Safety Data Sheet.

3. Laboratory Test Reports. Submit laboratory test data as required under SECTION 03300, CAST-IN-PLACE CONCRETE for concrete to be used as concrete grout.

4. Mill test reports for each shipment of cement, regardless of quantity, prior to incorporation into the work.

5. Manufacturer's specifications and instructions for all admixtures, curing materials, adjustable inserts and non-shrink non-metallic grout. Manufacturer’s certification of compatibility of all admixtures.

1.05 - PRODUCT HANDLING

A. Comply with the requirements of SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers, and printed instructions.

C. Store materials in accordance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to six months or the manufacturer's recommended storage time, whichever is less.

D. Reject material that becomes damp, lumpy or otherwise unacceptable and immediately remove from the site and replace with acceptable material at no cost to the Owner.

E. Deliver non-shrink cement based grouts as pre-blended, prepackaged mixes requiring only the addition of water.

F. Deliver non-shrink epoxy grouts as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. Quality Assurance

1. Comply with requirements in SECTION 01400, QUALITY ASSURANCE and as specified.

2. Qualifications

a. Grout manufacturer to have a minimum of 5 years of experience in the production and use of the type of grout proposed for the Work.

3. Field Testing

a. Field testing and inspection services required will be provided by the Owner. Provide assistance in the sampling of materials and provide any ladders, platforms, etc. for access to the Work. Comply with the applicable ASTM Standards for testing.

b. The field testing of concrete grout will be as specified for concrete in SECTION 03300, CAST-IN-PLACE CONCRETE.

c. Take compression test specimens from the first placement of each type of grout to ensure compliance with these Specifications.

1) Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing one at seven days and two at 28 days.

2) Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B. A set of three specimens will be made for testing at seven days.

1.07 - REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Burlap Cloth made from Jute or Kenaf

B. American Petroleum Institute (API):

1. RP 686: Recommended Practice for Machinery Installation and Installation Design

C. ASTM International (ASTM):

1. C33: Standard Specification for Concrete Aggregates
2. C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or (50-mm) Cube Specimens)
3. C150: Standard Specification for Portland Cement
4. C531: Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings
5. C579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
6. C827: Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixes
7. C939 Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
8. C1107: Standard Specification for Packaged Dry, Hydraulic, Cement Grout (Non-shrink)
9. D695: Standard Test Method for Compressive Properties of Rigid Plastics

D. U.S. Army Corps of Engineers Standard (CRD):

1. C621: Corps of Engineers Specification for Non-shrink Grout

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

1.08 - RESPONSIBILITIES

A. Assist the Owner in obtaining specimens for testing and furnish all materials necessary for fabricating the test specimens.

B. The cost of laboratory tests on grout will be paid by the Owner except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of defective work, and re-testing all at no cost to the Owner.

1.09 - WARRANTY

A. Warrant the materials and products specified in this Section against defective materials and workmanship with the manufacturer's standard warranty, but for no less than one year from the date of substantial completion.

B. Warrant the work against defects for one year from the date of substantial completion.

PART 2 - PRODUCTS

2.01 - GENERAL

A. Provide materials produced by one manufacturer or supplier in order to provide standardization of appearance.

2.02 - APPLICATION

A. Unless indicated otherwise, provide grouts as listed below:

TABLE 03600-1	
Type of Grout	**Application**
Cement Grout	Surface repairs
Non-Shrink – Class I	Storage tanks and other non-motorized equipment.
	Filling block-out spaces for embedded items such as railing posts, gate guide frames, etc. (Where placement time is less than 20 min.).
	Repair of holes and defects in concrete members that are not water bearing and not in contact with soil or other fill material.
Non-Shrink – Class II	Column base plates.
	Filling block-out spaces for embedded items such as railing posts, gate guide frames, etc. (where placement time exceeds 20 min.)
	Under precast concrete elements.
Non-Shrink Epoxy	Machinery subject to severe shock loads and high vibration.
Concrete Grout	Toppings and concrete/grout fill.

2.03 - MATERIALS

A. Non-shrink Class I Grout:

1. Non-shrink Class I Grout shall have a minimum 28-day compressive strength of 5,000 psi, when mixed at a fluid consistency.
2. Non-shrink Class I grout shall meet the requirements of ASTM C1107, Grade B or C, when mixed to fluid, flowable and plastic consistencies.
3. Products:
    a. Sika Corporation; SikaGrout 212
    b. BASF Corporation; MasterFlow 713
    c. Euclid Chemical Comany; Euco NS
    d. Or equal.

B. Non-shrink Class II Grout:

1. Non-shrink grout shall be a high precision, fluid, extended working time grout. The minimum 28-day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.
2. Grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C1107.
3. Non-shrink grouts shall meet the requirements of ASTM C1107; Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939.
4. The grout when tested shall not bleed or segregate at maximum allowed water.

5. Products:
    a. BASF Corporation; Masterflow 928
    b. Euclid Chemical Co.; Hi-Flow Grout
    c. Sika Corporation; SikaGrout 212
    d. Or equal.

C. Cement Grout:
1. Cement grouts shall be a mixture of one part Portland cement conforming to ASTM C150 types I, II, or III and one to two parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout, but not to the degree that it will allow the grout to flow.
2. Cement grout materials shall be as indicated in SECTION 03300, CAST-IN-PLACE CONCRETE cast-in-place concrete.

D. Concrete Grout:
1. Concrete grout shall conform to the requirements of SECTION 03300, CAST-IN-PLACE CONCRETE except as specified herein. Proportion with cement, coarse and fine aggregates, water, water reducer, and air entraining agent to produce a mix having an average strength of 4,000 psi at 28 days. Coarse aggregate size shall be 3/8-inch maximum. Keep the W/C ratio as low as practical while still retaining sufficient workability.

E. Non-shrink epoxy-based grout:
1. Provide a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in seven days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30×10^{-6} when tested in conformity with ASTM C531.
2. Products:
    a. BASF Corporation; MasterFlow 648
    b. Five Star Products, Inc.; HP Epoxy Grout
    c. Sika Corporation; Sikadur 42 Grout-Pak
    d. Euclid Chemical Company; High Strength Epoxy Grout
    e. Or equal.

F. Dry Pack Grout:
1. Dry pack (to be packed or tamped in place) shall be mixed to a zero slump consistency.
2. When mixing the batch, add only enough water to the dry materials to produce a rather stiff mixture. Additions of water shall be made in small increments until the desired consistency is obtained.

G. Non-epoxy Bonding Compound:
1. Provide non-epoxy bonding compound that is re-wetable for up to two weeks.
2. Products:
    a. Larsen Products Corporation; Weld-Crete
    b. Sta-Dry Manufacturing Corporation; Link
    c. Euclid Chemical Company; Euco Weld
    d. Or equal.

2.04 - CURING MATERIALS

A. Curing materials for cement grout shall be as specified in SECTION 03300, CAST-IN-PLACE CONCRETE and as recommended by the manufacturer for prepackaged grouts.

PART 3 - EXECUTION

3.01 - GENERAL

A. Grout shall not be placed until base concrete or masonry has attained its design strength.

B. Prepare surfaces for curing, and protection of cement grout in accordance with SECTION 03300, CAST-IN-PLACE CONCRETE.

C. Shade the work sites from sunlight for at least 24 hours before and 48 hours after grouting.

D. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.02 - PREPARATION

A. Clean concrete surfaces to receive grout free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints, and free of all loose or unsound material or foreign matter that may affect the bond or performance of the grout.

B. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

C. Remove all loose rust, oil or other deleterious substances from metal embedments prior to the installation of the grout.

D. Wash concrete surfaces clean and keep them moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturate by covering the concrete with a plastic sheet or using either a soaker hose, flooding the surface or other method acceptable to the Engineer. Remove visible water from the surface upon completion of the 24-hour period prior to grouting. Use an accepted adhesive bonding agent in lieu of surface saturation when accepted by the Engineer for each specific location of grout installation.

E. Epoxy based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.

F. Construct grout forms or other leak proof containment. Forms shall be lined or coated with release agents recommended by the grout manufacturer.

G. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other accepted means. Prevent the shims, wedges, and blocking devices from bonding to the grout by appropriate bond breaking coatings and remove them after grouting unless otherwise accepted by the Engineer.

3.03 - GROUTING MACHINERY FOUNDATIONS

A. After the machinery has been set in position and placed at the proper elevation by steel wedges, the space between the bottom of the machinery base and the original placement of concrete shall be filled with a pourable non-shrink grout. Grout and grouting procedure shall be in accordance with API 686.

3.04 - INSTALLATION

A. Cement Grouts and Non-shrink Cementitious Grouts:

1. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel, or admixtures without prior approval by the grout manufacturer and the Engineer.

2. Avoid mixing by hand. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the additional water required to obtain workability. However, do not exceed the manufacturer's maximum recommended water content.

3. Place grout into the designated areas in a manner that will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner that will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (re-temper) after initial stiffening.

4. Just before the grout reaches its final set, cut back the grout to the substrate at a 45-degree angle from the lower edge of bearing plate unless otherwise accepted by the Engineer.

5. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer.

B. Non-shrink Epoxy Grouts:

1. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not over mix. Mix full batches only to maintain proper proportions of resin, hardener, and aggregate. Partial mixes will be rejected and will require the suspect grout to be removed and be replaced.

2. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 degrees F or above 90 degrees F.

3. Place grout into the designated areas in a manner that will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

4. The extension of grout horizontally beyond base plate shall be less than or equal to the grout thickness.

5. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

C. Concrete Grout:

1. Provide the underlying concrete surface with a broomed finish. Protect and keep the surface clean until placement of concrete grout.

2. Remove the debris and clean the surface of all dirt and other foreign materials.

3. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16- to 1/8-inch thick cement paste.

D. Dry Pack:

1. Dry pack consistency shall be such that the grout is plastic and moldable but will not flow.

2. The use of pneumatic pressure for dry-packed grouting requires acceptance of the Engineer.

3.05 - CLOSEOUT ACTIVITIES

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

END OF SECTION

SECTION 03730

CONCRETE REPAIR

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PART 1 - GENERAL

1.01 - SCOPE

A. Provide materials labor, equipment, and services necessary to repair concrete as specified.

B. Complete concrete repair operations in accordance with these specifications and the various system manufacturers' instructions regarding surface preparation, application, inspection and requirements for safety.

C. Complete crack repair work in accordance with these specifications and crack repair material manufacturer's instructions.

D. Complete joint repair work in accordance with these specifications and the joint repair material manufacturer's instructions.

E. The areas of concrete repair shall be determined by the Contractor and the Engineer and shall include any location where acidic attack of the concrete surfaces has reached a depth of ½" or deeper and at any air voids, bug holes or poorly consolidated concrete areas where the specified filler/surfacer materials cannot be used for filling or surfacing of the concrete.

F. If repair work is required for an area indicated to receive protective lining or coating, provide such repair in accordance with the requirements of this specification and the related lining or coating specifications.

G. The repair work specified herein is intended to cover the requirements for repair of concrete only, to a maximum depth of approximately 4-inch. If after blasting and cleaning, an area is discovered that requires a repair greater than 4-inch deep, or an area is discovered that requires repair or replacement of reinforcing steel notify the Engineer so that details may be provided to the Contractor to complete the repair.

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

1.02 - MEASUREMENT AND PAYMENT

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

B. Crack Repair: The quantities in linear feet to be measured for payment shall be the actual length of cracks repaired by the methods and materials specified under.

1. Epoxy crack repair.
2. Flexible polyurethane crack repair.
3. Rigid polyurethane crack repair.

C. Spall Repair Depth 4-inch or less: The quantities in square feet to be measured for payment shall be the actual square footage of spalled concrete repaired by the method and materials specified under spall repair.

D. Spall Repair Depth Greater Than 4-inch: The quantities in cubic feet to be measured for payment shall be the actual cubic footage of spalled concrete repaired by the method and materials specified under spall repair.

E. Crystalline Waterproofing Crack and Joint Repair: The quantities in linear feet to be measured for payment shall be the actual length of joints repaired by the methods and materials specified under crystalline waterproofing crack and joint repair.

F. Pipe Penetrations: The quantities in linear feet to be measured for payment shall be the actual circumference repaired by the methods and materials specified under pipe penetrations.

G. Waterproofing Treatment: The quantities in square feet to be measured for payment shall be the actual square footage of concrete surface to which the coating shall be applied specified under waterproofing treatment.

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

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

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification section number and title and Drawing numbers and titles.

1. Procedures proposed for the accomplishment of repair work. Include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations to be coordinated with other works in progress.

2. Manufacturer's recommendations and product data sheets for all repair materials including performance criteria, surface preparation, ambient condition requirements and applications, curing requirements, volatile organic compound (VOC) data, and safety requirements.

3. Material Safety Data Sheets (MSDS) for any materials brought on-site including all repair system materials, solvents and abrasive blast media.

4. Qualifications of foreman and epoxy gun operators and demonstration of meeting the minimum requirements specified.

5. Design Mixes: Provide concrete and cement mortar in conformance with SECTION 03300, CAST-IN-PLACE CONCRETE and as specified herein.

1.05 - PRODUCT HANDLING

I. Comply with the requirements of SECTION 01610, DELIVERY, STORAGE AND HANDLING.

J. Provide shelter to store materials in area or areas designated by the Owner solely for this purpose. Confine mixing, thinning, clean-up and associated operations and storage of repair mortar materials debris before authorized disposal, to these areas.

K. Mix all specified materials in the sheltered mixing operation and materials from direct sunlight and inclement weather. Protect facilities from staining and damage.

L. Do not dispose of waste materials on-site.

M. Store waste temporarily in closed, nonflammable containers until final disposal. Keep no rubbish in Contractor's area longer than 24 hours.

N. Deliver all materials to the job site in new, unopened containers. Each container shall bear the manufacturer's name and label. Labels on all material containers shall contain the following information:

1. Name of product.

2. Federal Specification Number if applicable.

3. Manufacturer's batch number.

4. Manufacturer's name.

5. Generic type of material.

6. Hazardous material identification label.

7. Shelf life date.

O. Clearly mark all containers indicating any safety hazards associated with the use of or exposure to the materials.

P. Handle and store materials to prevent damage or loss of label. Protection of materials is the Contractor's responsibility.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. Quality Assurance

1. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

2. Furnish the names of all subcontractors proposed for use for this work including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, polyurethane, polymer-modified and cement-based compounds.

3. Include in accepted applicator qualifications:

    a. A minimum of five years' experience in applying epoxy, polyurethane and polymer-modified and cement-based compounds, and crystalline waterproofing repair systems similar to those specified in this Section.

    b. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for the preparation of the surface, and proper methods for mixing, placing, curing, and caring of the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

4. Adhere strictly to the manufacturer's printed recommendations supplied with the product regarding temperature at time of application for all work. Do not use epoxy materials when either the temperature of the concrete to be repaired or the ambient temperature is below 50 degrees F 24 hours before, during, or for a period of 48 hours after the completion of the repair. Do not use crystalline waterproofing materials when either the temperature of the concrete to be repaired or the ambient temperature is below 40 degrees F 24 hours before, during, or for a period of 48 hours after the completion of the repair. Temporary heat may be used to meet the specified requirements.

5. Use new materials and use within the shelf life limitations set forth by the manufacturer. Clearly mark the shelf life limitations of each container.

6. The Contractor is ultimately responsible for the concrete repair work. Inspections by the Engineer or others do not limit the Contractor's responsibility.

7. Make all parts of the work accessible for inspections by the Engineer. Correct any conditions not in conformance with the specifications at no additional cost to the Owner.

8. Provide a Representative on site at all times when work is ongoing to represent the Contractor and to have authority to receive and execute all instructions given by the Engineer.

9. Allow changes in the specified repair work methods only with the permission of the Engineer.

10. Provide technical field support or training services required by the accepted material manufacturers at no additional cost to the Owner.

11. Provide materials from a single manufacturer for all components of a single repair.

D. Project/Site Conditions

1. Environmental Requirements:

    a. Comply with the repair material manufacturer's recommendations as to environmental conditions under which materials can be applied and cured.

    b. Do not apply materials when dust is being generated.

2. Protection:

    a. Cover or otherwise protect finish work or other surfaces not being repaired.

3. Ventilation:

    a. Provide ventilation to meet product requirements prior to, during, and after application.

1.07 - REFERENCES

A. National Association of Corrosion Engineers (NACE):

1. 6D-173: "A Manual for Painter Safety"

2. 6F-163: "Surface Preparation of Steel or Concrete Tank Interiors"

3. TPC2: "Coatings and Linings for Immersion Service"

B. American Concrete Institute (ACI):

1. 503.4: Standard Specification for Repairing Concrete with Epoxy Mortars

C. ASTM International (ASTM):

1. C33: Standard Specifications for Concrete Aggregates
2. C150: Standard Specification for Portland Cement
3. C321: Standard Test Method for Bond Strength of Chemical-Resistant Mortars
4. C882: Test Method for Bond Strength of Epoxy Resin Systems
5. D570: Test Method for Water Absorption of Plastics
6. D638: Test Method for Tensile Properties of Plastics
7. D695: Test Method for Compressive Properties of Rigid Plastics
8. D790: Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
9. D4262: L.R. Standard Test Method for pH of Chemically Cleaned or Acid Etched Concrete Surfaces
10. E329: Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
11. E337: L.R. Standard Practice Test Method for Measuring Humidity with a Psychrometer.

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

1.08 - SERVICES OF MANUFACTURERS REPRESENTATIVES:

A. Provide the services of a qualified manufacturer's technical representative to instruct the Contractor's personnel in the mixing, proper use and application of the epoxy, polyurethane, polymer-modified, crystalline repair systems and cement-based compounds.

B. Provide written certification from the manufacturers' representative that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with manufacturer's requirements.

C. Provide on-site time required for the manufacturer's representative to achieve a successful installation at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 - WATER

A. Use water free from injurious amounts of ice, oil, acid, alkali, salt, organic matter, or other deleterious substances and conforms to requirements of ASTM C1602.

B. Water shall not contain more than 500 mg of chlorides or more than 500 mg of sulfates.

C. Heat or cool water to obtain concrete repair product temperatures in accordance with manufacture’s printed recommendations, and in accordance with ACI 305.1 and ACI 306.1.

2.02 - AGGREGATE

A. All aggregates shall conform to ASTM C33 and SECTION 03300, CAST-IN-PLACE CONCRETE.

2.03 - EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures.

B. Products:

1. Sika Corporation; Sikdur 32 Hi-Mod
2. Euclid Chemical Company; Duralcrete
3. BASF Corporation; MasterEmaco ADH 326
4. Or equal.

2.04 - ANTI-CORROSION COATING

A. Anti-corrosion coating shall be a three-component, solvent free, and moisture tolerant epoxy-modified cementitious material.

B. Products:

1. Sika Corporation; Sika Armatec 110
2. Sto Corporation; CR 246
3. Euclid Chemical Company; Duralprep A.C.
4. Or equal.

2.05 - EPOXY CRACK REPAIR BINDER

A. Epoxy crack repair binder shall be a two-component, 100 percent solids, high-modulus, low viscosity epoxy adhesive suitable for crack grouting by injection or gravity feed.

B. Products:

1. Sika Corporation; Sikadur 52
2. Euclid Chemical Company; Duralcrete LV
3. BASF Corporation; MasterInject 1380
4. Or equal.

2.06 - FLEXIBLE POLYURETHANE CRACK REPAIR MATERIAL

A. Flexible polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophilic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough flexible foam seal that is impenetrable to water.

B. Products:

1. Prime Resins; Prime Flex 900 XLV
2. Sika Corporation; Sikafix HH Hydrophilic
3. Euclid Chemical Company; Dural Aqua-Fil
4. Or equal.

2.07 - RIGID POLYURETHANE CRACK REPAIR MATERIAL

A. Rigid polyurethane crack repair material shall be a one-component, water-activated polyurethane hydrophobic injection grout capable of 700 percent expansion. Polyurethane grout shall form a tough rigid foam seal that is impenetrable to water.

B. Products:

1. Euclid Chemical Company; Dural Aqua-Dam LV
2. Prime Resins; Prime Flex 920
3. Sika Corporation; Sikafix HH LV
4. Or equal.

2.08 - EPOXY REPAIR MORTAR

A. Epoxy Repair Mortar shall be two-component, 100 percent solids, and 100 percent reactive epoxy resin system.

B. Spall repair mortar for use in horizontal applications.

1. Products:
   a. BASF Corporation; MasterEmaco ADH 327
   b. Sika Corporation; Sikadur 22 Lo-Mod
   c. Euclid Chemical Company; Euco #4565 Mortar
   d. Or equal.

C. Spall repair mortar for use in vertical and overhead applications.

1. Products:
   a. Sika Corporation; Sikadur 23 Lo-Mod Gel
   b. BASF Corporation; MasterEmaco ADH 327
   c. Or equal.

2.09 - SPALL REPAIRS USING NON-SHRINK CEMENTITOUS MORTAR

A. Products:

1. BASF Corporation; MasterEmaco S 488CI
2. Sika Corporation; Sika Repair 224
3. Sauereisen, Inc.; Restokrete Underlayment No. F-120
4. Or equal.

2.10 - SPALL REPAIRS USING POLYMER MODIFIED CEMENTITOUS MORTAR

A. Repair spalls repair not requiring formwork using a two-component, polymer-modified cementitious mortar having a minimum 28-day compressive strength of 6,000 psi.

B. Spall repair mortar for use in horizontal applications.

1. Products:
   a. Sika Corporation; Sikatop 122 Plus
   b. Euclid Chemical Company; Duraltop Flowable Mortar
   c. BASF Corporation; MasterEmaco T302
   d. Or equal.

C. Spall repair mortar for use in vertical applications.

1. Products:

a. Sika Corporation; Sikatop 123 Plus

b. Euclid Chemical Company; Duraltop Gel

c. BASF Corporation; MasterEmaco N 423RS

d. Or equal.

2.11 - SPALL REPAIRS REQUIRING FORMWORK

A. Repair spalls repair requiring formwork using a two-component, polymer-modified cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 5,000 psi. Mix each unit of mortar with Saturated Surface Dry (SSD) pea gravel to form the repair material following the manufacturer's recommendations.

B. Products:

1. Sika Corporation; Sikatop 111 Plus

2. Euclid Chemical Company; Duraltop Flowable Mortar

3. BASF Corporation; MasterEmaco N 1500HCR Self Consolidated-Extended

4. Or equal.

2.12 - CRYSTALLINE WATERPROOFING CRACK AND JOINT REPAIR

A. Repair cracks and joints using a crystalline waterproofing crack and joint repair system consisting of a three stage application of filling a square or U-shaped routed out crack or joint in equal lifts followed by a surface applied slurry over a 12-inch width of the crack.

B. Products:

1. Kryton International; Krystol T1 and Krystol T2.

2. Xypex Chemical Corporation; Xypex Concentrate and Xypex Concentrate (Dry-Plug).

3. Penetron International; Penetron and Penecrete Mortar

4. Or equal.

2.13 - PIPE PENETRATIONS EXTERIOR OF CELL

A. Repair pipe penetrations using a crystalline waterproofing crack and joint repair system consisting of a three stage application of filling a square or U-shaped routed out area at the pipe/concrete interface in equal lifts.

B. Products:

1. Kryton International; Krystol T1 and Krystol Bari-Cote.

2. Xypex Chemical Corporation; Xypex Concentrate and Xypex Concentrate (Dry-Plug).

3. Penetron International; Penetron and Penecrete Mortar

4. Or equal.

2.14 - WATERPROOFING TREATMENT

A. Waterproofing treatment shall be a surface applied crystalline waterproofing system shall be a brush or spray applied two coat system.

B. Products:

1. Kryton International; Kryton T1 and Kryton T2.
2. Xypex Chemical Corporation; Xypex Concentrate.
3. Penetron International; Penetron.
4. Or equal.

2.15 - WATERPROOF MEMBRANE PATCH

A. Waterproof membrane patch shall be a hypalon sealing strip secured to the concrete substrate with an epoxy adhesive.

B. Install sealing system per manufacturer's recommendations.

C. Products:

1. Sika Corporation; Sikadur Combiflex SG System
2. Trelleborg Engineered System; Waterproofing Band
3. Or equal.

2.16 - CEMENT BASED TEXTURED COATING

A. Products:

1. Sika Corporation; Sikatop 144
2. Euclid Chemical Company; Duraltop Coating
3. BASF Corporation; MasterSeal 581
4. Or equal.

2.17 - SEALANT

A. Sealant shall be a two-component polyurethane sealant as specified in SECTION 03150, CONCRETE ACCESSORIES. Primers and bond breakers shall conform to the sealant manufacturer's recommendations.

2.18 - EXPANSION JOINT FILLER

A. Expansion joint filler shall be as specified in SECTION 03250, CONCRETE JOINTS AND ACCESSORIES.

PART 3 - EXECUTION

3.01 - GENERAL REQUIREMENTS

A. Perform exterior work during dry weather and appropriate temperature conditions in accordance with the manufacturer's recommendations. Protect unfinished work during inclement weather with tarpulins or heavy gage polyethylene sheeting.

B. Perform work in spaces within structures at temperature and conditions suitable for proper curing in accordance with the manufacturer's recommendations.

C. Coordinate concrete rehabilitation work with other work being performed.

D. Remove scaling, broken, loose and disintegrating materials by use of hand tools or power driven saws, down to solid unyielding material.

E. Clean surfaces thoroughly of efflorescence, oils, grease and other objectionable material in area to be repaired in accordance with the manufacturer's recommendations.

3.02 - EPOXY BONDING AGENT

A. Use epoxy bonding agent to adhere fresh mortar to existing concrete. Roughen existing concrete surfaces prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance. Place repair material while bonding agent is still tacky or per the written instructions of the manufacturer. Reapply bonding agent if bonding agent cures prior to placement of repair material.

B. Conform to all the requirements of ACI 503.4, and as specified herein.

3.03 - ANTI-CORROSION COATING

A. Sandblast, clean and coat reinforcing steel that is cut or exposed during alteration and/or repair operations with an anti-corrosive coating.

B. Cover all exposed parts of the steel with the coating and apply according to manufacturer's recommendations.

3.04 - EPOXY CRACK REPAIR

A. Cracks on horizontal surfaces: When permitted by the Engineer repair existing cracks by gravity feeding an epoxy crack repair binder into the prepared crack.

1. Rout concrete surface at the crack to form a minimum 1/4-inch wide by 1/4-inch deep V-notch and clean to remove all loose and foreign particles. Fill crack with clean, dry sand and pour epoxy crack repair binder into V-notch, completely filling crack.

2. As binder penetrates into crack, apply additional binder to the V-notch.

B. Cracks on vertical or horizontal surfaces: Repair cracks by pressure injecting an epoxy crack repair binder into the prepared crack. Seal cracked surfaces and install injection ports per manufacturer's recommendations.

1. Do not damage reinforcement steel when drilling holes for injection ports. If rebar is encountered during drilling, abandon the hole and relocate. Patch the abandoned hole immediately with epoxy mortar flush with the surface of the existing concrete.

2. Inject crack with epoxy crack repair binder once the surface sealing material has cured as directed by the manufacturer.

3. Remove injection ports upon satisfactory completion of crack injection and patch with epoxy mortar.

3.05 - RIGID AND FLEXIBLE POLYURETHANE CRACK REPAIR

A. Repair leaking cracks by pressure injecting with a waterproof hydrophilic or hydrophobic injection grout as directed by the Structural Engineer of Record. Seal crack surfaces and install injection ports per manufacturer's recommendations.

B. Do not damage rebar when drilling holes for injection ports. If rebar is encountered during drilling, abandon the hole and patch immediately with epoxy mortar flush with the surface of the existing concrete.

C. Inject crack with hydrophilic or hydrophobic injection grout as directed once the surface sealing material has cured, as directed by the manufacturer.

3.06 - SPALL REPAIR

A. Saw cut the perimeter of the repair area to a minimum depth of 1/4-inch below the surface of the concrete. Chip all loose concrete in the repair area to remove loose and degraded concrete to a minimum of 1/4-inch or until a sound substrate is reached. Clean the area to be repaired and restore to the original dimensions with spall repair patching material according to the manufacturer's recommendations.

B. Make final finished surface of patches flat, level and even with the existing concrete surface. Do not feather repair mortar to meet existing concrete surface.

C. Finish final patches on horizontal surfaces consistent with the finish on the existing structure.

3.07 - JOINT REPAIR

A. Remove sealant, bond breaker and joint filler.

B. Remove unsound concrete on the joint faces.

C. Remove laitance and provide a clean dry surface.

D. Prepare an epoxy mortar by combining epoxy crack repair binder with aggregate following the manufacturer's instructions.

E. Restore surface to original dimensions by trowelling epoxy mortar onto the existing substrate in a manner to ensure bonding following the manufacturer's instructions.

F. Cure repair in accordance with the manufacturer's instructions.

G. Install new joint filler, bond breaker and sealant.

3.08 - WATERPROOF MEMBRANE PATCH

A. Clean and install waterproof membrane textured patches on existing concrete areas requiring a textured patch according to manufacturer's recommendations.

3.09 - CEMENT BASED TEXTURED COATING

A. Clean existing concrete areas requiring a textured coating and apply the cement based textured coating according to manufacturer's recommendations.

B. Complete other concrete rehabilitation prior to applying coating.

3.10 - CRYSTALLINE WATERPROOFING CRACK AND JOINT REPAIR

A. Identify all cracks and joints to be repaired prior to commencing repair operations.

B. Using a concrete saw or angle grinder, create a 1/4 inch deep groove 1/2 inch to either side of the crack or joint to create a vertical seam for chipping operations. Using a 1 inch square chisel, chip a 1 inch wide chase along all cracks and joints to a minimum depth of 1.5 inches. The chase must be square or U-shaped.

C. Clean the chase of dust and loose concrete.

D. Pre-wet the surface to a saturated-surface-dry (SSD) condition. Do not leave any standing, pooled, or puddled water.

E. Fill one-third of the depth of the chase with the first lift of repair material. Cure the material per manufacturer’s printed instructions.

F. Fill the next one-third of the chase with the second lift of repair material. Cure the material per manufacturer’s printed instructions.

G. Fill the remaining one-third of the chase with the third and final lift of repair material. Cure the material per manufacturer’s printed instructions.

H. If the surface of the concrete is not receiving a complete Waterproofing Treatment, apply a slurry coat of waterproofing treatment to 6-inch to either side of the crack or joint.

3.11 - PIPE PENETRATIONS

A. Identify all pipe penetrations to be repair prior to commencing pipe penetration repairs.

B. Pipe penetration repairs shall not be performed against flowing or seeping water.

C. Prepare a recessed chase using a 1 inch square chisel to chip a 1 inch wide chase to a minimum depth of 1.5 inches. The chase must be square or U-shaped.

D. Prepare the pipe surface so that the repair products will adhere to the pipe in accordance with manufacturer printed instructions. Remove all grease, oil, corrosion, and scale. Abrade the pipe surface within the chase by coarse sanding to achieve a coarse surface profile.

E. Clean the chase of dust and loose concrete.

F. Fill one-third of the depth of the chase with the first lift of repair material. Cure the material per manufacturer's printed instructions.

G. Fill the next one-third of the chase with the second lift of repair material. Cure the material per manufacturer's printed instructions.

H. Fill the remaining one-third of the chase with the third and final lift of repair material. Cure the material per manufacturer's printed instructions.

3.12 - WATERPROOFING TREATMENT

A. Repair surface defects in accordance with Section 3.06, Spall Repair.

B. Clean existing concrete areas by high pressure water blasting (3,000 psi minimum) to remove loose concrete and surface contaminants. Wash and rinse with a detergent or concrete degreaser if required to remove contaminants prior to water blasting. Sand blasting, scarifying, shot blasting, other mechanical methods, or acid-etching are not permitted.

C. Apply first coat of waterproofing treatment to a surface saturated dry surface. Apply at the recommend rate in accordance with manufacture's printed instructions for the surface orientation. Cure the material in accordance with the manufacturer's printed instructions.

D. Apply second coat of waterproofing treatment to a surface saturated dry surface following the recommended cure time for the first coat. Apply at the recommend rate in accordance with manufacture's printed instructions for the surface orientation. Cure the material in accordance with the manufacturer's printed instructions.

E. Wait a minimum of 14 days following completion of final curing prior to cleaning and filling tanks that are to contain potable water.

3.13 - CURING

A. Cure repair materials in accordance with manufacturer's printed instructions.

3.14 - CLEANING

A. Mechanically remove excess material from walls, floors, etc. after material has cured.

B. Clean excess materials caused by work under this Section from existing surfaces by the use of power sanders. Vacuum surfaces to receive final cleaning and finishing specified under other sections of the specifications. Sand cracks (except those repaired by crystalline waterproofing crack and joint repair methods) flush to adjacent surfaces.

C. Remove misplaced sealants using methods and materials recommended by the manufacturers. Leave finished work and work area in a neat and clean condition.

D. Rinse tanks containing drinking water with potable water following completion of repairs.

3.15 - LEAKAGE TESTING

A. Provide leakage testing in accordance with SECTION 03800, LEAKAGE TESTING OF CONTAINMENT STRUCTURES.

B. Leak test all cells in the single test. Do not test cells individually.

3.16 - CLOSEOUT ACTIVITIES

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

END OF SECTION

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SECTION 03800

LEAKAGE TESTING OF CONTAINMENT STRUCTURES

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide method of testing concrete containment structures for leakage as specified herein and/or as shown on the Contract Drawings.

B. All containment structures shall be leak tested unless specifically exempted by the Engineer.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

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

1.05 - PRODUCT HANDLING

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

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

1.06 - DESIGN CRITERIA

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

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

1.07 - REFERENCES

A. American Concrete Institute (ACI):

1. 350.1: Tightness Testing of Environmental Engineering Concrete Structures and Commentary.

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

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Provide piping and equipment to test concrete structures for leakage as described herein.

PART 3 - EXECUTION

3.01 - GENERAL

A. Hydrostatically test reinforced concrete structures which will contain fluids to determine that they conform to leakage criteria specified herein and are free of detectable leaks. Do not hydrostatically test walls that are to be restrained or laterally supported by slabs until slab concrete has obtained the specified compressive strength.

B. Prior to testing, clean exposed surfaces by thoroughly hosing and removing surface laitance and loose matter from walls and slabs. Remove wash water and debris from the structures by means other than washing through plant piping. All potential leakage points shall be identified and repaired prior to filling the tank with water for the tightness test. Methods for repairing concrete shall be as described in SECTION 03730, CONCRETE REPAIR WORK.

C. No backfilling, floor finish, concrete or mortar fill, wall insulation, gas proofing or protective coatings shall be applied to or installed in any new containment structures until they have been subjected to loading for settlement and tested for leakage. Testing shall not be done until the concrete has reached its specified design strength.

3.02 - PRELOADING TEST

A. For the Preloading Test the Contractor shall maintain the liquid level in the structures at the design maximum water level for 72-hours. If the characteristics of settlement of the structure so require, the loading shall continue for a longer period to permit the necessary consolidation of the foundation material, in which case the Contractor shall be entitled to no extra compensation, but a commensurate extension of time for completion of the whole work under this contract shall be allowed.

3.03 - LEAK TEST PROCEDURE

A. Leakage testing shall meet the provisions of ACI 350.1 – Tightness Testing of Environmental Engineering Concrete Structures. The test criterion shall be HST-050 (0.050 percent per day) [or HST-NML (no measurable loss) or HST-100 (0.100 percent per day] as defined by ACI 350.1

B. During the test period, the excavation around the structure shall be kept dewatered by the Contractor. Dewatering shall maintain the groundwater level to below the top of the base slab. The Contractor shall temporarily seal all bottom openings and wall openings below maximum water level in the structures, furnish and fill the structures to the design maximum water level with clean water. The Contractor shall make his own arrangements for handling the water for testing and its transfer from one structure to another and its final disposal.

C. Filling rate shall not exceed a 4 feet per hour or as permitted by the Engineer. Filling shall be at a uniform rate with continuous monitoring.

D. During the leakage test period, the Engineer will inspect the structure for leakage or change in volume. If moist spots become visible, indicating the existence of minor leaks, or if the water level indicates hidden leakage, the Contractor shall furnish all materials and do all work necessary to locate the leaks and make the structure watertight to the complete satisfaction of the Engineer. No additional compensation will be allowed for such work.

E. If, in the opinion of the Engineer, during the course of the test weather conditions are such that it becomes difficult to accurately monitor the water level in the tank, the test shall be stopped, and started over again when weather permits, at no additional cost to the Owner.

F. On conclusion of the test, the Contractor shall pump or drain the water from the structure and dispose of it without damage to structures or surrounding facilities.

G. The structure will be considered as passing the water tightness test when no wet spots are observed on the exterior surfaces of the containment structure during the water tightness test period and when the measured loss is less than the maximum specified

3.04 - REPAIR METHODS

A. Methods for repairing concrete not passing the leakage test shall be as described in SECTION 03730, CONCRETE REPAIR WORK.

3.05 - CLOSEOUT ACTIVITIES

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

END OF SECTION

SECTION 05500

MISCELLANEOUS METAL

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PART 1 - GENERAL

1.01 - SCOPE

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

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

1.04 - SUBMITTALS

A. Shop Drawings: Submit the following in accordance with SECTION 01300, SUBMITTALS:

1. Manufacturer's literature describing standard items.

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

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

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

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

1.05 - PRODUCT HANDLING

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

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

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

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

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

1.06 - DESIGN CRITERIA – Not Used

1.07 - QUALITY ASSURANCE

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

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

C. Welding Qualification and Certification:

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

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

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

1.08 - REFERENCES

A. Aluminum Association (AA):

1. AA M12C22A41.

a. M12: Mechanical Finish, Non-Specular.

b. C22: Chemical Finish, Medium Matte.

c. A41: Clear Anodic Coating, Class I.

2. AAM12C22A42:

a. M12: Mechanical Finish, Non-Specular.

b. C22: Chemical Finish, Medium Matte.

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

B. American Institute of Steel Construction (AISC):

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

C. American Welding Society (AWS):

1. D1.1: Structural Welding Code Steel.

D. Aluminum Association Standard Anodic Finish (AASAF).

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

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

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

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Steel:

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

B. Stainless Steel

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

C. Aluminum:

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

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

E. Welding:

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

2.02 - FABRICATION

A. General:

1. Fabricate true to shape, size and tolerances as indicated and specified with straight lines, square corners or smooth bends; free from twists, kinks, warps, dents, and other imperfections. Straighten work bent by shearing or punching.
2. Dress exposed edges and ends of metal smooth, with no sharp edges and with corners slightly rounded. Construct connections and joints exposed to weather to exclude water.
3. Provide sufficient quantity and size of anchors for the proper fastening of work.
4. Fabricate details and connection assemblies in accordance with drawings and with projecting corners clipped and filler pieces welded flush.
5. Weld shop connections, bolt or weld field connections, unless otherwise noted or specified.
6. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.
7. Use connections of type and design required by forces to be resisted, and to provide secure fastening.
8. Welding
    a. Grind exposed edges of welds to a 1/8-inch minimum radius. Grind burrs, jagged edges and surface defects smooth.
    b. Prepare welds and adjacent areas such that there is (1) no undercutting or reverse ridges on weld bead, (2) no weld spatter on or adjacent to weld or any other area to be painted, and (3) no sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
9. Bolting
    a. Provide Type 316L stainless steel stud bolts and nuts with heavy aluminum washer for fastening of aluminum material.
    b. Draw up bolts or nuts tight and deform threads where possible. Use bolts of lengths required so that bolts do not project more than 1/4-inch beyond face of nut. Do not use washers unless specified. Provide hexagonal head bolts with hexagonal nuts.
    c. Provide holes required for the connection of adjacent or adjoining work wherever noted on drawings. Locate holes for bolting equipment to supports to a tolerance of + 1/16-inch of exact dimensions indicated.
    d. Provide plastic protection caps.

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

C. Fabricated Products:

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

2.03 - ALUMINUM PLATE COVERS AND FRAMES – NOT USED

2.04 - LOOSE LINTELS AND CMU PARTITION SUPPORTS – NOT USED

2.05 - ENGINE EXHAUST SLEEVE – NOT USED

2.06 - GRAB BARS – NOT USED

2.07 - ALUMINUM PIPE RAILS – NOT USED

2.08 - UNPUNCHED ALUMINUM PLANK – NOT USED

2.09 - ALUMINUM LADDERS

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

1. Provide rungs knurled or dimpled to minimize slipping.

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

C. Conform to OSHA Regulation 1910.27 for safety cages.

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

2.10 - ALUMINUM FINISHES

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

2.11 - ALUMINUM PROTECTION

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

1. Members Encased in Concrete: Zinc chromate primer.

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

B. Manufacturers:

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

2. Bitumastic 300M by Carboline Co.

3. Or acceptable equivalent product.

2.12 - RUNGS

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

1. Provide rung knurled or dimpled to minimize slipping.

2.13 - FALL PREVENTION SYSTEM FOR LADDERS

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

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

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

2.14 – STEEL BOLLARDS AND GUARD POSTS

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

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

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

2.15 - HATCHES

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

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

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

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

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

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

2.16 - MISCELLANEOUS ITEMS

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

PART 3 - EXECUTION

3.01 - GENERAL

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

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

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

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

3.02 - ALUMINUM PROTECTIVE COATING

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

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

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

3.03 - ALUMINUM PIPE RAILINGS – Not Used

3.04 - ALUMINUM HANDRAILS – Not Used

3.05 - LADDERS

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

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

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

3.06 - ALUMINUM GRATINGS AND FRAMES – Not Used

3.07 - ALUMINUM PLATE COVERS – Not Used

3.08 - LIFTING HOOKS

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

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

3.09 - ENGINE EXHAUST SLEEVE – Not Used

3.10 – RUNGS AND GRAB BARS

A. Space rungs and grab bars at 12-in. on center or as indicted.

B. Apply protective coat of bituminous material to embedded parts of rungs and grab bars.

3.11 - STRUCTURAL DOOR FRAMES – Not Used

3.12 - ANGLE PROTECTION – Not Used

3.13 - FALL PREVENTION SYSTEM

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

3.14 - ALUMINUM PLANK – Not Used

3.15 - CONTRACT CLOSEOUT

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

END OF SECTION

SECTION 05519

POST-INSTALLED CONCRETE ANCHORS

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PART 1 - GENERAL

1.01 - SCOPE

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

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Submit the following after award.

1. Product specifications with recommended design values and physical characteristics for epoxy dowels, expansion and undercut anchors.
2. Quality Assurance Submittals:
    a. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
    b. Certificates: ICC ES Evaluation Reports.
3. Manufacturer’s installation instructions.
4. Installer Qualifications & Procedures: Submit installer qualifications as stated herein. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

B. ICC ESR document for each type and size of anchor to be installed in the work.

1.05 - PRODUCT HANDLING

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

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

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. Store anchors in accordance with manufacturer’s recommendations.

1.06 - DESIGN CRITERIA

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

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

1.07 - QUALITY ASSURANCE

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

1. Installer Qualifications:

a. Drilled-in anchors shall be installed by an installer with at least five years of experience performing similar installations.

2. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the installer on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:

a. hole drilling procedure

b. hole preparation & cleaning technique

c. adhesive injection technique & dispenser training / maintenance

d. rebar dowel preparation and installation

e. proof loading/torqueing

3. Certifications: Unless otherwise authorized by the Engineer, anchors shall have one of the following certifications:

a. ICC ES Evaluation Report indicating conformance with current applicable ICC ES Acceptance Criteria.

1.08 - REFERENCES

A. ASTM International (ASTM):

1. ASTM A307: Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

2. ASTM A449: Specification for Quenched and Tempered Steel Bolts and

3. ASTM A563: Specification for Carbon and Alloy Steel Nuts

4. ASTM F436: Standard Specification for Hardened Steel Washers

5. ASTM A36: Specification for Carbon Structural Steel

6. ASTM A193: Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

7. ASTM A510: Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel

8. ASTM A108: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

9. ASTM F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

10. ASTM F594: Standard Specification for Stainless Steel Nuts

11. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

12. ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

13. Reinforcing Dowels: ASTM A615

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

PART 2 - PRODUCTS

2.01 - FASTENERS AND ANCHORS

A. Bolts and Studs: ASTM A307; ASTM A449 where “high strength” is indicated on the Drawings.

B. Carbon and Alloy Steel Nuts: ASTM A563.

C. Carbon Steel Washers: ASTM F436.

D. Carbon Steel Threaded Rod: ASTM A36; or ASTM A193 Grade B7; or ISO 898 Class 5.8.

E. Wedge Anchors: ASTM A510; or ASTM A108.

F. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.

G. Stainless Steel Nuts: ASTM F594.

H. Zinc Plating: ASTM B633.

I. Hot-Dip Galvanizing: ASTM A153.

J. Reinforcing Dowels: ASTM A615

2.02 - DRILLED-IN ANCHORS

A. Wedge Anchors: Not Allowed.

B. Screw Anchors: Screw type. Pre-drilling of the hole requires a standard ANSI drill bit with the same diameter as the anchor and installing the anchor will be done with an impact wrench. Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating equivalent to DIN EN ISO 4042 (8μm min.).

2. Products:

   a. Hilti Kwik-HUS-EZ.

   b. Powers Fasteners; Wedge-Bolt

   c. Simpson; TITEN HD.

   d. Or equal

C. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer’s installation instructions. Type and size as indicated on Drawings.

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) [or carbon steel HIT TZ rods conforming to ASTM A510 with chemical composition of AISI 1038].

2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.

3. Reinforcing dowels shall be A615 Grade 60.

4. Products:
    a. Hilti; HIT-Z anchor rods with HIT-HY 200R.
    b. Powers Fasteners; PE1000+
    c. Simpson; Strong TIE SET-XP
    d. Or equal
5. Reinforcing dowels shall be A615 Grade 60.

D. Drop-in Anchors: The use of drop-in anchors is prohibited.

PART 3 - EXECUTION

3.01 - DRILLED-IN ANCHORS

A. Drill holes with rotary impact hammer drills using carbide-tipped bits or hollow drill bit system. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.

1. Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.
2. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
3. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

B. Perform anchor installation in accordance with manufacturer instructions.

C. Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

D. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

E. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.02 - REPAIR OF DEFECTIVE WORK

A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

3.03 - FIELD QUALITY CONTROL

A. Testing: 10% of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If any of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.

1. Tension testing should be performed in accordance with ASTM E488.
2. Torque shall be applied with a calibrated torque wrench.
3. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed D/10, where D is the nominal anchor diameter.

B. Minimum anchor embedment, proof loads and torques shall be as recommended by the manufacturer.

3.04 - CLOSEOUT ACTIVITIES

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

END OF SECTION

SECTION 07160

BITUMINOUS DAMPPROOFING

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PART 1 - GENERAL

1.01 - SCOPE

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

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

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

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

3. "Provide" shall mean furnish and install.

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

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

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

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

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

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

1.04 - SUBMITTALS

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

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

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

2. Recycled Content Submittal

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

1.05 - PRODUCT HANDLING

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

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

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

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

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

1.06 - DESIGN CRITERIA

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

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

1.07 - QUALITY ASSURANCE

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

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

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

1.08 - REFERENCES

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

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

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

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

1.09 - SYSTEM PERFORMANCE REQUIREMENTS

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

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

1.10 - PROJECT CONDITIONS

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

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

1.11 - SEQUENCING AND SCHEDULING

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

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

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

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

C. 220AF Fibered Dampproofing by Karnak Chemical Corporation.

D. Or acceptable equivalent product

2.02 - BITUMINOUS DAMPPROOFING

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

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

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

2.03 – PROTECTION COURSE

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

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

PART 3 - EXECUTION

3.01 - EXAMINATION

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

3.02 - PREPARATION

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

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

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

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

E. Prime substrate as recommended by manufacturer.

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

3.03 – INSTALLATION, GENERAL

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

B. Application: Apply dampproofing to the following surfaces.

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

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

3. Where indicated on the Drawings.

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

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

3.04 – PROTECTION AND CLEANING

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

3.05 - INSTALLATION OF PROTECTION COURSE

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

3.06 - CONTRACT CLOSEOUT

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

END OF SECTION

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SECTION 07900

JOINT SEALANTS

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PART 1 - GENERAL

1.01 - SCOPE

A. Provide joint sealants as indicated and specified including the following:

1. Exterior Joints in Vertical Surfaces and Non-traffic Horizontal Surfaces as Indicated Below:
    a. Joints between architectural precast concrete units.
    b. Control and expansion joints in unit masonry.
    c. Perimeter joints between materials listed above and frames of doors, louvers, and windows.
    d. Other joints as indicated.
    e. Joints at precast concrete coping.
2. Interior Joints in Vertical Surfaces and Horizontal Non-traffic Surfaces as Indicated Below:
    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints of exterior openings where indicated.
    c. Tile control and expansion joints.
    d. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
    e. Perimeter joints between interior wall surfaces and frames of interior doors, louvers, and windows.
    f. Perimeter joints of toilet fixtures.
    g. Other joints as indicated.
3. Interior Joints in Horizontal Traffic Surfaces as Indicated Below:
    a. Joints as indicated.
4. Construction joint materials for concrete work shall be in accordance with SECTION 03250, CONCRETE JOINTS AND ACCESSORIES.

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

1.02 - MEASUREMENT AND PAYMENT

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

1.03 - DEFINITIONS

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

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

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

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

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

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

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

1.04 - SUBMITTALS

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

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

1. Product Data: For each joint sealant product specified.

2. Samples: For selection purposes submit three (3) of manufacturer's standard color chart including bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

1.05 - PRODUCT HANDLING

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

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

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

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

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

1.06 - DESIGN CRITERIA

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

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

1.07 - QUALITY ASSURANCE

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

B. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in service performance.

C. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

1.08 - REFERENCES

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

1. ASTM C 834: Standard Specification for Latex Sealing Compounds.
2. ASTM C 919: Standard Practice for Use of Sealants in Acoustical Applications.
3. ASTM C 920: Standard Specification for Elastomeric Joint Sealants.
4. ASTM C 1193: Standard Guide for Use of Joint Sealants.

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

1.09 - SYSTEM PERFORMANCE REQUIREMENTS

A. Provide joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.10 - PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
2. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 degrees F (4.4 degrees C).
3. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.11 - SEQUENCING AND SCHEDULING

A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

1. Provide paintable sealants at locations that are exposed to view.

2.02 - MANUFACTURERS

A. Type 1 - General Purpose Exterior Sealant: Polyurethane; ASTM C920, Type M, Grade NS, Class 25; two components.

1. Sonolastic NP-2; Sonneborne
2. Dymeric; Tremco
3. Sikaflex-2c, NS; Sika
4. Dynatrol 2; Pecora
5. Vulkem 922; Vulkem
6. Chem-Calk 500; Bostik
7. Or acceptable equivalent product.

B. Type 2 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.

1. Tremco Acrylic Latex; Tremco
2. AC-20; Pecora
3. Chem-Calk 600; Bostik
4. Or acceptable equivalent product.

C. Type 3 - Bathtub/Tile Sealant: White silicone; ASTM C920, Uses M and A; single component, mildew resistant.

1. Sanitary 1700; GE Silicones
2. 898 Silicone; Pecora
3. 786 MR Silicone; Dow Corning
4. Or acceptable equivalent product.

D. Type 4 - Acoustical Sealant: Butyl or acrylic sealant; ASTM C920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.

1. Tremco Acoustical Sealant; Tremco
2. AC-20 FTR Acoustical Sealant; Pecora Corp.
3. Sheetrock Acoustical Sealant; United States Gypsum Co.
4. Or acceptable equivalent product.

2.03 - JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Closed cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.

C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self adhesive tape where applicable.

2.04 - MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 - EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.02 - PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.

3. Remove laitance and form release agents from concrete.

4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 - INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.

b. Do not stretch, twist, puncture, or tear joint fillers.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

F. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration unless otherwise indicated.

G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations.

3.04 - CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.05 - PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

3.06 - SCHEDULE

A. Exterior Joints for Which No Other Sealant Type is Indicated: Type 1; colors as selected.

B. Joints Between Exterior Metal Frames and Adjacent Work (except masonry): Type 2.

C. Interior Joints for Which No Other Sealant is Indicated: Type 2; colors as selected.

D. Joints Between Plumbing Fixtures and Walls and Floors, and Between Countertops and Walls: Type 3.

E. Exposed and Concealed Joints where Acoustical Sealant is indicated and required: Type 4, colors as selected.

3.07 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 09940

SHOP PAINTING

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1.05 - PRODUCT HANDLING 2
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2.01 - MATERIALS 3
PART 3 - EXECUTION 3
3.01 - APPLICATION 3
3.02 - TOUCH-UP 3
3.03 - CONTRACT CLOSEOUT 3

PART 1 - GENERAL

1.01 - SCOPE

A. Provide labor, materials, equipment and incidentals required for the surface preparation and application of shop primers and finish coats, as specified herein.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

Manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures and dry mil thicknesses, including list of items and surfaces to receive shop painting.

1.05 - PRODUCT HANDLING

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Deliver materials to application area in original, unbroken containers, plainly marked with name and analysis of product, manufacturer's name, and shelf lift date. Do not store or use contaminated, outdated, prematurely opened, or diluted materials.

C. Store coated items to prevent damage or dirtying of coatings. Avoid need for special cleaning and store coated items out of contact with ground or pavement. Place suitable blocking under coated items during storage.

D. Do not expose surfaces to weather for more than six months before being top-coated, or less time if recommended by coating manufacturer.

E. Protect surfaces not to receive paint coatings during surface preparation, cleaning, and painting.

F. Protect coatings from damage during shipment and handling by padding, blocking, use canvas or nylon slings, and use care when handling.

G. At time of delivery of shop painted items to job site, ensure coatings are undamaged and in good condition.

1.06 - DESIGN CRITERIA

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. Job Conditions

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
2. Do not apply coatings when dust is being generated.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Coatings are divided into the following service types, as determined by conditions:

1. Non-Potable Water

a. All ferrous metals not subject to potable water provide one coat with a dry film thickness of 2.5 to 3.0 mils with one of the following:

(1) #1 Purple Prime made by Tnemec Co.

(2) Carbozinc 859 by Carboline Co.

(3) Multiprime EFD Epoxy Fast Day Inhibitive Primer 94-109 made by PPG Protective & Marine Coatings (4.0 – 6.0 DFT).

2. Potable Water

a. Ferrous metals submerged or which are subject to splash action in contact with potable water, provide one coat with a dry mil thickness of 3.0 to 3.5 mils of a certified NSF Standard 61 product by one of the following:

(1) 91 H20 Urethane Zinc Rich Primer made by Tnemec Co.

(2) Carboguard 561 made by Carboline Co.

(3) Aquapon High Build Potable Water Epoxy 95-132 Series made by PPG Protective & Marine Coatings (4.0 – 6.0 DFT).

B. Shop prime with primers guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in SECTION 09941, FIELD PAINTING for use in the field and which are recommended for use together.

PART 3 - EXECUTION

3.01 - APPLICATION

A. Surface Preparation and Priming

1. Sandblast clean in accordance with SSPC-SP-6, Commercial Grade, immediately prior to priming non-submerged components scheduled for priming, as defined above.

2. Sandblast clean in accordance with SSPC-SP-10, Near White, immediately prior to priming submerged components scheduled for priming, as defined above.

3. Before priming, provide surfaces dry and free of dust, oil, grease and other foreign material.

4. Shop prime in accordance with approved manufacturer's printed recommendations.

B. Non-primed Surfaces: Apply approved coating in accordance with manufacturer's printed recommendation.

3.02 - TOUCH-UP

A. Repair or replace damaged or defective coated areas. Resultant shop painting: Paint items as specified.

B. Remove damaged or defective coatings by specified blast cleaning to meet surface cleaning requirements, just before recoating. When small areas of coating need touch up, surface preparation may be done with suitable power needle gun to match specified blast cleaning.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 09941

FIELD PAINTING

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PART 1 – GENERAL

1.01 - SCOPE

A. Provide and apply paints and coatings specified and indicated. Prepare, clean, and finish all existing and new surfaces to be field painted as specified and indicated.

1. The terms “paint” and “coating” used herein include emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, organic or inorganic, whether used as intermediate, or finish coats.

B. Complete painting and test patches for existing surfaces in accordance with specifications, paint manufacturer's current surface preparation and application instructions and safety requirements. In the event of conflict, the more stringent specifications will apply.

C. Furnish and apply pipe, valve, and equipment identification legends as specified.

D. Items Not to Be Field Painted:

1. SECTION 15056, PIPE SUPPORTS

a. All pipe supports will be delivered with finish paint and will not require field painting.

2. SECTION 15600, HEATING, VENTILATION AND AIR CONDITIONING EQUIPMENT

a. All equipment except piping valves, meters and fittings will be delivered with finish paint and will not require field painting. Painting Subcontractor shall paint piping, valves, meters and fittings as specified herein as indicated on the contract drawings.

b. HVAC ductwork shall not be field painted.

3. Stainless steel and CPVC piping, fittings and supports will not be field painted, except that identification of piping with stencil text shall be provided by the work of this section.

E. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. List of coating products (Paint Schedule) with brand, type and manufacturer including dry film thickness and volatile organic compound (V.O.C.) regulations conforming to these specifications. Refer to Paragraph 2.04.

2. Manufacturer's current printed recommendations and data sheets for each product including performance criteria, surface preparation, application instructions.

3. Product data and pertinent information including results of test patch data indicating compatibility of field applied coatings with shop applied primers including a schedule listing each primer with field applied coatings to be applied over the primer.
4. Color chip samples of manufacturer's full range of colors for initial selection by Engineer.
5. Color chip samples matching colors indicated in Piping Identification Schedule, included in this specification. Submit list of piping to be included under each color.
6. Submit manufacturer's published data showing service record specified herein.
7. Submit letter(s) signed by paint manufacturer certifying that submitted products are suitable for application on the surfaces to be coated and for the service conditions.
8. Product data for mil thickness testing equipment including operating instructions.
9. Field Submittals
    a. Submit letter(s), signed by Contractor, stating that existing and new surfaces to be coated are ready for preparation as specified herein.
    b. Submit letter(s) signed by Painting Subcontractor, certifying that existing and new surfaces to be coated have been prepared in accordance with paint manufacturer's printed instructions and are ready for field paint application.
    c. Approved mil thickness test results, including location, and surface or item for identification.
    d. Provide samples of existing paint coatings to paint manufacturer for identification of existing coatings. Submit to Engineer final recommendations of the paint manufacturer for the proper type of coatings that can be applied to existing surfaces. If the specified paint coating for existing surfaces is not acceptable to paint manufacturer, then the painting subcontractor and paint manufacturer shall submit the recommended coating at no additional cost.

1.05 - PRODUCT HANDLING

A. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING and as specified herein.

B. Deliver materials to painter's area in original, unbroken, containers with name and analysis of product, manufacturer's name, and shelf life date. Do not use or retain contaminated, outdated, prematurely opened, or diluted materials.

C. Store coated items and protect coating from damage and foreign matter, by not allowing contact with soil or pavement, exposure to wind-blown particles, or other harmful contacts which necessitate special cleaning. Use blocking during storage.

D. Protect coated items, whether prime or finish, from damage due to shipping and handling.

E. Paint Storage and Mixing Areas and Waste Disposal
    1. Store paints and painter's materials in area or areas designated by the Engineer solely for this purpose. Confine mixing, thinning, clean-up and associated operations, and storage of painting debris, to these areas before authorized disposal.
    2. Do not use plumbing fixtures, piping or mechanical equipment for mixing or disposal of paint materials.
        a. Transport water to paint area by temporary hose or piping.
        b. Store waste temporarily in closed, nonflammable containers until final legal disposal. Keep no rubbish in painter's area longer than 24 hours. Legally dispose any hazardous materials and place all non-hazardous waste in the central trash trailer area.

1.06 - DESIGN CRITERIA

A. The materials specified are intended to be standard materials of demonstrated successful performance, as manufactured by reputable concerns. Materials shall be designed and manufactured in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the materials.

B. Job Conditions

1. Environmental Requirements:

a. Comply with manufacturer's printed recommendations as to environmental conditions under which coatings and coating systems can be applied.

b. Do not apply coatings when dust is being generated.

2. Protection

a. Cover or otherwise protect finish work of other trades and surfaces not being painted concurrently or not to be painted.

b. Do not paint over nameplates, tagging or other identification devices.

C. Quality Assurance

1. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified herein.

2. Use products of one manufacturer in any one paint coating system with compatible coating materials. Provide same coating product for touch-up as for original coating.

3. Do not use or retain contaminated, outdated, or diluted materials for painting. Do not use materials from previously opened containers.

4. Provide paint products having a minimum of five (5) years of service, with no peeling, flaking, chipping, blistering, or fading, under similar service conditions.

1.07 - REFERENCES

A. Society for Protective Coatings (SSPC) Specifications:

1. SSPC-PA 1: Shop, Field, and Maintenance Painting of Steel.

2. SSPC-PA-2: Measurement of Dry Coating Thickness with Magnetic Gages.

3. SSPC-SP 1: Solvent Cleaning.

4. SSPC-SP 3: Power Tool Cleaning.

5. SSPC-SP 6: Commercial Blast Cleaning.

6. SSPC-SP10: Near-White Blast Cleaning.

B. American National Standards Institute (ANSI)

1. A13.1: Scheme for the Identification of Piping Systems, Designation.

C. National Sanitation Foundation (NSF)

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 – PRODUCTS

2.01 - MANUFACTURERS

A. Tnemec Co., Inc.

B. Carboline.

C. PPG Protective & Marine Coatings, Inc.

2.02 - MATERIALS – GENERAL

A. Products: Recommended by their manufacturer for intended service.

B. Material Compatibility

1. Provide block fillers, undercoats and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2. Provide field applied coatings that are compatible with shop applied primers.

2.03 - COLORS AND FINISHES

A. Interior finish colors: As indicated in Finish Schedule and Pipe Identification Schedule.

B. To provide contrast between successive coats, lightly tint each coat to distinguish it from preceding coats.

C. Unless otherwise indicated for finish paint, use gloss or semi-gloss on metal, and satin finish on masonry and concrete.

2.04 - COATING TYPES

A. Coatings are described in the COATING IDENTIFICATION SCHEDULE by abbreviations, generic type, minimum solids by volume and minimum dry film thickness. Provide coatings that comply with the volatile organic compounds (VOC) regulations applicable to the project site and in no case to exceed 3.5 lbs/gal.

COATING IDENTIFICATION SCHEDULE

				Manufacturer		
Abbreviation	**Generic Type**	**Solids by Volume (%) See Note 1**	**DFT Per Coat See Note 2**	**Tnemec Co., Inc.**	**Carboline**	**PPG Protective & Marine Coatings, Inc.**
AGE	Alkyd- Enamel	49	2.0-3.0	23 Enduratone	Carbocrylic3359 or 3359 DTM	PPG Industrial Alkyd Enamel 7-824 Series
AGU	Alkyd	56	2.0-3.0	Series 36	Undercoater	Undercoater
AL	Emulsified Acrylic	43	2.0-3.0	Series 6	Carbocrylic 3350	PPG Pitt-Tech EDF Exterior WB Acrylic Dry Fog 90-812 Series
APE	High Build Acrylic Polyurethane Enamel	60/745	3.0-5.0	Series 73 1074	Carbothane 134HG	PPG Amercoat 450H
BF	Cementitious Acrylic Filler	68	100 sq. ft. per gal.	Series 130	Sanitile 100	BF Cementitious PPG Amercoat 965
HSE	High Solids Catalyzed Epoxy	70	6.0-8.0	Series N39	Carboguard 893SG or 691 NSF	PPG Amerlock2/400 or Amerlock 2 NSF
LTE	Polyamide Epoxy	58	4.0-6.0	Series 161 or N69F	Carboguard 893SG or 691 NSF	PPG Amerlock2/400 or Amerlock 2 NSF

COATING IDENTIFICATION SCHEDULE

				Manufacturer		
Abbreviation	**Generic Type**	**Solids by Volume (%) See Note 1**	**DFT Per Coat See Note 2**	**Tnemec Co., Inc.**	**Carboline**	**PPG Protective & Marine Coatings, Inc.**
MAEP	Modified Aliphatic Amine Epxoy Mortar	100	125	Perma-Shield H_2S	---	---
PE See Note 3	Polyamide Epoxy	60	5.0-7.0	Series 61 or N69F	Carboguard 893SG or 691 NSF	PPG Amerlock2/400 or Amerlock 2 NSF
PRW	Pressure washing and cleanup with materials recommended by Paint Manufacturer.					
PVA	Poly Vinyl-Acrylic-	28	1.0-1.5	Series 51-792	Carbocrylic120	PPG Speedhide6-2 Primer
TY	Polyamide Epoxy	56	2.0-3.0	Series 66	---	---
ZR	Zinc Rich Primer	63 See Note 4	3.0-4.0	Series 91-H_2S or Series 90-97 or Series H90-97	Carbozine 859 or Carbozinc 11	PPG Amercoat 68HS or Dimetcote 9

Notes:

1. Solids by volume based on Tnemec Co., Inc.
2. Dry film thickness and performance criteria based on Tnemec Co., Inc. Provide dry film thicknesses for equivalent products as recommended by manufacturer.
3. If application of PE type coating occurs during low temperatures, provide and apply LTE type coating in lieu of PE and substitute throughout in Paint Schedule at end of Section, unless otherwise recommended by coating manufacturer.
4. 80% minimum zinc by weight. If intended for bolted connections, provide minimum Coefficient of Friction as recommended by bolt manufacturers.

B. Description of coating types includes minimum acceptable percent, by volume, of component solids. Brand identification is to establish standard of quality. Products meeting general physical characteristics and performance criteria, are acceptable.

C. Provide coatings submerged in potable water with National Sanitation Foundation approval.

2.05 - PIPE, VALVE/EQUIPMENT IDENTIFICATION AND COLOR CODING

A. Provide identification of existing and new pipes, valves, pumps, tanks and similar vessels by color as specified in the Pipe Identification Schedule and with name of contents, directional flow arrows and other required legend.

B. For existing and new pipe systems, use stenciled letters and arrows or self-adhesive labels or tapes located at intervals no greater than 20 ft. apart on straight runs except that stainless steel piping at intervals shall be no greater than 15 ft. apart on straight runs. Mark each valve, branch, wye change in direction and each side of floor and wall penetrations.

C. Labels or tapes shall be moisture and U.V. resistant.

D. Provide legend of size, character and location conforming to ANSI A13.1 for stenciled letters or labels.

E. Refer to notes at end of Pipe Identification Schedule for further clarifications.

PART 3 - EXECUTION

3.01 - INSPECTION

A. Examine existing and new surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work.

B. Do not proceed with surface preparation or coating application until after submitting to the Engineer a letter signed by Contractor, stating that existing and new surfaces to be painted are in acceptable condition for preparation and painting according to the Painting Subcontractor and in accordance with paint manufacturer’s printed instructions.

C. Do not proceed with coating application until after submitting to the Engineer a letter signed by paint manufacturer certifying that submitted products are suitable for application in accordance with paint manufacturer’s printed instructions.

3.02 - PREPARATION

A. Basic Steps:

1. Prepare and paint existing and new surfaces in heated enclosure unless the ambient weather conditions ensure still, dry air above 50 degree F temperature, and humidity above manufacturer's printed recommended level. Do not apply paints to surfaces in direct sunlight. Conform to manufacturer's printed instructions for safety requirements.

2. Coordinate cleaning and painting operations to eliminate contamination of one by the other.

3. Maintain coating materials at manufacturer's recommended mixing and application temperatures for not less than 24 hours before use. Have clean containers, spray equipment, applicators and accessory items ready for use before decanting or mixing paint materials.

4. Coordinate materials to be applied with previous coatings on affected surfaces. Obtain, in all cases, manufacturer's written directions, and follow them strictly, except where otherwise specified.

5. Coordinate preparation and material compatibility requirements with the work specified in SECTION 15400, PLUMBING SYSTEMS and SECTION 15600, HEATING, VENTILATING AND AIR CONDITIONING.

B. Before any paint application, clean existing and new surfaces to be coated of dust, dirt, grease, white rust, paint unsuitable for top coating, efflorescence, oil, moisture, foreign matter or similar conditions detrimental to coating bond and durability.

1. Following cleaning, apply preparatory treatment in strict accordance with manufacturer's written instructions.

2. Fill imperfections and holes in surfaces to be painted with material recommended by paint manufacturer.

C. Metals to Receive Paint Finishes:

1. Prepare ferrous metals, including field welds and unprimed shop welds, without shop prime coats as follows:

a. Near White blast cleaned (SSPC-SP-10), for submerged components.

b. Commercial blast cleaned (SSPC-SP-6), for non-submerged components.

c. Use needle gun for field welds and shop welds which occur in narrow, unprimed areas in an otherwise shop primed surface, followed by SSPC-SP1-solvent wipe.

2. Clean previously shop primed ferrous metals in accordance with manufacturers printed recommendations prior to field painting.

3. Non-ferrous and galvanized metal surfaces scheduled for paint finish:

   a. Clean in accordance with manufacturers recommendations prior to field painting (SSPC-SP-1 including power washing).

   b. Brush blast all exterior and interior exposures above constant 35% relative humidity or treat with Oakite LTS or equal etching solution. Brush blasted galvanized metal surfaces to receive a uniform profile of 0.75-1.25 mils.

   c. For interior galvanized and non-ferrous metals not exposed to wet environments apply in accordance with manufacturers written instructions.

D. Concrete to Receive Paint Finishes:

1. Clean thoroughly of form oil, release agents, dirt, dust, grease, paint, loose material and foreign matter. Remove laitance, roughen smooth surfaces by brush sand blasting, remove fins and projections, fill voids and honeycombs with material recommended by paint manufacturer.

2. Prime after concrete has dried in strict accordance with manufacturer's printed instructions.

3. Concrete in Immersion: Brush blast all new and existing surfaces to receive coating to achieve profile of 2.0-4.0 mils. Previously coated surfaces shall be inspected and evaluated prior to commencing work.

E. Concrete unit masonry for paint finishes: Clean thoroughly by brushing, scraping and sanding or grinding slick areas. Remove loose or projecting mortar, solvent wash oil, grease, paint spots before applying block filler.

F. Provide higher degree of cleaning for acceptable equivalent paint products when paint manufacturer recommends in his printed surface preparation recommendations.

G. Delay painting of areas which will be damaged by heat from welding, until welding is complete. Reclean and recoat substrate as specified for original coats, when coated areas have been damaged by welding or have not been painted to allow welding.

H. PVC Pipe: Sand all surfaces with 60-80 grit paper to provide profile to adhere coatings.

3.03 - TOUCH-UP

A. Before applying field coat, touch-up abraided areas of shop coats with paint of the same type. Apply an entire coat to abraided area. Touch-up coats are in addition to, and not a substitute for first field coat. Clean deteriorated surfaces as specified herein and in accordance with manufacturer’s recommendations before applying touch-up coat.

B. Equipment, motors, pumps, instrumentation panels, electrical switchgear, and similar items with shop coats, paint filler, enamel or other treatment customary with manufacturer; after installation, touch-up scratches and blemishes before applying field coats.

3.04 - APPLICATION

A. Refer to Paint Schedule at end of this specification for coating requirements. Provide additional prime, undercoat, and finish coats as specified, indicated, and recommended by coating manufacturer's printed instructions.

B. Conditions

1. Do not apply paints or other finish to wet or damp surfaces, except in accordance with instructions of manufacturer. Do not apply exterior paint during cold, rainy, or frosty weather, or when temperature is likely to drop to freezing. Do not apply paints to surfaces in direct sunlight.

2. Paint surfaces which have been cleaned, pretreated, or otherwise prepared for painting with first field coat as soon as practicable after such preparation has been completed, but in any event prior to deterioration of prepared surface.

3. Coat blast cleaned metal surfaces in accordance with SSPC guidelines, before any rusting or other deterioration or contamination of the surface occurs. Do not coat blast cleaned surfaces later than 8 hours after cleaning.

C. Methods

4. Spraying with apparatus may be substituted for brush application of paints in locations approved for spraying.

5. Prepare surfaces, mix and apply paint materials in strict accordance with manufacturer's printed instructions and recommendations. Control temperature of materials upon mixing and application, surface temperature and condition, thinning and modifying.

6. Protect surfaces to be coated, before, during and after application.

D. Workmanship

7. Apply coating materials to meet manufacturer's spreading rate and dry film thickness recommendations. Dry film thicknesses specified are constant for brush, spray, roller or other form of application.

a. Control thinning in accordance with V.O.C. regulations for spray use and to manufacturer's printed instructions, and produce specified dry film thickness on level surfaces, interior and exterior angles.

8. Apply paints and coatings using painters continuously employed in the painting profession for no less than five (5) years, brushed or rolled out carefully to a smooth, even coating without runs or sags. Curing time in accordance with manufacturers printed instructions.

9. Finish surfaces: Uniform in finish and color, and free from flash spots and brush marks.

3.05 - PROTECTION AND CLEAN-UP

A. Protect existing and new surfaces to be painted or coated under this Section as follows:

1. Arrange for preparation and coating activities to be performed in areas and during times when no continuous traffic and no dust generating activity will be present.

2. During time between preparation and coating, protect work from dust and dirt with dropcloth. Do not allow contact with surfaces in this time period.

3. During painting activity, clearly mark the area being used by painters to prevent interference with painting being applied as specified.

4. After painting, clearly barricade painted surfaces with cones, plastic barrier tape, or other visible barrier. Locate "WET PAINT" signs near painted surfaces. Do not remove barriers and signs until paint surface dries throughout entire film thickness.

B. Cover existing water surfaces to protect them from dust and debris.

C. Remove or completely mask existing and new accessory items, finish hardware, lighting fixtures, escutcheon plates, trim and similar finish items not to be painted before painting adjacent surfaces. Carefully replace and reposition upon completion of adjacent painting and cleaning work.

D. Upon completion of the work, clean up paint spots, oil, and stains from floors, glass, hardware, and similar finished items and remove tape.

3.06 - SCHEDULE OF PAINTING

A. Coordinate and schedule the various cleaning, touch-up and finishing operations. Transmit and coordinate the transmission of materials data, color selections and coating system methods between the coating applicators. Do not exceed exposure and recoat time limits.

PIPE IDENTIFICATION COLOR SCHEDULE
VALVES, BLOWERS, PIPE, PUMPS, TANKS

		Paint Color		
Pipe System	**Legend Symbol**	**Component**	**Letters and Arrows**	**Stencil Text**
Air Low Pressure	ALP	N/A	White	Air Low Pressure
Drain	D or W	Black	White	Drain
Potable Water Supply	W1	Light Blue	White	Potable Water – Cold
Raw Wastewater	RWW	Gray	Black	Raw Wastewater
Sequencing Batch Influent	SBI	Gray	Black	Sequencing Batch Influent
Sump Pump Discharge	PD	Black	White	Sump Pump Discharge
Vent	VT	Black	White	Vent

Notes:

1. All piping shall be labeled with stencil text name.
2. Provide and place a 2-inch color band (4-in. bands for the color yellow) extending around the complete perimeter of the tray on each side of the stencil text and directional arrow designation.
3. Provide banding 4 ft. 0 in. on center for sludge lines not otherwise specified above.
4. PVC, PVDF, copper, stainless-steel and galvanized steel shall be labeled, but not painted.
5. Potable and non-potable water is to be painted and labeled with the colors shown above per MA plumbing code.
6. Tubing of any kind shall not be painted or labeled unless potable or non-potable water per MA plumbing code.
7. If pipe of any kind is less than 2” do not paint unless potable or non-potable water per MA plumbing code.

PAINT SCHEDULE

		Field Coats		
Item No.	**Surface or Item**	**1st**	**2nd**	**Final**
1	Ferrous parts of operating devices and supports, guard posts and bollards	PE	PE	APE
2	Items with factory finish	Touch-up with materials supplied by manufacturer		
3	Shop painted ferrous metals, galvanized metals and equipment submerged, non-submerged and subject to splashing	PE	HSE	HSE
4	Exterior shop painted ferrous metals, galvanized metals and equipment submerged, non-submerged and subject to splashing	PE	HSE	APE

PIPE IDENTIFICATION COLOR SCHEDULE
VALVES, BLOWERS, PIPE, PUMPS, TANKS

			Paint Color		
Pipe System	**Legend Symbol**	**Component**	**Letters and Arrows**		**Stencil Text**
5	Concrete Wetwells (interior walls, floor and ceiling)		Concrete Surfacer: Tnemec Series 218 Mortar-Clad at 1/16-inch thickness HSE Finish: Series 434 PermaShield polyamine epoxy mortar at 125.0 mils dft		
6	PVC piping		PE	---	PE

Notes:

1. If prime coat has been exposed for more than 6 months, Painting Subcontractor will provide test patches to insure adhesion of field-applied coatings. Test patches in accordance with paint manufacturer's instructions.
2. Provide patching compound for existing and new concrete surfaces before beginning field painting, in accordance with Paint Manufacturer's recommendations. Patch existing concrete masonry unit walls immediately after demolition has been completed and areas have been cleaned.
3. Repaint all existing piping which is modified (existing piping which is partially demolished or to which new piping and equipment will be connected) for the services listed in the Pipe Identification Schedule. Piping, valves, supports, and accessories are to be repainted. Floors, walls, and ceiling surfaces are also to be repainted.
4. Conform to paint manufacturer's written instructions with regard to surface preparation and compatibility of new paint coatings over existing paint coatings. Painting Subcontractor shall take samples of existing paint coatings and coordinate with paint manufacturer and identify the generic type existing. Final recommendations of the paint manufacturer shall be given to the Painting Subcontractor in writing for the proper generic type coating that can be applied to the existing surfaces. If the specified paint coating for existing surfaces is not acceptable by paint manufacturer, then the Painting Subcontractor shall submit the recommended coating and at no additional cost. Paint coating submitted shall have the performance criteria for the intended purpose of that existing item/surface with regard to corrosion-resistance, self-priming, and ease of application.

3.07 - FINAL TOUCH-UP

A. Prior to final completion and acceptance, examine painted and finished surfaces and retouch or refinish areas to leave touched-up areas with same appearance as and even with the surrounding finish specified.

B. After doors have been fitted and hung, refinish edges, tops and bottoms.

3.08 -TESTING

A. Conduct field testing in the presence of the Engineer for specified mil thickness in accordance with SSPC-PA-2.

B. Test results shall meet requirements of SSPC-PA-2. Failure of test results shall require that surfaces be repainted until approved results of testing have been obtained for the specified mil thickness.

3.09 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 11306

SUBMERSIBLE SOLIDS HANDLING PUMPS AND APPURTENANCES

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Submersible Solids Handling Pumps and Appurtenances as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections with DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specficiation.

C. Provide and test submersible solids handling pumps, motors, discharge base elbow, and appurtenances as indicated and in compliance with Contract Documents.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the previously provided costs for the addition of the three Submersible Solids Handling Pumps and therefore, shall be utilized to cover the cost of the discrepancy between the Shop Drawing and this section.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limted to the following:

1. Data regarding pump and motor characteristics and performance:

a. Prior to fabrication and testing, provide manufacturer's guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity, horsepower, efficiency and $NPSH_3$.

(1) For units of same size and type, provide curves for a single unit only.

b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum impeller diameters available, acceptable operating range (AOR) and preferred operating range (POR).

c. Results of shop performance tests as specified.

d. Submit curves for manufacturer's guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch (A4) sheets, one curve per sheet.

2. Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide $NPSH_3$ curve for each speed.

3. Motor data in accordance with SECTION 01171 – ELECTRIC MOTORS, PARAGRAPH 1.04 – SUBMITTALS.

4. Full load current

5. Locked rotor current

6. Outlines, dimensions, weights and wiring diagrams.

7. Efficiency and power factor at ½, ¾ and full load.

8. Service factor

9. Nameplate data.

10. Statement certifying that motor insulation system is compatible with output of VFD system provided under SECTION 16260 – LOW VOLTAGE VARIABLE FREQUENCY DRIVES.

11. Shop drawing data for accessory items.

12. Certified setting plans, with tolerances, for anchor bolts.

13. Manufacturer's literature as needed to supplement certified data.

14. Operating and maintenance instructions and parts lists.

15. Listing of reference installations as specified with contact names and telephone numbers.

16. Certified results of hydrostatic testing.

17. Certified results of dynamic balancing.

18. List of recommended spare parts other than those specified.

19. Shop and field inspection reports.

20. Bearing Life: Certified by the pump manufacturer. Include design data.

21. Pump shop test results.

22. Motor shop test results.

23. Qualifications of field service engineer.

24. Recommendations for short and long-term storage.

25. Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.
26. Special tools.
27. Number of service person-days provided and per diem field service rate.
28. Recommended location of discharge pressure gauges.
29. Manufacturer's product data, specifications and color charts for shop painting.
30. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
31. The latest ISO 9001 series certification.
32. Provide a scaled drawing for each pump service showing the pumps, motors, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.
33. Material Certification
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
    1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
    1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations,

B. The materials and equipment shall be stored on a flat, clean, dry surface to tprevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in Section 01610 DELIVERY, STORAGE AND HANDLING.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do no purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indacted on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Comply with the requirements specified in Section 01400 QUALITY ASSURANCE.

B. Pumps shall be the product of one manufacturer.

C. Pumps shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the pumps, motors and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

    a. The Contractor shall coordinate the variable frequency motor controllers supplied under Division 16 with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

    b. Variable frequency motor controllers shall be provided under Division 16 in accordance with Section 16260, VARIABLE FREQUENCY DRIVES.

2. Guide cables or rails and hatches can be supplied by the Contractor or the pump manufacturer at the Contractor's option. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

    a. The Contractor shall coordinate the hatch size with the pump manufacturer and submit as part of the shop drawings a written statement signed by the Contractor and pump manufacturer that the Contractor has received the required information from the pump manufacturer and that all parties have reviewed the hatch size and coordinated the hatch size, bridge crane and equipment removal.

    b. The Contractor shall coordinate the cable or rail size with the pump manufacturer and submit as part of the shop drawings a written statement signed by the contractor and pump manufacturer that the Contractor has received the required information from the pump manufacturer and that all parties have reviewed the cable or rail size and coordinated the size and equipment removal.

G. Services of Manufacturer's Representative as stated in Section 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping and electrical:

   a. 1 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

   a. 1 person-days.

4. Performance Testing: Field performance test equipment specified.

   a. 2 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of pumps shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

J. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.08 - REFERENCES

A. American Bearing Manufacturers Association (ABMA)

1. 9: Load Ratings and Fatigue Life for Ball Bearings.

2. 11: Load Ratings and Fatigue Life for Roller Bearings.

B. ASTM International (ASTM)

1. A36/A36M: Standard Specification for Carbon Structural Steel.

2. A48/A48M: Standard Specification for Gray Iron Castings.

3. A576: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

4. A743/A743M: Standard Specification for Castings, Iron-Chromium, Iron-Chromium Nickel, Corrosion Resistant, for General Application.

5. D2240: Standard Test Method for Rubber Property – Durometer Hardness.

C. American National Standards Institute (ANSI)

1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

D. Hydraulic Institute (HI)

1. Current Standards.

2. 11.6: Submersible Pump Tests

E. National Electrical Manufacturers Association (NEMA)

1. MG1: Motors and Generators.

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

A. The Owner has standardized on Submersible Solids Handling Pumps as manufactured by KSB.

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - SYSTEM DESCRIPTION

A. Pump capacities and operating data are indicated in the Process Pump Schedule.

B. Raw Wastewater Pumps: Pump unscreened raw wastewater from wet wells.

C. Coordinate pump dimensions and weights with Portable Davit Crane (DAV.HST-1). Hoist supplied by Owner.

D. Pumps normally operate with a flooded suction except that pumps will be subject to a suction lift if indicated in the Process Pump Schedule.

E. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

2.03 - SEISMIC DESIGN REQUIREMENTS

A. Conform to the requirements indicated on the structural drawings and as specified in Section 01900, SEISMIC DESIGN REQURIEMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

2.04 - PUMP CONSTRUCTION

A. Pumps: Recessed impeller, vortex type, single-stage, centrifugal pumps. Driven as indicated in the Process Pump Schedule.

B. Design and proportion all parts of pump specially adapted for the service specified and indicated.

C. Pump Mounting: Provide type as indicated and specified.

1. Mount each pump on a discharge elbow with discharging vertically.

D. Pump Casing, Fronthead, Backhead and Lower Housing:

1. Materials

a. Cast iron ASTM A48 Class 35.

b. ASTM A532 Class IIIA or HC600

(1) Minimum 600 to 650 BHN

2. Provide lifting devices on pump/motor assembly for handling.

    a. Type 316 stainless steel.

3. Provide ribs or reinforcing if required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to support the motor.

4. Face and drill flanges of discharge connections in accordance with 125-lb ANSI/ASME B16.1 Class 125 Standard.

5. Where a rail pipe is required face and drill suction in accordance with 125-lb ANSI/ASME B16.1 Class 125 Standard.

6. Provide components with machined registered concentric shoulder fits for precision alignment. Equipment without registered fits is not acceptable.

7. Pumps with splitter vanes in casing are not acceptable unless specifically indicated in the Process Pump Schedule.

E. Impeller

1. Type: Recessed radial curved vane or cupped type solids handling single suction.

    a. Straight vane impellers are not acceptable

2. Pump capable of passing a sphere size as indicated in the Process Pump Schedule.

3. Material

    a. Ni-Hard, ASTM A532 Class I, HC 600, or ASTM A532 Class IIIA minimum 650 BHN, or wear resistant hardened duplex stainless steel CD4MCu for pumps specified with Ni-Hard or High Chrome Iron Casing.

    b. Impellers shall be of wear resistant materials as specified above.

    c. Taper fit or key-seat and hold impeller to shaft by a streamlined bolt or locknut capable of holding in event of motor reversal under full torque. Impeller fasteners: Type 416 stainless steel.

    d. Statically and dynamically balance each impeller.

2.05 - MOTORS

A. Provide in accordance with Section 01170, ELECTRIC MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor speed: As stated in the Process Pump Schedule.

D. Enclosure: Explosion proof, Class I, Division 1, Group D; UL Listed or FM Approved.

E. In addition to the requirements for bearings specified under Electric Motors in Section 16220, MOTORS, provide pump motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

F. Operate without overheating at the speeds specified and indicated.

G. Service Factor: 1.15, with 1.0 inverter duty rating for pumps equipped with variable frequency motor controllers.

H. Minimum Efficiency

1. 100 percent Load

2. 75 percent Load

3. 50 percent Load

I. Rating: 460V, 3-phase, 60 Hertz.

J. Insulation: Class H with Class B temperature rise, 40 degrees C ambient.

K. Site Altitude: Less than 3,300 feet above sea level.

L. Motors

1. Provide complete sealed electric submersible squirrel cage induction motors in accordance with the above and as specified herein.
2. Provide all components housed in an air or oil filled cast-iron watertight electric submersible squirrel cage induction motor in accordance with the above and as specified herein.
3. Insulate stator-winding and lead with moisture resistant Class F or Class H insulation for continuous duty in 40 degrees C rise liquids.
4. Provide motor capable of ten (10) starts per hour at maximum speed.
5. Motor shaft: Type 416 or Type 420 stainless steel or ASTM A576 Cr 1040 with Type 420 stainless steel sleeve.
    a. One piece internal pump/motor shaft.
    b. Provide shaft of sufficient diameter that the ratio of the shaft overhand, distance from lowest bearing to the impeller hub, to the shaft diameter through the seal area not to exceed 2.5.
6. Dynamically balance rotor to within NEMA vibration limits.
7. All hardware: Type 316 stainless steel.
8. Provide all cables of multi-conductor SOW-A, G-GC or W of sufficient length to extend from pump motor to a junction box. Cable size shall be in accordance with NEC specifications.
9. Cable Entry
    a. Provide all power and control lead wires double sealed entering the motor in a method that prevents cable wicking.
    b. Provide the sealing system consisting of a rubber grommet to seal the cable exterior followed by interior epoxy seal.
    c. Provide each cable wire with a section of insulation removed to establish a window area of bare wire and each wire surrounded by epoxy potting material.
    d. Provide a cable strain relief mechanism as an integral part of this sealing system.
    e. Provide the cable sealing system capable of withstanding an external pressure test of 1,200 psi as well as a cable assembly pull test as required by UL or FM.
    f. Provide the cable entry rated by UL or FM for submerged operating depths to 85 feet.
    g. Singular grommet or other similar sealing systems are not acceptable.
10. Seals
    a. Provide two separate tandem-mounted mechanical seals with the upper and lower seals mounted to rotate in the same direction.
    b. Upper Seals
        (1) Provide seal completely immersed in an oil or glycol bath sealing the oil chamber and motor housing.
        (2) Materials: Silicon carbide rotating and stationary faces.

c. Lower Seals

(1) Provide lower seal with mating faces immersed in the oil or glycol bath sealing the pump volute and oil chamber.

(2) Materials: Silicon carbide rotating and stationary faces.

(3) Provide a cover extending completely over the lower seal spring.

d. Springs: Type 316 stainless steel.

e. Elastomers: Viton.

11. Moisture and Temperature Probes

a. Provide two moisture detection probes to detect moisture in the seal and stator cavity measuring conductivity.

b. Provide moisture detection panel and one piece cable from pump to panel, see electrical drawings for panel location. Contractor to provide conduit and cable from pump to control panel.

c. Provide sufficient length of cable to extend from the pump assembly to a junction box above top of wet well as stated in Part 6.

d. Provide O-ring sealed plugged fill and drain inspection ports.

e. Provide winding over temperature protection.

f. Moisture detection to alarm, over temperature to shut down pumps, indicate condition and alarm.

g. Provide NEMA 4X Type 316L stainless steel panel with moisture detection system.

12. Bearings

a. Provide a minimum of two bearings permanently lubricated but capable of being regreased.

b. Minimum B-10 bearing life of 100,000 hours.

13. Provide all mating surfaces machined and fitted with O-rings. All fittings shall be metal to metal contact between each machine surface.

14. Provide a Type 316 stainless steel or cast iron lifting attachment capable of lifting the entire pump and motor assembly.

15. Motors shall conform to UL or FM quality assurance specifications and be manufactured by an ISO-9001 company.

2.06 - DISCHARGE BASE

A. Provide an ASTM A48 Class 35 cast iron discharge base assembly including a 90 degree elbow and base to support the entire weight of the pump and motor and to secure the lower end of the guide rails.

B. Provide base machined to receive sliding bracket of pump discharge.

C. Provide seat constructed of bronze or non-metallic O-ring that is self-cleaning, non-clogging and non-sparking UL LISTED or FM APPROVED explosion proof.

D. Bolt to floor with Type 316 stainless steel anchors.

2.07 - GUIDE ASSEMBLY

A. Provide Schedule 40 Type 316L stainless steel guide rails or Type 316 cables for each pump discharge assembly.

1. Guide Rail: Pump manufacturer's standard size but not less than 2-inch diameter.

B. Provide Type 316L stainless steel intermediate supports for guide rails with a maximum spacing of 10 feet between supports.

C. Provide Type 316L stainless steel top guide rail retainer brackets to support the guide rails or cables. Bracket to be attached to top slab of wet well.

D. Provide Type 316 stainless steel wire rope of sufficient length, to reach from pump to top of wet well plus 10 feet and of strength for lifting pump and motor. Provide wire rope designed for attachment to lifting bail provided on motor and to the guide rail retainer bracket.

2.08 - HARDWARE

A. Type 316 stainless steel.

2.09 - GAUGES

A. Provide gauges assemblies for discharge of each pump in accordance with Section 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

B. Discharge Gauges: Compound type with operating range with top limit above pump shutoff head at maximum pump speed.

1. Scale: inches Hg to psi.

2.10 - SHOP PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

2.11 - SHOP TESTING

A. Provide motor shop testing in accordance with Section 01171, MOTORS and as specified.

1. Conduct motor efficiency and power factor tests at full load 100 and 50, 75 percent load.

2. Provide the following motor tests in accordance with ANSI/HI 11.6

a. Test motor integrity in a submerged condition.

b. Dry run no load test.

c. Motor electrical integrity test.

d. Moisture and temperature sensors integrity test.

B. Pump Tests

1. Test pump casings under a hydrostatic head of at least 75 psi or 150 percent of rated shutoff head, whichever is greater. Test casing with pump assembled.

2. Provide certified performance tests as specified herein for all pumps.

3. Certified performance testing.
    a. Testing of submersible pumps dry is not acceptable.
    b. Run pump at full speed rating point for 60 minutes prior to start of any testing.
    c. Full speed tests
        (1) Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.
        (2) Take readings to determine flow, differential pressure, rpm, horsepower, and wire to water efficiency.
        (3) Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available.
    d. Variable speed tests
        (1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.
        (2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.
        (3) Run a second test at a speed approximately midway between full and minimum speed.
        (4) Run addition tests for each reduced speed operating condition specified and indicated.
    e. Conduct additional tests as follows:
        (1) Run each pump at the minimum speed rating point for 4 hours and continuously record motor temperature. Pumps must be run submerged at LWL submergence as indicated.
    f. Factory tests on pumps
        (1) Use factory calibrated test drives.
    g. Provide a minimum of 30 days written notice to the Engineerprior to shop testing.
4. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.
5. Testing Acceptance Grade and Tolerances
    a. ANSI/HI 14.6 Acceptance Grade: 1U.
    b. Efficiency Tolerance: -0 percent.
    c. If pumps do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.
6. Tests of variable frequency motor controllers specified in Section 16260, VARIABLE FREQUENCY DRIVES.
7. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.
8. Repeat tests until specified results are obtained.
9. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

3.02 - INSTALLATION

A. Install items in accordance with shop drawings, and manufacturer's printed instructions.

B. Install pumping units and align.

1. Set base on metal shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support.

C. After alignment is correct, grout using high grade non-shrink grout.

1. Do not imbed leveling nuts in grout.

3.03 - PAINTING

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.05 - MANUFACTURER’S FIELD SERVICES

A. Manufacturer’s Field Services shall be provided as specified herein.

3.06 - MANUFACTURER’S TRAINING

A. Manufacturer’s training shall be provided as pecified herein.

3.07 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.08 - SPARE PARTS

A. Comply with the requirements specified in Section 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each pump
    a. One complete set of gaskets and O-rings.
2. For each set of pumps of the same size and performance.
    a. One set of all special tools required.

3.09 - SPARE UNITS

A. Contractor to furnish and deliver to Owner PS4.P-3 and associated appurtenances.

3.10 - FIELD TESTING

A. Test piping connections to prove the pump nozzle are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See DIVISION 1, GENERAL REQUIREMENTS for checklist.

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineerto determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, and motor inputs.

a. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

2. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

3. Repeat tests until specified results are obtained.

4. Contractor to provide all water labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

b. All calibrations must be within 30 days of the field testing.

c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

F. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

3.10 - CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 11308

RECESSED IMPELLER PUMPS AND APPURTENANCES

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PART 1 - GENERAL

1.01 - SCOPE

A. Provide and test recessed impeller pumps, motors, and appurtenances as indicated and in compliance with Contract Documents.

B. Attention is directed to the DOCUMENT 0700, GENERAL CONDITIONS and all the sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENTS AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the previously provided costs for the addition of the one SBR Transfer Recessed Impeller Pump and therefore, shall be utilized to cover the cost of the discrepancy between the Shop Drawing and this section.

1.03 - DEFINITONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Data regarding pump and motor characteristics and performance:

a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity, horsepower, efficiency and NPSHr.

(1) For units of same size and type, provide curves for a single unit only.

b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum impeller diameters available, acceptable operating range (AOR) and preferred operating range (POR).

c. Results of shop performance tests as specified.

d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch sheets, one curve per sheet.

2. Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide NPSH3 curve for each speed.
3. Motor data in accordance with SECTION 01171 – ELECTRIC MOTORS, Paragraph 1.04 – Submittals.
4. Wiring diagrams for motors.
5. Motor FLA data.
6. Shop drawing data for accessory items.
7. Certified setting plans, with tolerances, for anchor bolts.
8. Manufacturer's literature as needed to supplement certified data.
9. Operating and maintenance instructions and parts lists.
10. Listing of reference installations as specified with contact names and telephone numbers.
11. Certified results of hydrostatic testing.
12. Certified results of dynamic balancing.
13. Bearing temperature operating range for the service conditions specified.
14. List of recommended spare parts other than those specified.
15. Shop and field inspection reports.
16. Bearing Life: Certified by the pump manufacturer. Include design data.
17. Pump shop test results.
18. Motor shop test results.
19. Qualifications of field service engineer.
20. Recommendations for short and long-term storage.
21. Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.
22. Special tools.
23. Number of service person-days provided and per diem field service rate.
24. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.
25. Recommended location of suction and discharge pressure gauges.
26. Manufacturer’s product data, specifications and color charts for shop painting.
27. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
28. The latest ISO 9001 series certification.
29. Certified statement of pump, motor and shafting alignment within manufacturer tolerances.
30. Provide a scaled drawing for each pump service showing the pumps, motors, hoists including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.

31. Material Certification:

    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements specified in SECTION 01610, DELIEVERY, STORAGE AND HANDLING.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. All equipment shall be provided by the same manufacturer.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

D. Seismic Design Requirements

1. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

2. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

3. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

4. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

1.07 - QUALITY ASSURANCE

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Pumps shall be the product of one manufacturer.

C. Pumps shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the pumps, motors, and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

a. The Contractor shall coordinate the variable frequency motor controllers supplied under Division 16 with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

b. Variable frequency motor controllers shall be supplied under Division 16 in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

c. Provide certificate of co-ordination signed by pump, motor and variable frequency motor controller manufacturer.

d. Provide motors in accordance with SECTION 01171 – ELECTRIC MOTORS.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

3. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

a. 1 person-days.

4. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

a. 1 person-days.

5. Field Performance Testing: Field performance test equipment specified.

a. 1 person-days.

6. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

7. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

8. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of pumps shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

J. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.08 - REFERENCES

A. American Bearing Manufacturers Association (ABMA).

B. American National Standards Institute (ANSI):

1. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.

C. American Society of Mechanical Engineers (ASME):

1. Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

D. ASTM International (ASTM):

1. A36/A36M: Standard Specification for Carbon Structural Steel.

2. A48/A48M: Standard Specification for Gray Iron Castings.

3. A322: Standard Specification for Steel Bars, Alloy, Standard Grades.

4. A532: Standard Specification for Abrasion-Resistant Cast Iron.

5. A743/A743M: Standard Specification for Castings, Iron-Chromium, Iron-Chromium Nickel, Corrosion Resistant, for General Application.

E. Hydraulic Institute (HI):

1. Current Standards.

2. 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

F. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

A. The Owner has standardized on recessed impeller pumps as manufactured by Pentair Aurora.

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - SYSTEM DESCRIPTION

A. Pump capacities and operating data are indicated in the Process Pump Schedule.

B. SBR Transfer Pumps (SBR.TP-4): Pump raw municipal wastewater that has been through a screen with 6 mm openings and pump from the aerated pre-equalization tanks.

C. Coordinate pump dimensions and weights with hoists as specified in Sections 14300.

D. Pumps normally operate with a flooded suction except that pumps will be subject to a suction lift if indicated in the Process Pump Schedule.

E. Provide equipment rated in accordance with the Environmental Classification Schedule on Contract drawing 00 E-601.

2.03 - PUMP CONSTRUCTION

A. Pumps: Recessed impeller, vortex type, single-stage, centrifugal pumps. Driven as indicated in the Process Pump Schedule.

B. Pump Configuration: As indicated in the Process Pump Schedule.

C. Design and proportion all parts of pump specially adapted for the service specified and indicated.

D. Pump Mounting: Provide type as indicated and specified.

1. Horizontal Pumps:

a. Mount each pump and drive on a common base.

(1) Material: ASTM A36 fabricated structural steel.

(2) Provide structural steel shape bases, bent form bases are not acceptable.

(3) Provide bases with provisions for grouting and for anchor bolts.

(4) Design baseplates to support pump and driver.

(5) Provide planed surfaces of bearing pads for pumps and drives.

E. Pump Casing, Fronthead and Wear Plate:

1. Provide materials for the pump services as follows:

a. Pump Services: SBR Transfer Pumps.

(1) Cast Iron ASTM A48 Class 35B

(2) Ni-Hard, ASTM A532 Class I, HC 600 or ASTM A532 Class IIIA

(3) Minimum 650 BHN.

2. Design casings for removal of rotating parts without disconnecting suction and/or discharge piping.

a. For pumps with cup type impellers provide a two (2) piece radially split casing with separate suction piece.

b. For pumps with radial vane impellers provide a one (1) piece casing. Pumps requiring a replaceable wear element completely surrounding the impeller are not acceptable.

3. Provide lifting devices on pump casings for handling.

4. Provide ribs or reinforcing required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to support the motor.

5. Provide flanged slotted suction and discharge connections or face and drill flanges of suction and discharge connections, in accordance with ANSI/ASME B16.1 Class 125-lb. ANSI Standard.

6. Provide components with machined registered concentric shoulder fits for precision alignment. Equipment

7. without registered fits is not acceptable.

8. Provide high point of casing with an air vent or provide a self-venting casing and low point with a drain.

F. Main Frame:

1. Cast iron ASTM A48/A48M Class 40.
2. Fit to casing with machined registered joints.
3. Provide main frame designed to resist without distortion, all stresses due to impeller thrust and bearing loads.
4. Provide main frame designed to support shaft and impeller and to contain stuffing box and bearings.

G. Bearings:

1. Outboard bearing to be combination thrust and radial type; inboard bearing radial type.
2. Provide bearings in a dust and moisture proof enclosures.
3. Provide bearings with minimum LB-10 life rating of 100,000 hours at specified operating conditions and 40,000 hours minimum at 25 percent of the BEP at highest speed, based on latest ABMA and ANSI Standards.
4. Grease lubricated anti-friction type.
    a. Provide means in bearing housing, such as removable plug diametrically opposite grease fitting, to prevent over greasing of bearing.
    b. Grease fittings: Alemite.

H. Pump Shaft:

1. ASTM A322-C4140 heat treated steel or stainless steel type 420 or 430, machined.
2. Protect shaft from wear at stuffing box and from contact with pumped liquid by removable and replaceable sleeve.
3. Sleeves:
    a. Extend sleeves through stuffing box.
    b. Pumps of hard metal construction: Type GGK-FP with Eut. 12496 coating, 55 to 62 HRC.

I. Impeller:

1. Type: Recessed radial curved vane or cupped type solids handling single suction.
    a. Straight vane impellers are not acceptable
2. Pump capable of passing a sphere size as indicated in the Process Pump Schedule.

J. Material:

1. Ni-Hard, ASTM A532 Class I, HC 600, or ASTM A532 Class IIIA minimum 650 BHN, or hardened duplex stainless steel CD4MCu for pumps specified with Ni-Hard or High Chrome Iron Casing.
2. Key-seat or taper and hold impeller to shaft by a streamlined bolt or locknut capable of holding in event of motor reversal under full torque. Impeller fasteners: Type 416 stainless steel.
3. Statically and dynamically balance each impeller.

K. Handhole Cleanouts:

1. Locate handholes in suction nozzle or separate suction piece for horizontal pumps to provide access to impeller and interior parts.
2. Equip handholes with covers designed for easy removal.
3. Shape interior surface of cover to maintain contour of interior of casing to which it is attached to maintain efficiency and to prevent lodging of solids.
4. Gaskets: Neoprene or Buna-N.

5. Hardware: Type 316 Stainless Steel.

L. Seals:

1. Split Mechanical Seal:

a. Manufacturer: Chesterton Style 442

b. Materials:

(1) Gland: Type 316 stainless steel.

(2) Rotary Holder: Type 316 stainless steel.

(3) Hardware: Type 316 stainless steel.

(4) Springs: Hastelloy C or Elgiloy

(5) Rotating Faces: Silicon Carbide.

(6) Stationary Faces: Silicon Carbide

(7) Elastomers: Viton

(8) Restriction Bushing: Split type, ESC Carbon Graphite PTFE or Type 316 SST.

c. For pumps specified and indicated not requiring seal water, provide Enviroseal Spiraltrac bushing version D, type A

d. Seals will be installed in the pumps at the jobsite by the seal manufacturer's field service technician. Seals installed at the pump manufacturer's facility are not acceptable.

M. Couplings: Horizontal Pumps:

1. Non lubricated, polyurethane flex material type.

2. Split design.

3. Spacer type.

4. Manufacturer: Rexnord Omega or acceptable equivalent product.

5. Provide guards for protection for personnel, conforming to OSHA requirements.

a. Guards and Hardware: Type 316 stainless steel.

2.04 - MOTORS

A. Provide in accordance with SECTION 01171, ELECTRIC MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and motor speed: As indicated in the Process Pump Schedule.

D. Provide motors for horizontal pumps with mounts for bolting to baseplate.

E. In addition to the requirements for bearings specified in SECTION 01171, ELECTRIC MOTORS, provide pump motors with ball or roller bearings. Provide bearing with a minimum LB-10 life of 100,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI/ASA S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet (1 meter) from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Provide motor service factor of 1.0 in accordance with NEMA MG-1 requirements for VFD driven motors.

I. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

J. Rating: 460V, 3-phase, 60 Hertz.

K. Provide VFD driven motors with normally-closed winding thermistors for motor over-temperature protection.

L. Provide motors as inverter duty rated for use with VFD's per NEMA MG1.

M. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

N. Site Altitude: Less than 3300 feet above sea level.

O. Provide Inpro/Seal bearing isolators.

2.05 - DRAIN AND VENT PIPING

A. Drain and vent piping: Schedule 5 Type 316L stainless steel with Pressfit connections or Schedule 40 Type 316L stainless steel with socket welded connections. Provide a sufficient number of unions to permit removal of each valve and in-line device.

B. Provide pipe and fittings in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

C. Valves: Provide size and type as indicated and in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

2.06 - GAUGES

A. Provide gauges assemblies for suction and discharge of each pump in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

B. Suction Gauges: compound type.

1. Scale: inches Hg to psi

C. Discharge gauges: Provide standard range with top limit above pump shutoff head at maximum pump speed.

1. Scale: psi

2.07 - SHOP PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

2.08 - SHOP TESTING

A. Provide motor shop testing in accordance with SECTION 01171, ELECTRIC MOTORS.

B. Pump Tests:

1. Test pump casings under a hydrostatic head of at least 75 psi or 150 percent of rated shutoff head, whichever is greater. Test casing with pump assembled.

2. Provide certified performance tests as specified herein for all pumps and spare rotating assemblies.

3. Certified performance testing.

a. Run pump at full speed rating point for 60 minutes prior to start of any testing.

b. Full speed tests:

(1) Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.

(2) Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

(3) Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available. Test with the job submergence as indicated.

c. Variable speed tests:

(1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.

(2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.

(3) Run a second test at a speed approximately midway between full and minimum speed.

(4) Run additional tests for each reduced speed operating condition specified and indicated.

d. Factory tests on pumps:

(1) Use factory calibrated test drives.

e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.

f. Do not test pumps with job split seals.

4. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.

5. Testing Acceptance Grade and Tolerances:

a. ANSI/HI 14.6 Acceptance Grade: 1U.

b. Efficiency Tolerance: -0 percent.

c. If pumps do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.

6. Tests of variable frequency motor controllers specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

7. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.

8. Repeat tests until specified results are obtained.

9. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Install items in accordance with accepted shop drawings, manufacturer's printed instructions and as indicated.

B. Install pumping units on a concrete pad and align thereon.

1. Install as indicated.

2. Coupling halves must be disconnected and only reconnected after alignment.

3. Set base on plastic or stainless steel shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support. The use of leveling nuts is not acceptable

C. Horizontal pumps: Dowel pump and drive to baseplate after alignment in field to facilitate realignment after disassembly.

D. Final Coupling Alignment:

1. Perform only after base is installed and piping is connected and pump nozzle connections tested as specified herein.

2. If realignment is required piping must be disconnected prior to alignment, piping reconnected and alignment checked prior to connecting coupling halves.

E. After alignment is correct, grout using high grade non-shrink grout.

1. For horizontal pumps fill entire base and leave no gaps or voids.

F. Split Mechanical Seals: Install seals with installation by the seal manufacturer's field service technician.

3.02 - FIELD TOUCH-UP PAINTING

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.03 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.04 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein

3.05 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided as specified herein.

3.06 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.07 - SPARE PARTS

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each pump:

a. One complete set of gaskets and O-rings.

b. One mechanical seal repair kit and restriction brushing for each pump provided with mechanical seals.

c. One shaft sleeve.

2. For each set of pumps of the same size and performance.

a. One set of all special tools required.

3.08 - FIELD TESTING

A. Test piping connections to prove the pump nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 01 for checklist.

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and vibration and motor inputs.
    a. Provide vibration signature test data for each pump and drive assembly.
        (1) Limit: 50 percent of ANSI/HI allowable limits.
    b. Bearing Temperature: Bearing temperature not to exceed 180 degrees F.
    c. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.
2. Run each pump for minimum four hours prior to taking temperature readings of the pumps, motors, and shafting.
3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
4. Repeat tests until specified results are obtained.
5. Contractor to provide all water, labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.
    a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.
    b. All calibrations must be within 30 days of the field testing.
    c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.
    d. Contractor is responsible for delivery and disposal of water used for testing.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

F. Remove and replace defective equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

3.09 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 01 for checklist.

END OF SECTION

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SECTION 11377

ROTARY POSITIVE DISPLACEMENT BLOWERS AND APPURTENANCES

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PART 1 - GENERAL

1.01 - SCOPE

A. Provide and test rotary positive displacement blowers, motors, V-belt drives, silencers, acoustical enclosures, variable frequency motor controllers and appurtenances as indicated and in compliance with Contract Documents.

B. Attention is directed to the DOCUMENT 0700,GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the previously provided costs for the addition of the one SBR Rotary Positive Displacement Blower and therefore, shall be utilized to cover the cost of the discrepancy between the Shop Drawing and this section.

1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data regarding blower, motor and acoustical enclosure characteristics and performance:
    a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate blowers, showing they meet indicated and specified requirements for capacity, pressure rise, horsepower, temperature rise and efficiency.
        (1) For units of same size and type, provide curves for a single unit only.
    b. Provide catalog performance curves at maximum blower speed indicated and specified for each service showing maximum and minimum speeds available.
    c. Results of shop performance tests as specified.
    d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch sheets, one curve per sheet.
2. Motor data in accordance with Specification 01171 – ELECTRIC MOTORS.
3. Full load current
4. Efficiency at ½, ¾ and full load.
5. Nameplate data
6. Service factor
7. Control Panels:
    a. Bill of Materials including manufacturer, model number and quantities.
    b. Annotated product cut sheets for enclosures and control panel components
    c. Wiring diagrams show all required field wiring and terminations
    d. Front elevations of control panels showing dimensions, location of panel internal and panel exterior mounted components. Provide elevations with and without doors.
    e. Wiring diagrams and wiring schematics clearly indicating all required field wiring and terminations.
    f. Submit wiring diagrams using project specific tags indicated on the Contract mechanical process, electrical and instrumentation drawings.
8. Materials listing
9. Shop drawing data for accessory items.
10. Certified setting plans, with tolerances, for anchor bolts.
11. Manufacturer's literature as needed to supplement certified data.
12. Operating and maintenance instructions and parts lists.
13. Listing of reference installations as specified with contact names and telephone numbers.
14. Certified results of blower pressure testing.
15. Certified results of dynamic balancing.
16. Bearing temperature operating range for the service conditions specified.
17. List of recommended spare parts other than those specified.
18. Shop and field inspection reports.

19. Bearing Life: Certified by the pump manufacturer. Include design data.
20. Blower shop test results.
21. Motor shop test results.
22. Qualifications of field service technician.
23. Recommendations for short and long-term storage.
24. Resonant frequency analysis for variable speed systems.
25. Shop and field testing procedures, set up, equipment to be used and testing tolerances to be followed.
26. Special tools.
27. Number of service person-days provided and per diem field service rate.
28. Results of field vibration test data including a vibration signature for each blower and drive assembly. Provide vibration testing procedure for review.
29. Recommended location of inlet and discharge pressure and temperature instrumentation.
30. Blow-off valve assembly and details.
31. Schematic control and power wiring diagrams.
32. Manufacturer's product data, specifications and color charts for shop painting.
33. The latest ISO 9001 series certification.
34. Provide a scaled drawing for each blower service showing the blower, drive and enclosure, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.
35. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.
    1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.
    1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
    2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The material and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Drawings.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Blowers shall be the product of one manufacturer.

C. Blowers shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the blowers, motors, filters, silencers, acoustical enclosures, controls and appurtenances from the blower manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

1. Variable frequency motor controllers are supplied under Division 16 in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

2. The blower system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

a. The Contractor shall coordinate the variable frequency motor controllers supplied under Division 16 with the blower and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, blower manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the blower and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection.

b. Also include all motor data and information that has been used for the coordination.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

   a. 2 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

   a. 2 person-days.

4. Field Performance Testing: Field performance test equipment specified.

   a. 2 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of blowers shall have a minimum of twenty five (25) operating installations with blowers of the size specified and in the same service as specified operating for not less than five (5) years.

J. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

K. For variable speed blowers systems the blower manufacturer must perform an analysis of the combined motor and blower assembly for resonant frequency or their harmonics independent of a structure.

1. Submit a copy of these calculations for the record.

2. Should calculations indicate the probability of encountering such frequencies within the speed range required, provide all additional supporting devices necessary to affect the unit mass, and raise or lower resonant point.

3. Provide and install such additional devices at no additional cost to the Owner.

1.08 - REFERENCES

A. American Gear Manufacturers Association (AGMA).

1. 6001: Design and Selection of Components for Enclosed Gear Drives

2. 6025: Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives

B. American National Standards Institute (ANSI):

1. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.

2. S2.19: Mechanical Vibration - Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Possible Unbalance, Including Marine Applications

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

1. 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

D. American Society of Mechanical Engineers (ASME):

1. B16.1: AN Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800

E. American Society for Testing and Materials (ASTM):

1. A48/A48M: Standard Specification for Gray Iron Castings.
2. A336/A336M: Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts
3. A1043/A1043M: Standard Specification for Structural Steel with Low Yield to Tensile Ratio for Use in Buildings

F. International Organization For Standardization (ISO):

1. 1217: Displacement compressors - Acceptance tests
2. 2151: Acoustics Noise test code for compressors and vacuum pumps Engineering method (Grade 2)
3. 9001: Quality management systems - Requirements

G. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
2. MG1: Motors and Generators.

H. Occupational Safety & Health Administration (OSHA)

1. 29 CFR Part 1910: Occupational Safety and Health Standards

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

A. The Owner has standardized on Rotary Positive Displacement Blowers as manufactured by Aerzen.

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - SYSTEM DESCRIPTION

A. Blower capacities and operating data are indicated in the Blower and Compressor Schedule.

B. System Operating Conditions:

1. Site Altitude, above mean sea level: 60 feet
2. Temperature Range: 0 to 100 degrees F
3. Relative Humidity Range: 0 to 100 percent
4. Provide blower motors sized for operating at the minimum and maximum temperatures without overloading at the relief valve setting.

C. Equipment Limitations:

1. Blowers: SBR.BLW-4
    a. Maximum Total Blower Assembly Weight: 3,000lbs.
    b. Maximum Enclosure Assembly Height: 66 in.
    c. Maximum Enclosure Length x Width: 60 x 61in.

D. Noise Criteria:

1. Upper noise levels with intake and discharge silencers not to exceed the following:

Frequency	dB(1 p),	(Ref. 0.0002 microbar)
63	104	75.1
125	100	81.8
250	94	85.9
500	91	82.5
1,000	88	79.2
2,000	86	73.1
4,000	87	67.5
8,000	87	56.2

2. Overall noise level from assembled blower and silencers not to exceed 90 dB(A) at 3.0 feet from equipment. Noise level from individual assembled blower not to exceed 80dB(A) at 3.0 feet, in the free field. Noise level in the room with three blowers running at maximum conditions not to exceed 97dB(A).

E. Coordinate blower assembly package dimensions and weights with hoists as specified in SECTION 14300, HOISTING EQUIPMENT.

2.03 - SEISMIC DESIGN REQUIREMENTS

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

2.04 - BLOWER CONSTRUCTION

A. Blowers: Rotary positive displacement type. Driven as indicated in the Blower and Compressor Schedule.

B. Provide blower configuration as indicated in the Blower and Compressor Schedule.

C. Design and proportion all parts of blowers to be especially adapted for the service specified and indicated. Provide room for inspection, repair and adjustment.

D. Blower Housing:

1. Cast iron ASTM A48/A48M Class 30 externally ribbed to prevent distortion.

2. Provide lifting devices on casings for ease of handling.

3. Face and drill flanges of inlet and discharge connections in accordance with 150-lb. ASME B16.1 (PN10) Standard.

4. Provide components with machined registered concentric shoulder fits to ensure precision alignment.

5. Provide tapped connections on inlet and discharge for pressure and temperature instrumentation connections.

6. Provide integral controlled pre-inlet for active pulsation control.

E. Rotors:

1. Type: Tri-lobe straight design. Two lobe types are not acceptable.
2. Provide stiff-shaft design with the first lateral critical speed at least 120 percent of the maximum allowable speed. Any torsional natural frequency shall be at least 10 percent above or 10 percent under the operating speed of the blower.
3. Material: Nodular cast iron with steel through shaft. Plug rotor cavities, dust tight to prevent contamination.
4. Dynamically balance rotors and shafts in accordance with ISO 1940/ANSI S2.19 G3.
5. Precision machined to final tolerances, coatings are not acceptable.
6. Material: Carbon Steel ASTM Type A1043/A1043M.

F. Bearings:

1. Anti-friction type.
2. Oil Splash lubricated. Grease lubrication is not acceptable.
3. Provide the drive shaft bearing sized for an overhung V-belt drive under maximum continuous operating load.
4. Provide bearings with minimum ABMA L-10 or B-10 life rating of 100,000 hours at specified operating conditions, based on latest ABMA and ANSI Standards. In addition, the bearing selection shall be such to achieve Mean Time Between Overhauls of five (5) years or more with normal maintenance.
5. Provide bearing covers and spacer ground for setting axial clearances for uniform bearing load.

G. Timing Gears:

1. Single helical type.
    a. Minimum AGMA quality rating: 12.
    b. Service factor: 1.70 minimum in accordance with AGMA.
2. Hardened alloy steel, ASTM A336/A336M CLF12.
3. Provide gears secured on tapered shaft ends using hydraulic expansion and interference fit allowing for stepless clearance setting and greater efficiency through accurate timing.

H. Bearing and Timing Gear Lubrication:

1. Splash Lubrication:
    a. Self-contained system.
    b. Provide oil level sight glass.

I. Seals:

1. Rotor Chamber Seals: Non contacting, no friction vented labyrinth seals, each containing:
    a. 4 piston rings.
    b. Oil deflector ring.
    c. Grooved, multiple labyrinth bushing.
2. Drive shaft seal: lip seal. Lip seal internal to the machine are not acceptable.
    a. Provide radial lip seal riding on a replaceable shaft sleeve. Lip seals riding directly on the blower shaft are not acceptable.
    b. Shaft sleeve.
    c. Provide access for seal replacement.

2.05 - DRIVES

A. V-Belt Drive:

1. Service Factor: 1.40 based on motor nameplate horsepower.
2. Belts: Matched cogged type V-belts.
3. Anti-static belt type.
4. Provide passive automatic V-belt tensioning device.
5. Dynamically balance sheaves for linear tip speeds > 6500 feet/min.
6. Provide metal guards for protection of personnel, guards to conform to OSHA standards. Guard material shall be perforated galvanized steel. Expanded metal, if used shall be limited to small surfaces not exceeded 1 foot^2.

2.06 – OUTSIDE INLET SILENCER/SCREEN

A. Blower manufacturer to provide a combination silencer and screen at the end of the inlet pipe outside.

B. Manufacturers:

1. Solberg.
2. Or an acceptable Equivalent.

C. Housing: Carbon Steel with a baked on enamel finish.

D. Screen: 316 stainless steel wire mesh.

E. Ends: ANSI 150 Flanges.

2.07 - INLET FILTERS/SILENCERS

A. Cast aluminum housing or welded steel construction.

B. Provide so that the inlet filter element is the last component in contact with the air prior to entering the blower. Any absorption material used in the intake silencer shall be upstream of the inlet filter element.

C. Provide washable filter elements of spun PVC construction:

1. Provide filter maintenance indicator.
2. The filter media shall have an average efficiency of 90 percent by weight per ASHRAE 52.2 with synthetic dust.

D. Provide arrangement that allows for the inspection of the blower rotor chamber without filter/silencer housing removal.

1. Pressure Rating: 15 psi.

2.08 - BASE FRAME/DISCHARGE SILENCER

A. Provide a combination unit, cast iron or welded steel construction.

B. The discharge silencer shall be designed to reduce the noise emitted by the piping leaving the blower package to 85 dB(A).

C. Provide capable of internal inspection without blower removal.

D. Distortion resistant, cylindrical vessel.

E. Provide low pressure drop design without diffuser elements.

F. Nonabsorption material type. Fibrous materials or any absorption materials, which could deteriorate over time and are not acceptable.

2.09 - DISCHARGE MANIFOLD

A. Welded or cast construction, flange mounted to discharge silencer discharge.

B. Designed to accommodate check valve and pressure relief valve..

2.10 - DISCHARGE CHECK VALVES

A. Provide full-bore type without the use of any internal springs.

B. Provide the discharge check valve removable without disconnecting the discharge piping.

C. Provide Type 316L stainless steel flap.

D. Elastomer materials: Suitable for continuous operation at 300 degrees F .

2.11 - PRESSURE RELIEF VALVES

A. Spring loaded, field adjustable with integral dampening air piston.

B. Body: Cast iron, flanged.

C. Trim: Bronze.

D. Provide valves mounted vertically, downstream of discharge silencer and upstream of the discharge check valve and any potential obstruction to the air stream. Valve shall discharge within segmented section of sound enclosure, to isolate relief valve discharge from blower and motor airspace.

E. Provide a single valve sized to pass full blower capacity.

F. The valve shall start opening at the blower maximum rated pressure.

G. The pressure rise across the fully opened valve not to exceed 10 percent of the pressure setting.

H. Valve setting: At least 0.7 psi higher than the maximum operating pressure to prevent chattering.

I. Provide the valve with a proportional characteristic and close within 0.1 psi of the pressure set point. Valves with a closing point lower than the set point are not acceptable.

2.12 - DISCHARGE FLEXIBLE CONNECTORS

A. Silicone rubber type, with Type 316 stainless steel clamps.

B. Working pressure: 15 psig

C. Temperature Rating: 300 degrees F.

2.13 - CONTROL PANEL

A. Mount control panel directly on blower package/enclosure. Provide UL 508A listed control panel.

B. Component Enclosure:

1. NEMA 4X.

C. Completely wire components to terminal boards.

D. Provide the following instruments flush mounted:

1. LOCAL/REMOTE Switch.
2. Emergency Stop (ESTOP) pushbutton
3. START-STOP pushbuttons, momentary-contact type with lock-out latch.
4. Inlet and Discharge Manometer: Remote magnetic dial type.
    a. Inlet Calibration: Inches w.c. vacuum and psi.
    b. Discharge Calibration: Pounds per square inch.

5. Inlet and Discharge Temperature: Non-mercury type.
    a. Case: Phenolic or aluminum with white laminated plastic dial.
    b. Unit with 4-1/2-inches dial with range of approximately 50 to 300 degrees F and accuracy of at least 1 percent of full scale range.
6. Provide manual reset buttons for limit switches.
7. Provide dry-type output contacts for remote indication of the following in accordance with Contract P&IDs:
    a. High Temperature Alarm
    b. High Pressure Alarm
    c. ESTOP Activated Alarm
    d. Run Status
    e. Not in Remote Status
8. Provide dry-type input contacts for the following in accordance with Contract P&IDs:
    a. Run Command
    b. Stop Command

2.15 - BLOWER PACKAGE ASSEMBLY

A. Provide all blower components as specified herein, pre-piped and mounted on a structural steel frame.
    1. Blower package and sound enclosure to be factory assembled. Assembly to be provided, tested and guaranteed by the blower manufacturer.
    2. Mount blower for vertical flow top to bottom, side/side flow arrangements are not acceptable.

B. Provide a vibration isolator for each leg of the assembly frame.
    1. Provide rubber type to absorb a minimum of 80 percent of the vibration over the entire operating range.
    2. Designed to bear weight of entire assembly without degradation.

C. Sound Enclosure:
    1. Provide to cover the entire blower package and all accessories specified.
    2. Provide mounted on steel skid, with oil drip pan and fork slots for lifting from the proper side.
    3. Galvanized steel sheet, painted as specified.
    4. No welding on external surfaces.
    5. Provide quick release side panels and hinged roof.
    6. Provide heavy duty steel latches and handles.
    7. Provide forced ventilation by means of a fan driven by blower shaft.
    8. Provide pressure relief valve outlet connected to a separate louvered port.
    9. Provide louvers of extruded and anodized aluminum.

2.16 - MOTORS

A. Provide in accordance with SECTION 16220, MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of blowers under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and motor speed: As indicated in the Blower and Compressor Schedule.

D. Provide NEMA motors. IEC motors are not acceptable.

E. In addition to the requirements for bearings specified under Electric Motors in SECTION 16220, MOTORS provide blower motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 50,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Service Factor: 1.15, with 1.0 inverter duty rating for blowers equipped with variable frequency motor controllers.

I. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

J. Rating: 460V, 3-phase, 60 Hertz.

K. Insulation: Class F with Class B temperature rise, 40 degrees C ambient.

L. Site Altitude: Less than 3,300 feet above sea level.

M. Provide Inpro/Seal bearing isolators for all blowers controlled by variable frequency motor controllers.

2.17 – SHOP PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

2.18 – SHOP TESTING

A. Provide motor shop testing in accordance with SECTION 01171, MOTORS.

B. Blower Tests:

1. Test blowers under a hydrostatic head of at least 20 psi.

2. Provide certified performance tests as specified herein for all blowers.

3. Certified performance testing.

a. Provide performance testing of the entire package assembly in the blower manufacturers facility

b. Run the blower assembly including acoustical enclosure at full speed rating point for 60 minutes prior to start of any testing.

c. Full speed and variable speed tests:

(1) Test blowers at the conditions specified and indicated and take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.

(2) Provide performance testing in accordance with ISO 1217 and noise testing in accordance with ISO 2151.

d. If blowers do not meet the tolerances specified, modify the equipment and retest until the specified results are obtained.

4. Tests of variable frequency motor controllers specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

5. In the event that specified tests indicate that blower, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all blowers, motors, and variable frequency drives at no additional cost to the Owner.

6. Repeat tests until specified results are obtained.

7. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Install items in accordance with shop drawings with no exceptions noted, manufacturer's printed instructions and as indicated.

B. Install blower package assembly on a concrete pad and align thereon.

3.02 - PAINTING

A. After installation and testing with no exceptions by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.03 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.04 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein.

3.05 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided as specified herein.

3.06 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.07 - SPARE PARTS

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each blower:

a. One complete set of gaskets and O-rings.

b. Two filters.

2. For each set of blowers of the same size and performance.

a. One set of all special tools required.

3.08 - FIELD TESTING

A. Test piping connections to prove the blower nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with blower nozzles. This must be performed and the piping acceptable prior to any field performance testing.

B. Field testing will not be conducted without a procedure with no exceptions noted, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 1 for checklist.

C. After installation of blower assemblies, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each blower in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record capacity, differential pressure, blower bearing housings and motor bearing temperature, noise and vibration and motor inputs.

a. Provide vibration signature test data for each blower and drive assembly.

b. Bearing Temperature: Bearing temperature not to exceed 180 degrees F.

c. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

2. Run each blower for minimum one hour prior to taking temperature readings of the blowers and motors.

3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

4. Repeat tests until specified results are obtained.

5. Contractor to provide all labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all blower systems even in those cases where permanent flow meters are installed.

b. All calibrations must be within 30 days of the field testing.

c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted.

3.09 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 11398

DIESEL ENGINE-GENERATOR SET AND APPURTENANCES

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PART 1 – GENERAL

1.01 - SCOPE

A. Furnish, place in operation, and test standby diesel engine driven generator set, EPA Compliant, complete with enclosure, instrumentation and controls, and required supporting systems as specified herein.

B. The unit shall be provided in an outdoor, weather-proof, non-walk-in, sound attenuated enclosure with an integral sub-base fuel storage tank with a capacity for 24 hours of standby operation running at full load.

C. The unit shall have a minimum power rating as indicated on Contract drawings, standby at 80 percent lagging power factor with three-phase, 60-Hertz, 480 volt, four-wire, alternating current generator.

D. The unit shall be arranged for automatic starting and stopping-, and load transfer upon failure of the normal source of power through the pump station electrical enclosure automatic transfer switch specified in SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT.

E. The engine generator set shall exhibit less than 20 percent voltage dip and less than 5 percent frequency dip during starting of the loads identified in Attachment A, Attachment B and Attachment C to this Section.

F. The engine-generator package shall be complete in all respects and shall include all equipment and controls necessary for a fully operational standby power supply system.

G. The generator unit shall comply with the Commonwealth of Massachusetts, local and federal codes and regulations for standby diesel generators.

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the previously provided costs for the addition of the One Diesel Engine Generator and therefore, shall be utilized to cover the cost of the discrepancy between the Shop Drawing and this section.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. “Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

2. Outline equipment drawings and elevation drawings with shipping splits with estimated weights defined.

3. Bill of Materials including manufacturer name, model number, and quantities.

4. Equipment catalog cuts clearly annotated to show which products and options are being supplied.

5. Wiring diagrams showing internal and external wiring. Wiring diagrams shall clearly indicate all required field wiring and terminations.

6. Enclosure layout drawings showing locations of internal and external mounted devices including light fixtures, receptacles, panelboards, heaters, batteries and battery chargers and fire alarm system components.

7. Submit catalog cut sheets for devices including light fixtures, receptacles, panelboards, batteries, battery chargers, and fire alarm system components.

8. Engine-generator skid base drawings.

9. Performance specifications of all items of equipment.

10. Engine generator loading calculation, per the requirements of Attachment A, Attachment B and Attachment C to this section.

11. Provide certificate of conformance to UL Standard 2200, Stationary Engine Generator Assemblies.

12. Attenuation curve for the silencing equipment as offered to accomplish the required silencing for this installation.

13. EPA Tier compliance certificate.

14. Data to be provided by engine generator system supplier:

a. Submit generator loading calculations and data for engine, generator, and accessories: (for rated kW capacity).

(1) Engine Data

(a) Manufacturer

(b) Model

(c) Number and arrangement of cylinders

(d) RPM

(e) Bore X stroke

(f) Maximum power at rated RPM

(g) BMEP at rated kW (including any parasitic loads and generator efficiency)

(h) Piston speed, feet per minute

(i) Make and model of governor

(j) Make and model of overspeed shutdown device

(2) Generator Data

(a) Manufacturer

(b) Model

(c) Rated kVA

(d) Rated kW

(e) Voltage

(f) Temperature rise above 40 degrees C ambient. Stator by thermometer and field by resistance in degrees C.

(g) Class of insulation

(h) Generator efficiency including excitation losses at 80 percent PF

1) Full load

2) Three quarters load

3) Half load

(i) Generator sub-transient reactance in ohms

(3) Guaranteed maximum fuel consumption rate at generator terminals @ 138,000 BTU/gallon of ultra-low sulfur diesel fuel:

(a) Full load, gal/hr

(b) Three-quarters load, gal/hr

(c) Half load, gal/hr

(4) Generator unit and accessories

(a) Weight of unit

(5) Exhaust gas emissions data, maximum values at full load, 3/4 load, 1/2 load, and 1/4 load:

Temperature in degrees F

(6) Flow in ACFM (mass and volume)

(7) Combustion air volume in CFM

(8) Cold cranking amperes rating of engine starting batteries (CCA).

1. Provide manufacturer's printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated.
2. Information on the proposed jacket water treatment and procedures for flushing of the cooling systems.
3. Engine-generator skid base drawings, indicating size and location of anchor bolts, and conduit locations.
4. Operations and Maintenance Manuals.
5. As-built drawings and material summary shall be shipped with the equipment.
6. Control panel layout drawings, dimensions, and component bill of materials. Outline drawings showing conduit entry areas and anchoring information. Description of control including operation of interface equipment.

7. Electrical, instrumentation, control and wiring diagrams in sufficient detail to allow installation of instrumentation and controls and electrical components.

8. Time versus current characteristic curves for generator main circuit breaker.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. The engine-generator set shall be factory designed, certified prototype tested, and as specified. The manufacturer shall be regularly engaged in the production of this type of equipment and shall maintain a permanent service organization and supply of spare parts, of the types utilized for the equipment specified herein.

1.08 - REFERENCES

A. American Gear Manufacturers Association (AGMA)

B. American Institute of Steel Construction (AISC)

C. American Iron and Steel Institute (AISI)

D. American Society of Mechanical Engineers (ASME)

E. American National Standards Institute (ANSI)

F. American Society for Testing Materials (ASTM)

G. American Welding Society (AWS)

H. American Bearing Manufacturers Association (ABMA)

I. Institute of Electrical and Electronic Engineers (IEEE)

J. National Electrical Code (NEC)

K. National Electrical Manufacturers Association (NEMA)

L. Occupational Safety and Health Administration (OSHA)

M. Steel Structures Painting Council (SSPC)

N. Underwriters Laboratories, Inc. (UL)

O. National Fire Protection Association (NFPA)

P. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.09 - SEISMIC REQUIREMENTS:

A. Generator unit shall conform to the seismic requirements as indicated and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

1.10 - UNIT PERFORMANCE

A. The units shall be utilized to provide standby power service in the event the normal source is not available.

B. The voltage regulation shall be within plus or minus one percent from zero load to full-rated load. Upon application or removal of full-rated load in one step, the transient voltage dip and recovery to steady state operation shall be within five seconds.

C. Stable or steady state operation is defined as operation with the frequency variation not exceeding plus or minus 0.25 percent (0.15 Hertz) and voltage variation plus or minus one percent of their mean value for constant load from zero load to full rated load. A rheostat shall provide plus or minus five percent voltage adjustment from rated voltage.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

A. The Owner has standardized on standby diesel engine driven generator sets as manufactured by Kohler.

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - GENERAL

A. Engine-generator set shall be a factory-assembled unit that is a standard production unit with existing torsional analysis data. Mixing and matching engine and generator by a third-party supplier is not acceptable.

B. The engine and generator shall be directly connected with a flexible coupling, shall be free from injurious torsional or other vibration and shall be mounted on a heavy steel sub-base.

C. The engine and generator shall be directly connected and shall operate at the same rotative speed. The use of gearing or other speed adjustment between the engine and the generator, such that the engine and generator operate at different rotative speeds will not be allowed.

D. The engine-generator set shall allow easy access to the various parts for maintenance purposes.

E. The engine-generator set shall be pre-piped and pre-wired.

F. The complete engine-generator unit shall be free from harmful torsional or other vibration throughout the entire operating range of speed and load. The engine manufacturer shall provide an analysis of the complete engine-generator unit, which shall show where any critical speed will be encountered, together with the order, the frequency and magnitude of any critical speed.

2.03 - ENGINE

A. The diesel engine shall be of V-type construction, four-stroke cycle, turbo-charged, full compression ignition, diesel, with mechanical fuel injection. The unit shall operate at a speed of not more than 1800 rpm.

B. The rating of the engine shall not exceed the manufacturer's published standby rating. The gross engine horsepower required to produce the standby rating shall not exceed the manufacturer's published continuous duty rating by more than 150 percent. Continuous duty rating shall be as defined in BS649 or DIN6270 but in no case shall it exceed the manufacturer's published continuous duty rating. The gross engine horsepower required for the generator set standby rating described above shall include all parasitic demands such as generator inefficiencies, fuel pumps, water pumps, and all accessories necessary to the unit's proper operation while operating at rated loads.

C. The engine shall be capable of satisfactory operation on ultra-low sulfur diesel fuel.

2.04 - ENGINE GENERATOR ENCLOSURE

A. Provide complete factory pre-wired, weatherproof, sound attenuated, non walk-in enclosure.

B. Building capable of withstanding wind equal to 125 mph.

C. Roof load equal to 50 psf.

D. The sound attenuation shall be provided with noise reduction level of 65 dBA at 23ft from the enclosure.

E. The inlet and exhaust air handling system shall provide the necessary level of sound attenuation.

F. Provide enclosure with high efficiency, LED type, industrial, enclosed with acrylic lens, fiberglass housing and UL listed light fixtures. Provide light switches at each door.

G. The enclosure shall be provided with electrical space heater(s), designed to hold a minimum space temperature of 50 degrees F, with outside temperature of -1 degree F. Building shall be pre-painted aluminum stressed-skin construction, door and door frame, lifting rings, mounting frame, insulation, electrical package, louvers, muffler mounting bracket, and other appurtenances to provide complete unit.

H. Electrical Package

1. All equipment and devices shall be U.L. listed.

2. Provide enclosure electrical package complete and factory pre-wired. The enclosure package shall include lighting, receptacles, heating and ventilation equipment.

3. Provide generator electrical

4. Provide ground studs for earth grounding.

I. Louvers and Dampers

1. Provide acoustical louvers and dampers for engine generator inlet, exhaust and ventilation air.

2. Fixed louvers, all aluminum construction, riveted into aluminized steel frame to form rigid, water resistant assembly.

3. Dampers shall be powered closed, spring open, fail safe type.

4. Properly size louvers and dampers to allow sufficient engine combustion air, radiator cooling air, and ventilation air with maximum 0.5 in. water restriction.

J. Enclosure shall be pre-painted steel construction, with removable panels to allow for maintenance with muffler mounting bracket, and other appurtenances to provide a complete unit.

1. Muffler and Mounting Bracket

a. Critical grade silencer with bracket.

b. Provide exhaust pipe with birdscreen and rain cap.

c. All interior engine exhaust piping to be insulated.

2. Fuel Piping

a. Provided integral with base fuel tank.

2.05 - EQUIPMENT

A. Governor

1. Provide isochronous solid state governor, capable of maintaining isochronous regulation from no load to full rated load within 0.25 percent of rated frequency.

2. The governor controller shall be mounted within the generator control panel. The governor shall have the capability for manual adjustment of speed setting and speed droop. Speed droop shall be adjustable from 0 to 5 percent from no load to full load. The controller shall eliminate all electromagnetic interference.

3. Provide a separate overspeed shutdown device which shall, in case of predetermined overspeed of the operation of various protective devices as later specified, instantly stop the engine without the fuel injection system losing its prime.

2.06 - GENERATOR AND EXCITATION SYSTEM

A. The generator shall be drip-proof, guarded, and be able to connect to the specified engine output and shall be 3-phase, 60-Hertz, 4-wire, 480-volt operation, "WYE" connected. The generator shall be mechanically and torsionally matched to the engine driver and shall be provided to withstand inherent pulsating torques of the engine. Full load efficiency of the combined generator, exciter and regulator shall be not less than 95 percent.

B. The generator shall conform to the applicable parts of the following standards, unless otherwise specified:

1. NEMA MG1, Motors and Generators
2. IEEE 43, Recommended Practice for Insulation Testing of Large AC Rotating Machinery
3. CSA C22.2-100 Designation ABL3
4. Testing shall be in accordance with IEEE-115 and NEMA MG-1 standards

C. The generator windings, insulation and excitation system shall be braced to withstand any possible short-circuit stresses.

D. The temperature rise of the generator windings, when operated at rated prime power load and under continuous duty conditions with cooling air inlet temperature of 40 degrees C, shall not exceed 130 degrees C when measured by the resistance method.

E. The stator frame shall be fabricated bar and plate steel construction.

1. All insulation materials used in the stator shall have a temperature rating of Class H per IEEE Standard 1. The coils shall be of a formed coil construction using a magnet wire meeting NEMA MW36-C specifications.
2. The complete stator shall be wound with a 2/3 stator winding pitch and processed in a vacuum pressure impregnation chamber. Encapsulation of the stator shall be accomplished with a two-part epoxy system.

F. The rotor shall be of the fully laminated, salient pole type. Cooling fans shall be an integral part of the rotor assembly. The rotor shall be dynamically balanced for all speeds up to 125 percent of rated speed per NEMA specification.

1. Insulation materials used on the rotor shall have a temperature rating of Class H. The poles shall be of a layer wound construction using a magnet wire meeting NEMA MW35-C or MW36-C specifications.
2. The complete winding and rotor pole assembly shall be in a vacuum pressure impregnation chamber. Encapsulation of the assembly shall be accomplished with a thixotropic, single component epoxy resin.

G. The exciter shall be a high frequency, direct connected, rotating brushless type, three phase, full wave rectified, and shall be matched with the generator rotor and control system. Both the armature and field windings shall be a vacuum pressure impregnated with epoxy resin.

H. The pilot exciter shall be permanent magnet generator type. The stator winding shall be vacuum pressure impregnated with epoxy resin. The permanent magnet generator shall have the ability to provide a nominal 300 percent of the 130 degrees C rise rated three-phase short circuit for ten seconds at the alternator terminals.

I. The digital voltage regulator shall be hermetically sealed, silicon controlled rectifier type and shall employ a zener reference and three phase sensing. The voltage regulator shall provide automatic protection of the entire unit on 3 phase short-circuits. The voltage regulator shall include automatic over-excitation and under-frequency protection. Input isolation transformers and filters shall be provided. Exciter shall be fast response type with a rotating rectifier and surge suppresser, 3-phase, full-wave bridge.

J. The voltage regulator and associated equipment shall be mounted in the generator terminal box. Manual voltage adjustment potentiometer shall be mounted in the Generator Control Panel.

K. Generator stator leads shall be connected to tinned copper bus bars in an oversize terminal box. The box shall allow bottom entry of cables and conduits shown on the contract drawings.

2.07 - SYSTEMS

A. Electrical Service – Support Systems

1. The generator shall be rated for a single incoming power source at 480VAC, 3-phase 60 Hertz, 60A and shall provide power to the generator ancillary support systems including jacket water heaters, battery chargers shall be using step-down transformers supplied integral with the generator package as required.

2. Provide integral generator distribution distribution panel rated a minimum of 65kAIC at 480VAC.

B. Fuel Storage System:

1. Provide base fuel storage tank, integral to the mounting of the engine generator unit.

2. The fuel tank shall be UL listed as “primary containment aboveground tank for flammable and combustible liquids”.

3. Provide necessary supply and return lines; drainage and supply valve control.

4. Tapped openings in tank shall be bushed to desired size with double-tapped cast-iron tank bushing.

5. Tank vent shall be standard weight, black steel pipe with screwed malleable-iron fittings.

6. Provide double-walled tank, with level indication and auxiliary pre-wired leak detection alarm contacts.

C. Engine Fuel System:

1. Diesel fuel system shall consist of an engine-driven fuel supply pump, fuel filters, and a base tank and lift pump set.

D. Electric (Battery) Starting System:

1. Starting shall be accomplished by a 24-volt, engine mounted, solenoid shift electric starter, capable of withstanding four consecutive continuous cranking periods of 15 seconds duration each separated by 15 seconds rest periods before shutting down completely and sounding the overcrank alarm.

2. The starting batteries shall be low maintenance, premium industrial grade, high-output, long-life, lead acid type especially designed for diesel engine cranking service, and of a capacity as recommended by the battery manufacturer for cranking the engine being furnished. The engine starting batteries shall be sized to also supply power to the generator control panel.

3. Furnish an engine starting battery charger for charging the starting batteries for the engine. The battery charger shall be U.L. listed, fully automatic, filtered, equalize and float-type, appropriate for wall or rack mounting. Supply voltage shall be 120 volts, AC, single phase, 60 Hz obtained from the generator electrical package. The DC output shall be not less than 20 amperes, regulated to within one percent with plus or minus ten percent fluctuations of the input voltage, and shall be current limited at 120 percent of rated output. Accessories shall include DC ammeter and voltmeter (panel type; 2 percent accuracy), adjustable float and equalize controls toggle switch, AC and DC circuit breakers, AC power failure alarm relay, low DC voltage alarm relay and DC ground fault relay. Fault relays shall operate individual alarm indicators on the face of the charger panel and shall also operate a common alarm relay for remote transmission of alarm. Charger shall have a continuous power rating sufficient to power all generator control devices in both the standby mode and the running mode.

E. Lubrication System:

1. The engine shall be provided with a full pressure lubricating oil system arranged to lubricate and cool the pistons and distribute oil to all moving parts of the engine including the turbocharger bearings. The system shall include a full flow oil filter of the replaceable element type, an appropriately sized shell and tube type oil cooler, and an automatic temperature regulator.

2. Furnish a low oil level float switch to alarm to the generator control panel.

F. Engine Cooling System Radiator:

1. General: Provide a unit mounted radiator complete with integral jacket water circulating pump, thermostatic central of cooling system, fan and drive motor sized to maintain full load operation continuously as specified herein for engine-generator set.
2. Provide radiator to operate engine at full rated generator load at 104 F ambient temperature.
3. Provide jacket water treatment for the prevention of both scale formation and corrosion in the engine water jackets and cooling system components which are in contact with the engine jacket water. This treatment shall be added to the cooling system prior to running the field acceptance test

G. Miscellaneous Equipment and Requirements

1. Heaters
   a. Automatic thermostatically controlled heater(s), shall be provided to maintain not less than 90º F temperature for the engine jacket water system.
   b. Heater(s) shall be rated 208/120VAC and shall be powered from the incoming 480VAC electrical service to the generator distribution panel support system.
   c. Heater shall be automatically deactivated when the engine-generator unit is in operation.
2. Emergency Stop Pushbuttons
   a. Furnish an emergency stop pushbutton on the engine control panel.
   b. The emergency stop buttons shall be maintained type, red colored, push to stop, mushroom type with a hinged plastic Lexan cover, labeled as "Emergency Stop," "Push."
   c. The pushbutton shall be wired to the engine-generator instrument/control panel and shall immediately stop the engine.
3. Control Power Fuses
   a. Fuses shall be mounted in locations where they are accessible. Pullout type fuses shall be provided.
4. Main Circuit Breaker
   a. Provide generator with a molded case circuit breaker to protect generator against overload and short circuit conditions. Circuit breaker shall be rated for 65 kA short circuit symmetrical and shall conform to the provisions of NEMA Standard AB1 and UL Standard 489.
   b. Provide circuit breaker with adjustable trip unit, rating plug, long-time, short-time and instantaneous protective relaying and ground fault protection.
5. Terminal Blocks
   a. Terminal blocks shall be one-piece, 20 AMP rated, with barriers appropriate for ring tongue terminals and provided with binding head screws. The terminal block rating shall be 600 V.
6. Solid State Circuitry
   a. Heavy-duty solid state controls, relays, timers or monitors shall meet the following specifications:

Accuracy:	+ 2% of set point
Temp Range:	- 40 C to +65 C (-40 F to 150 F)
Protection:	Transient overvoltage with-stand of 1500 volts peak, 1 m sec. time constant
Ratings:	Current ratings to exceed application of devices. Devices shall be UL listed.

2.08 - SYSTEM OPERATING SEQUENCE

A. The engine generator unit shall be operated in the following manner:

1. The engine generator unit shall be arranged for automatic or manual starting and stopping.

2. The engine generator shall be brought up to rated voltage and frequency and closed onto facility main Switchboard through open transition automatic throw-over system.

B. Normal – system utility powered:

1. During normal system operation, the normal (utility) shall power the electrical distribution system with loads as indicated.

C. Loss of utility power - standby operation:

1. Upon loss of utility power, automatic transfer switch shall sense loss of power and after an adjustable time delay the automatic transfer system shall initiate generator start.

2. When the generator is up to speed and capable of accepting load, pump station loads will transfer to generator power.

3. Upon return of utility power, the automatic transfer switch shall initiate transfer back to the utility after an adjustable time delay.

4. After an adjustable cool-down period, the engine-generator shall shutdown.

2.09 - ENGINE CONTROL PANEL

A. The engine starting control logic shall be microprocessor based and shall automatically start, protect and monitor the engine-generator set. Electro-Mechanical controls are unacceptable.

B. The following gauges shall be mounted within an engine mounted control panel. Gauges shall be digital:

1. Jacket water temperature cooler temperature into heat exchanger

2. Lube oil temperature

3. Lube oil pressure

4. Lube oil filter differential pressure.

C. An engine coolant level switch shall be furnished. Level switch shall shut down generator on low level.

D. The engine starting control logic shall be capable of controlling the following engine devices.

1. Starting motor magnetic switch.

2. Electrically operated fuel control.

3. Normally open protective switches that close for abnormal conditions of pressure, temperature, speed and liquid level.

E. The panel shall have the following controls:

1. Emergency stop

2. Lamp test

3. Cycle crank

4. Voltage control

5. Cool-down timer

6. Phase selector switch

7. Programmable relays 4 (std)

8. Stop/Auto/Test.

F. The panel shall be provided with the following indicating lights:

1. Low oil pressure
2. High coolant temperature
3. Over speed
4. Over crank
5. Emergency stop
6. Fault shutdown
7. 3 spare lights, programmable input.
8. Not in Auto

G. Protection shall include:

1. Over and under voltage
2. Over and under frequency
3. Low coolant level
4. Oil temperature.

G. Provide contacts to alarm the following functions:

1. Low oil pressure
2. Sub-base oil tank rupture
3. Low fuel
4. Fuel tank leak
5. Battery malfunction
6. Low battery voltage
7. Common fault alarm
8. Not in automatic
9. In exerciser mode
10. E-stop activated
11. Generator run status
12. Low coolant level

H. Provide analog (4-20mA) output from fuel tank control panel for fuel level.

I. Engine Start/Stop Operation: The automatic engine control logic shall initiate operation of the engine upon receipt of a signal from a contact at the facility main Switchboard automatic transfer system. The contact(s) shall close for engine run and open for engine stop.

J. If the engine fails to start after 4 adjustable cranking attempts (factory set at 10 seconds on, 10 seconds off, adjustable from 5 to 30 seconds) or if any protective device should operate while the engine is running, the engine shall be disconnected from service and immediately stopped. The engine control logic shall lock the failed set out of service and requires a manual reset. The engine control logic shall include a provision for conversion to single cycle cranking, adjustable from 35 to 210 seconds.

K. Three-position engine control switch:

1. **Stop/Reset:** In this position, the engine shall not be capable of starting and/or running. If the engine was shutdown due to the operation of a protective device, the shutdown malfunction shall be reset when the

switch is moved to this position. If the engine is running when the switch is moved to this position, it shall be immediately shutdown.

2. **Automatic:** In this position, the engine control shall be in readiness for fully automatic operation upon receipt of a start signal.

3. **Test:** When placed in this position, the engine shall start and run as if a start signal were received except it shall not be connected to the bus unless a start signal is received. When returned to the automatic position, the engine will shut down.

2.09 - SHOP PAINTING

A. The engine-generator set shall be shop primed and finished coated in accordance with the manufacturer's standard practice prior to shipment. A supply of touch-up paint shall be supplied by the manufacturer.

2.10 - SHOP TESTING

A. The complete engine-generator set shall be shop tested to simulate a complete and integrated system prior to shipment.

B. The procedure for the shop test of the diesel engine shall cover the engine manufacturer’s standard practice.

2.11 - SPARE PARTS

A. Provide a recommended list of spare parts.

PART 3 – EXECUTION

3.01 - INSTALLATION AND START UP

A. The generator unit shall be mounted on a concrete pad.

3.02 - FIELD TEST

A. Upon completion of the installation and as soon as conditions permit, the diesel engine driven generator, including the engine, generator, electrical circuit controls, transfer controls other devices shall be tested to assure that the system functions as specified.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF TEXT

See Attachments

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ATTACHMENT A
Pump Station No. 4

Loads to be powered up by the engine-generator for engine generator load calculation.
The Generator shall be capable of picking up the loads in order shown.

Equipment List

Equipment	Total Quantity	Quantity Operating	HP/AMPS/kVA/kW
Step 1			
Dry-type Transformer T.04-1 (15 kVA)	1	1	7.5kVA
Odor Control Fan PS4.OC-1*	1	1	½ HP
Exhaust Fan PS4.OC-EF-1*	1	1	½ HP
Step 2			
PS4.P-1**	1	1	40HP
Step 3			
PS4.P-2**	1	1	40HP
Step 4			
PS4.P-3**	1	0	40HP

* Motor is powered by full voltage motor starter.

** Motor is powered with 6-pulse variable frequency drive with passive harmonic filter.

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SECTION 11600

SEQUENCING BATCH REACTORS

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PART 1 - GENERAL

1.01 - SCOPE

A. The Contractor shall assign full responsibility for the functional operation of the new Fine Bubble Diffuser System (Air Diffuser Assemblies) to Aqua Aerobic Systems, Inc. (MANUFACTURER). The MANUFACTURER shall be responsible for all engineering necessary in order to select, furnish, inspect the installation of the equipment installation and connections, calibrate, and place into operation the Air Diffuser Assemblies as indicated and specified herein.

B. The installation of the equipment furnished by the MANUFACTURER shall be the responsibility of the installing contractor in accordance with all requirements of the contract documents.

C. Provide and test sequencing batch reactor Air Diffuser Assemblies (e.g., equipment and appurtenances) as indicated and specified.

D. The Owner pre-selected the MANUFACTURER of the Sequencing Batch Reactors and associated Air Diffuser Assemblies to be provided under this section. Refer to SECTION 99999, ATTACHMENTS for the Shop Drawing

received from Aqua Aerobic Systems, Inc. In the event of a discrepancy between the Shop Drawing and this section, this section shall govern.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 012025, MEASUREMENT AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the previously provided costs for the addition of the two Fine Bubble Diffuser Systems and therefore, shall be utilized to cover the cost of the discrepancy between the Shop Drawing and this section.

1.03 - DEFINITIONS

A. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Sales bulletins or other general publications are not acceptable as submittals for review. Submit only when necessary to provide supplemental technical data.

C. Shop Drawings: Submit the following in accordance as specified.

1. Certified shop and working drawings including complete performance data for the equipment.
    a. Equipment manufacturer shall submit electronic files of the proposed equipment in the capacity, size, and arrangement as indicated and specified.
    b. Electronic files shall conform to the following minimum requirements:
        (1) Files shall be AutoCad 2013 or Higher.
        (2) Files shall be submitted as part of the Shop Drawing submittal.
        (3) Submit Files on CD or DVD.
        (4) Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

(5) Files shall include Tag Names, Parts List (identifying each component), Dimensions, component weights and connection sizes.

(6) Files shall be drawn to scale.

(7) Drawings shall be in conformance with all other requirements as specified in this specification.

2. Factory work sheets as specified herein.
3. System piping schematic.
4. Manufacturer's literature and specifications. Show catalog dates.
5. Manufacturer's process design calculations.
6. Clearly mark all drawings and data to show only items applicable to work.
7. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.
8. Qualifications of field service technician.
9. Shop and Field inspections reports.
10. Number of service technician days provided and per diem field service rate.
11. Manufacturer's product data, specifications, and color charts for shop painting.
12. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
13. The most recent ISO 9001 series certification or Quality Control Plan.
14. Material Certification
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and similar effluent objectives indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of ten (10) installations in operation for a minimum of ten (10) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

E. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. If deviations and clarifications from the drawing are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
2. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

F. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 - PRODUCT HANDLING

A. Provide as specified herein.

B. Shipping

1. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

2. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

3. The Contractor shall obtain spare parts from the MANUFACTURER at the same time as pertaining equipment. The Contractor shall maintain possession of spare parts until Substantial Completion at which time, all spare parts shall be turned over to the Owner.

C. Receiving

1. Inspect and inventory items upon delivery to site.

2. Store and safeguard equipment, material and spare parts in accordance with MANUFACTURER 's written recommendations and instructions.

1.06 - DESIGN CRITERIA

A. Air Diffuser Assemblies equipment and operating data as specified herein.

B. The MANUFACTURER will design and furnish the following equipment/systems for installation by the CONTRACTOR.

C. The Air Diffuser Assemblies shall be identical to the Air Diffuser Assemblies previously installed.

D. Influent Conditions

1. Influent wastewater flow and influent design parameters to the SBR system are summarized below.

Phase 1	Min Month	Annual Average	Max Month	Max Day	Peak Hour
Flow, gpd	224,713	264,368	374,649	689,120	792,500
BOD, lbs/d		626	800	1,022	
TSS, lbs/d		725	948	1,359	
TKN, lbs/d		136	172	199	
Design Temp, ^{o}C	10	15	20	24	

Phase 2	Min Month	Annual Average	Max Month	Max Day	Peak Hour
Flow, gpd	321,163	377,839	535,928	957,417	1,101,000
BOD, lbs/d		884	1,127	1,446	
TSS, lbs/d		1,030	1,346	1,940	
TKN, lbs/d		188	238	276	
Design Temp, ºC	10	15	20	24	

2. Note that based on the seasonal location and weather conditions, the Max Month loads and Min design temperature will not be coincident.

E. Effluent Conditions

1. Effluent design parameters from the SBRs are summarized below.

Constituent	SBR Effluent Requirements
BOD, mg/L	20
TSS, mg/L	20
TN, mg/L	7

2. Note that the Biological process is sized to meet effluent requirements under Max Month conditions.
3. Note that the SBR system (i.e., tank size, tank volume, aeration requirements, etc.) is sized and controls programed to be able to achieve a TN of 7 mg/L without the addition of a supplemental carbon source and a TN of 3 mg/L with the addition of a supplemental carbon source that would be provided by others in the future.

F. Equipment

1. The following equipment list is intended to establish a level of quality, not to be an all-inclusive list of equipment to be furnished or not to be furnished. The shop drawing shall contain an itemized list of all equipment, revised instrumentation and controls determined by the MANUFACTURER to allow the SBR to perform in the manner in which it is intended. All equipment shall be required to meet all OSHA requirements.
2. Provide equipment rated in accordance with the Environmental Classification Schedule on the Contract electrical drawings.
    a. Instrumentation
        1) The MANUFACTURER is responsible for the updates to the previously installed equipment (e.g., instrumentation and control system) to achieve the effluent requirements as stated herein including level and pressure/vacuum instruments. This also includes internal panel hardware modifications and programming changes to accommodate the additional blower. The new blower shall be integrated into the existing control sequence, and the sequence shall be revised such that the blowers operate in Lead, Lag 1, Lag 2, Standby configuration. The general contractor will be responsible for the performance and warranty of all ancillary items to the SBRs not furnished by the MANUFACTURER.

b. Shop Drawing Submittal - The following information is to be submitted with the Shop Drawing.

1) Complete process design submittal with support calculations shall be presented showing effluent quality expected under the following conditions for the SBR effluent:

a) Design Year Phase 1 and Phase 2 Annual Average Flow/Loading

b) Design Year Phase 1 and Phase 2 Maximum Month Flow/Loading

c) Design Year Phase 1 and Phase 2 Peak Flow/Loading

2) Provide any ancillary equipment, controls, etc. required to provide a complete SBR system, and to furnish this equipment and controls, not otherwise specifically specified herein.

1.07 - REFERENCES

A. American National Standards Institute (ANSI):

1. B16.1: Standard for Cast-Iron Pipe Flanges and Flanged Fittings, 125 lb.

B. American Society for Testing Materials (ASTM):

1. A36: Specification for Structural Steel

C. National Electric Code.

D. American Bearing Manufacturers Association (ABMA):

1. ANSI/ABMA 9-1990 (R2000) Load Ratings and Fatigue Life for Ball Bearings.

2. ANSI/ABMA 11-1990 (R1999) Load Ratings and Fatigue Life for Roller Bearings)

E. American Gear Manufacturers Association (AGMA).

F. National Electrical Manufacturers Association (NEMA).

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.08 - QUALITY ASSURANCE

A. Provide in accordance as specified herein.

B. Equipment shall be MANUFACTURER 's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

C. Welding: In accordance with American Welding Society Code D1.1.

D. Submit copies of AWS certificates.

E. Provide shop tests as specified.

F. Provide Services of MANUFACTURER 's Representative as specified herein.

G. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment specified.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve the Contractor of the obligation to place equipment in operation as specified.

a. Installation: Inspect location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connections:1 person-day.

b. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified. 1 person-days.

c. Field Performance Testing: Field performance test equipment specified. 1/2 person-days.

d. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions. 1/2 person-days.

e. Credit to the Owner, all unused service person-days specified above, at the MANUFACTURER 's published field service rate.

f. Any additional time required of the factory trained service technician to assist in placing the equipment in operation or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

K. Buy American - This equipment is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

1.09 - SEISMIC REQUIREMENTS

A. Conform to the requirements indicated on the structural drawings and as specified herein.

B. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements as indicated and specified.

C. Provide certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and as indicated.

PART 2 – PRODUCTS

2.01 - MANUFACTURERS

A. Aqua Aerobic Systems, Inc.

B. The Owner has standardized on Retrievable Fine Bubble Diffusers as manufactured by Aqua Aerobic Systems, Inc.

C. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - SYSTEM DESCRIPTION

A. The following is a general description of the equipment to be supplied and coordinated by the SBR Supplier:

1. One Air Diffuser Assembly for each SBR basin.

2. Provide all other items as indicated and specified.

B. Tank and process design were sized to accommodate Phase 2 maximum day flows/loads utilizing normal SBR operating cycle. The use of a compressed cycle (i.e. – “Storm mode”) is not allowable unless flows exceed specified Phase 2 Maximum Day flows.

2.03 - SBR EQUIPMENT

A. Fine Bubble Diffuser System

1. Performance Requirements

a. Air Diffuser Assemblies: Provide retrievable air diffuser assemblies in the SBR basins as specified and indicated. The design shall provide for additional aeration assemblies and blower (by others) for Phase 2 conditions as specified herein.

b. Each air diffuser assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track/beam, flexible airline, isolation valve, and lifting mechanism. The four (4) inch diffuser manifold shall be stainless steel. The entire assembly shall be located such that each diffuser centerline is twelve (12) inches above the basin floor.

2. Design Criteria

a. Air Supply System: The SBR’s will receive air supply from aeration blowers located in the lower level of the Administration Building and will be supplied by others. Three blowers (2 duty/1standby) were installed by others for the Phase 1 conditions and a fourth blower is being supplied by others for Phase 2 conditions under this Project.

b. The Air Diffuser Assemblies shall be designed such that with the use of guiderails, retrieval accessories, etc. already installed under Phase 1. The wet installation of additional diffuser racks under Phase 2 will meet the Phase 2 standard oxygen requirement conditions as outlined below while meeting the minimum SOTE requirements listed.

Phase 2 Oxygen Requirements (Std Conditions)

	Annual Average	Maximum Month	Maximum Day
SOR, lbs/hr-tank	231	296	362
Ave Water Depth, ft	16.1	16.6	17.8
Minimum Required SOTE at Ave Water Depth, percent	32	30	28

c. Air diffuser assemblies shall be of the tubular, non-clog, fine bubble type with a flexible perforated air release membrane. Each membrane shall be held in place by two Type 304 stainless steel band clamps, and cleanable with a high-pressure wash water.

d. The diffuser membrane shall be constructed from EPDM rubber and be suitable for continuous or intermittent aeration. The membrane shall include UV inhibitor and be designed for resistance to chemicals, weathering.

e. Each diffuser assembly shall include a three-inch diameter wire reinforced EPDM flexible air line with quick disconnect end fittings, a threaded flange, elbow and quick disconnect adapters. The vertical track/beam shall support the lifting mechanism assembly during operation and servicing.

f. Each assembly shall include a three-inch diameter manually operated isolation butterfly valve for connection to the main air distribution piping by the installing contractor.

2.04 – PAINTING – Not Used

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Install items in accordance with MANUFACTURER's printed instructions, as specified, and indicated.

B. MANUFACTURER's representative to perform inspection of Air Diffuser Assemblies equipment and conduct check-out and training as specified herein.

3.02 - FIELD TESTING

A. Perform field testing of all equipment functions and alarms.

1. Make all adjustments necessary to place equipment in specified working order at time of above tests.

2. Remove all replaced equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and approved.

3.03 - PROCESS PERFORMANCE GUARANTEE

A. The Air Diffuser Assemblies will be installed at a wastewater treatment facility (WWTF) servicing a collection system which were both completed in 2022. The SBR system was previously supplied by the MANUFACTURER and suitable to meet the Phase 1 conditions.

B. The MANUFACTURER shall be responsible for the process performance of the SBRs (Phase 1 and Phase 2) and shall guarantee the equipment operation in accordance with the design requirements. The Process Performance Guarantee shall be secured by a Performance Bond issued to the OWNER for 100 percent of the Allowance specified in SECTION 01020, ALLOWANCES. The MANUFACTURER agrees to furnish a Performance Bond in the sum of the full amount of the Allowance and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums, fees, etc. for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Performance Bond shall be provided as part of the shop drawing submittal. Submittals which do not include the required performance bond or irrevocable letter of credit will be summarily rejected and returned to the Contractor without further review and consideration.

3.04 - WARRANTY

A. The MANUFACTURER shall provide a Warranty Bond of the Fine Bubble Diffuser Systems warranting that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects. The warranty shall be secured by a Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the Allowance specified in SECTION 01020, ALLOWANCES. The MANUFACTURER agrees to furnish the Warranty Bond in the sum of the full amount of the Allowance and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

B. It is the MANUFACTURER's responsibility to resolve any and all warranty claims.

C. The Warranty Bond shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

3.05 - ACCEPTANCE TESTING

A. The Air Diffuser Assemblies will be installed at a wastewater treatment facility (WWTF) servicing a new collection system which were both completed in 2022. The SBR system was previously supplied by the MANUFACTURER and suitable to meet the Phase 1 conditions.

B. The MANUFACTURER shall provide a Performance Bond of the Air Diffuser Assemblies regarding the performance of the new Air Diffuser Assemblies with the existing SBR System (supplied by the MANUFACTURER) in order to meet the Phase 1 and Phase 2 conditions. The Performance Bond shall be issued jointly to the CONTRACTOR and the OWNER for 100 percent of the Allowance specified in SECTION 01020, ALLOWANCES. The MANUFACTURER agrees to furnish a Performance Bond in the sum of the full amount of the Allowance and duly executed by the said MANUFACTURER as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the MANUFACTURER. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Performance Bond shall be provided as part of the shop drawing submittal. Submittals which do not include the required Performance Bond will be summarily rejected and returned to the Contractor without further review and consideration

D. The Acceptance Test shall demonstrate performance under design loading conditions. This might be accomplished through simulating higher loading conditions by operating only one SBR, or by lowering MLSS levels to simulate design maximum F:M ratios for example. It is the MANUFACTURER's responsibility to develop a test protocol for approval by the Engineer. The test protocol at a minimum should demonstrate compliance with the SBRs performance requirements under Maximum Month or Simulated Maximum Month Loading as follows:

- Average SBR Effluent BOD <= 20 mg/l
- Average SBR Effluent TSS <= 20 mg/l
- Average SBR Effluent TN <= 7 mg/l

E. All sampling will be based on flow weighted 24-hour composites.

F. Testing shall be conducted such that compliance with the above requirements is demonstrated for a minimum of five (5) consecutive days with the system operating in (or simulating) design process control parameters such as design SBR cycle allocation times, design max MLSS, Design Max SRT, Design Min F:M, etc. Operation of the WWTF to include sampling during the Acceptance Test shall be the responsibility of the OWNER. The system supplier may provide oversight of the test at its discretion.

G. Should the system pass the Acceptance Test, the Performance Bond will be released following approval of the Engineer. Should the system fail the Acceptance Test, the MANUFACTURER will be given up to two opportunities to make adjustments and retest. Should the system fail all Acceptance Tests - maximum of three (3) attempts, within three months, the OWNER reserves the right to call the Performance Bond. None of the above releases the system supplier to making such modification as necessary to bring the system into compliance with the performance requirements of this specification.

3.06 - FIELD TOUCH-UP PAINTING – Not Used

3.07 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 13300

INSTRUMENTATION AND CONTROL SYSTEM – GENERAL

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide a complete, functional control system as specified herein and/or as shown on the Contract Drawings. It is the intent that all equipment shall be of the same manufacturer and model that was provided on the previous contracts; 2019-01 Wastewater Treatment Facility and Effluent Disposal and 2019-02 Collection System and Pumping Stations

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Retain the services of Electrical Installations, Inc. to perform the work of System Integrator (SI) as defined in these specifications.

Electrical Installations, Inc.
930B American Legion Hwy
Westport, MA 02790
(508)636-8600

D. Provide and test the instrumentation and controls systems as specified and indicated on the Contract Drawings.

E. Provide all equipment, installation, services, and appurtenances required to achieve a complete, integrated, and fully operational system.

F. Test all components individually as well as in a system as specified.

G. Provide and calibrate instruments as specified in SECTION 13330, PROCESS INSTRUMENTS.

H. Provide and test PLC control panels as specified in SECTION 13340, PLC CONTROL PANELS.

I. Program and integrate system to function as defined in SECTION 13331, CONTROL SYSTEM INTEGRATION.

J. SCADA instrumentation, hardware, software, and programming standards shall be coordinated with client standards defined under Contract No. 2019-01 DOWNTOWN AREA WWTF AND EFFLUENT DISPOAL.

K. The Contractor shall be responsible with the assistance of the SI or the coordination of other equipment furnished in this contract with overall control system requirements.

L. Preconstruction Meeting: The Contractor shall arrange a Preconstruction Meeting. The meeting shall be held prior to the submission of shop drawings. The meeting shall be held at the job site. The meeting shall be attended by the Contractor, the Owner, a technical representative of the SI and the Engineer. The purpose of the meeting shall be to review the scope of work, submittal procedures, project documentation, proposed instruments and control systems, contacts and communications and other issues that the Contractor, Owner or the SI may wish to discuss.

M. All equipment shall comply with the electrical area classification indicated in the electrical drawings.

N. Design the system and equipment used therein, to resume normal operation without manual intervention, following resumption of power after a power failure.

O. Provide UL approved materials and equipment.

P. Ambient Conditions for control panels

1. Minimum Temperature: 50 °F
2. Maximum Temperature: 90 °F
3. Relative Humidity: 95% Non-condensing

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. An allowance has been included in SECTION 01020, ALLOWANCES which will be required to be utilized by Contractor during the preparation of their bid. The measurement and payment shall include all work required, including but not limited to, all necessary equipment, labor, materials and supplies, connection to all necessary utilities, and the like, in order to provide the SCADA System Integration Programming. A paid invoice from the Integrator shall be submitted to the Engineer by the Contractor. Should the actual charge exceed the amount or be less than the amount indicated, the difference will be paid by or returned to the Owner.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Field Instrumentation

C. Provide submittals for all instrumentation and control systems equipment as indicated under the referenced specification sections.

1. Operation and Maintenance Manuals.

2. Submit "record copy" of all drawings previously submitted for review within 30 days after completion of system installation as part of operating and maintenance instructions. Show all changes and modifications made during installation. Define special maintenance requirements particular to system along with special calibration and test procedures.

3. Submit brief description of calibration procedures listing actual calibration and test equipment. Include typical calibration sheet and description of loop check procedures, provide typical loop check sheet.

4. Provide manufacturer's certified statement of installation approval.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESSGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Quality Assurance

1. Work of SI service personnel shall be coordinated by the Contractor.

2. Coordinate with instrumentation, mechanical and electrical systems suppliers to identify any signal isolation, signal boosting devices or auxiliary relays that may be required to complete the system.

3. Provide auxiliary devices for proper operation, such as transducers, relays, current/current isolators, and signal boosters for interfacing with equipment provided under this and other sections of this specification.

4. Provide a qualified manufacturer representative to oversee the installation, the placing and location of system components, the location of sleeves, methods of installing conduits and special cables, mounting, piping, and wiring of one of each type of device, and methods of protecting all equipment prior to being placed into service, their connections to the process equipment panels, cabinets and devices, subject to the Owner’s approval. Provide on-site services for a minimum period of three 8-hour days, excluding travel time. Certify that all field wiring for power and signal circuits are correctly installed and terminated in accordance with best industry practice and provide for all system grounding to insure a satisfactory functioning installation. Schedule and coordinate work under this section with that of the electrical work specified under applicable Sections of DIVISION 16, ELECTRICAL.

5. Upon completion of installation, provide service personnel, for field check-out of the System.

6. Instrument Calibration: Calibrate electronic and pneumatic test equipment within 6 months prior to use. Accuracies of test equipment shall be traceable to Bureau of Standards.

7. Provide calibration tag to all calibrated instruments. The calibration tag shall have the name and phone number of the SI who performed the calibrations with the date of calibration and the date of the next calibration. The tag shall be signed by the individual that performed the calibration. Linkage or range adjustments sealed by colored lacquer immediately following calibration. Provide calibration records to the Engineer prior to substantial completion.

8. System energizing not allowed prior to receipt of certified statement from Contractor and supplier approving system and authorizing energizing of system.

9. Protect materials and equipment against damage in storage and during construction.

10. Replace damaged materials or equipment as determined by the Engineer at no additional cost to the Owner.

1.07 - REFERENCES

A. Federal Specifications: WW-T-799F; Tube, Copper, Seamless, Water, (For Use with Solder-Flared-Or Compression Type Fittings).

B. National Fire Protection Association: NFPA 70.

C. The International Society of Automation (ISA) PR7.1, Pneumatic Control Circuit Pressure Test, Tentative Recommendation Practice.

D. American Petroleum Institute (API) RP-550 Manual of Installation of Refinery Instruments and Control Systems.

E. The International Society of Automation (ISA) S5.2, S5.3 and S5.4, Instrument Loop Diagrams, standard.

F. National Electrical Manufacturers Association (NEMA) Publication, General Standards for Industrial and Control Systems, ICS1 and Industrial Controls and Systems ICS2.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.08 - WARRANTY

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. Equipment Manufacturer - Not Used

C. Contractor

1. The Contractor shall provide a warranty that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply. The Warranty, obtained by the Contractor, shall be secured by a Performance Bond issued jointly to the Contractor and the Owner. The Contractor agrees to furnish a Warranty in the sum of the full amount of the equipment price and duly executed by the said Contactor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Owner, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Equipment Manufacturer. Bonds must be issued by surety companies listed on the latest IRS Circular 570.
2. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract.
3. The Contractor shall be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s and Equipment Manufacturer’s responsibility to resolve any and all warranty claims.

E. The Warranties shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bonds will be summarily rejected and returned to the Contractor without further review and consideration.

PART 2 - PRODUCTS

2.01 - GENERAL

A. Equipment, cabinets and other devices furnished hereunder shall be rated for continuous use in the intended application.

B. The system shall consist of current production products.

C. Equipment shall be UL listed (or approved equivalent listing where UL listing is not available).

D. Refer to equipment specification sections as referenced.2.02 - SPARE PARTS

A. Spare Parts:

1. Provide spare parts specified in the products specifications.

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

3.02 - INSTALLATION

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Minimum requirements of all wiring of the equipment shall be as specified under DIVISION 16, ELECTRICAL.

C. Provide proper installation of the equipment in accordance with manufacturer’s written instructions and/or as approved by the Engineer. Coordinate the proper installation of equipment with the Work of all other trades.

3.03 - PAINTING

A. Shop painting and the surface preparation is a part of the Work specified in this section and shall be as specified in SECTION 09940, FIELD PAINTING.

3.04 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.05 - MANUFACTURER'S FIELD SERVICES

A. Provide field services for the instrumentations and control systems as specified under the respective section.

3.06 - MANUFACTURER'S TRAINING

A. Provide training for the instrumentations and control systems as specified under the respective section.

3.07 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.08 - SPARE PARTS

A. Provide spare parts for the instrumentations and control systems as specified under the respective section.

3.09 - SHOP TESTING

A. Provide shop testing for the instrumentations and control systems as specified under the respective section.

3.10 - FIELD TESTING

A. Provide field testing for the instrumentations and control systems as specified under the respective section.

3.11 - GENERAL INSTALLATION

A. Install instrumentations and control systems as specified under equipment sections and in accordance with manufacturer's instructions.

3.12 - TRAINING

A. Upon completion of the start-up, provide competent training personnel for a period of not less than three, 8-hour working days, excluding travel time, for training of personnel in the use, operation and maintenance of the instrumentation and control system. Training to utilize the submitted operation and maintenance manuals and record copy drawings as reference materials. Training to be for 6 personnel in each class. Each class to be of a 4-hour duration.

3.13 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 13330

PROCESS INSTRUMENTS

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide a complete, functional control system as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. The System Integrator (SI) shall furnish process instruments as specified and in accordance with the Contract Documents.

D. Instrument Product Sheets are as specified herein, Attachment A.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Field Instrumentation

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and consideration.

D. Submit Product Data Sheets, in accordance with ISA-S20 with the information noted below and other data pertinent to the equipment and the application.

1. Initial submission for review to accompany Shop Drawings:

a. The product manufacturer and the supplier or representative.

b. The complete model or catalogue number(s) including any special options.

c. The available adjustment range(s) and the operating range(s).

2. Second Submission during pre-commissioning, testing and calibration period:

a. Serial numbers, part numbers, dates of installation and calibration.

b. Calibration and programming procedure.

c. Calibration and programming documentation.

d. Provide linkage or range adjustments sealed by colored lacquer following calibration.

e. This submission is for signature by the Contractor and the Engineer following acceptance of the operation of each instrument.

3. Final Submission of signed-off Product Data Sheets included with Operating and Maintenance Instruction Manuals:

a. All of the above information.

b. Phone number and email address of contact person for product support/service.

E. Submit Shop Drawings for all instruments. Manufacturers' catalog cuts and product specifications shall be accepted only if the following information is clearly indicated and highlighted for the equipment proposed:

1. Submit information on each instrument to demonstrate compliance with the data sheet.

2. Tag names, quantities, options provided, full description and performance data.

3. Installation details depicting mounting assemblies, physical dimensions.

4. Termination details, clearly indicating the type and lengths of external wiring required and electrical connections.

5. Power supply rating, input and output signal ranges, maximum measured process range and calibrated scale, physical, electrical and environmental requirements.

6. Specific catalog model numbers for each piece of equipment and its accessory options, clearly referenced by the respective instrument or equipment tag name. Improperly tagged items shall be rejected.

7. Sales bulletins and other general publications are not acceptable as submittals except where necessary to provide supplemental technical data.

F. Submit a separate document with manufacturers' recommended list of spare parts, including individual pricing with the shop drawings.

G. Drawing submissions shall clearly show the enclosures proposed for each instrument.

H. Submit completed Calibration forms and Instrument Installation Checklist forms.

I. Submit schedule of proposed instrument nametag inscriptions.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details regarding the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings and on the data sheets.

C. Quality Assurance

1. All instruments shall be UL listed or equivalent listing system when UL listing is not available.

1.07 - REFERENCES

A. American Petroleum Institute (API):

1. RP 551: Process Measurement Instrumentation

B. International Society of Automation (ISA):

1. S-20: Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

C. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.08 - WARRANTY

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. In addition, the equipment shall be warranted to be free from defects in workmanship, design and materials for a period of 5 years from shipment. If any part of the equipment should prove to be defective during the warranty period, the manufacturer at no expense to the Owner shall replace the part.

C. All installed equipment shall conform to the contract specifications and to manufacturer’s published specifications. The warranty shall begin at the substantial completion date and remain in effect for a period of one (1) year from that date. The Contractor shall repair, adjust, service and/or replace any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The Owner will incur no costs for service or replacement of parts during the warranty period. All third party warranties shall be passed through from the Contractor to the Owner.

D. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

E. The Contractor shall warrant that the system will function in accordance with the manufacturer's published technical description guides and as specified herein.

PART 2 - PRODUCTS

2.01 - GENERAL REQUIREMENTS

A. Provide instruments with enclosure rating indicated on electrical drawings or in instrument Product Sheet - whichever is more stringent.

B. Instruments shall have an integral indicator to display the current process measurement, calibrated in engineering units. Blind instruments shall be provided with a separate digital indicator mounted adjacent to the instrument as specified.

C. Provide electronic instruments with linear 4-20 mA DC isolated output signals capable of driving a maximum load of 750 ohms.

D. Electronic instruments shall have integral configuration capability. Instruments without integral configuration capability shall be provided with a wireless remote handheld terminal. One handheld terminal shall be provided for each type of device in the Contract Documents.

E. Provide standard instrument process connections of 1/2-inch (12.7 mm) NPT female, other than pressure gauges which shall be 1/2-inch (12.7 mm) NPT male.

F. Instruments shall be of current manufacturer design. Obsolete equipment or equipment that has been identified for withdrawal from the market by the manufacturer before date of shop drawing submittal shall not be accepted.

G. Field measure lengths for transducer cables and similar items prior to ordering and supply adequate cable length for application.

2.02 - MATERIALS

A. Provide manufacturer's written certificate that the materials of construction are suitable for the service and process fluids.

2.03 - EQUIPMENT

A. Provide instruments in accordance with the Product Sheets, Schedules, and Special Construction notes in the attachments to this Section.

2.04 - ACCESSORIES

A. Provide the necessary mounting brackets and mechanical shields to secure and protect transducers and other instrumentation devices.

B. Provide all electrical connections, transducer junction boxes, power supplies, and accessory items or options required to satisfy each application.

C. Provide cable between transducers and transmitter units with adequate length based on the location of the devices as shown on the Contract Drawings. Cables shall be continuous run with no splices.

D. Mounting brackets shall be AISI 316 Stainless-steel, and design to securely fasten the devices.

E. Provide shields for outdoor mounted electronic instrument with integral displays, to provide protection against rain, ice and snow and shade from the sun.

F. Provide all special instrumentation communication cables, transducer cables, power cables, process sensing/sampling lines and capillary tubing in field measured lengths without joints or couplings in accordance with the Manufacturer's written instructions.

G. Provide identification nametags for instruments, engraved stainless-steel, 3-inch x 1.5-inch x 1/16-inch. Affix to component with minimum 18 AWG minimum stainless-steel wire or stainless-steel screws. Provide inscription in block letters with following lines, text height as indicated:

1. Line 1: Device Tag and Name, ¼-inch.
2. Line 4: Power Source, 1/6-inch.

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

3.02 - INSTALLATION

A. All materials and equipment shall be installed in a neat, workmanlike manner.

B. Minimum requirements of all wiring of the equipment shall be as specified under DIVISION 16 - ELECTRICAL.

C. Provide proper installation of the equipment in accordance with manufacturer’s written instructions and/or as approved by the Engineer. Coordinate the proper installation of equipment with the Work of all other trades.

3.03 - PAINTING

A. Shop painting and the surface preparation is a part of the Work specified in this section and shall be as specified in SECTION 09940, SHOP PAINTING.

3.04 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.05 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided for installation and startup for the equipment - 1 calendar day (via 1 separate trip to project site).

3.06 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided for training of Owner's personnel for the equipment at the project site - 1 calendar day (via 1 separate trip to project site).

3.07 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.08 - SPARE PARTS

A. Provide spare parts as indicated on the instruments’ data sheets.

3.09 - SHOP TESTING – Not Used

3.10 - INSTALLATION

A. Provide, install, test, calibrate and commission instruments and all peripheral devices necessary in accordance with the Contracts Documents.

B. Install instruments as follows:

1. Install instruments in accordance with the manufacturer's written instructions.
2. Instruments shall be pedestal or wall mounted. Mounting brackets shall not be fastened to process piping or equipment.
3. Mounting brackets, Screws, bolts, nuts and other fasteners shall be 316 Stainless-steel.
4. Do not mount instruments on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration.

C. Locate instruments as follows:

1. Locate instruments and their associated sensors, local isolation valves, isolation switches and other related accessories so that they are readily accessible for operation, maintenance or removal.
2. Orient instrument displays to be easily viewed from a standing position.
3. Position instruments so that they do not block or obstruct walkways or access points and provide space around installation for removal of covers, etc.
4. Unless otherwise indicated in the Contract Documents, mount instruments 55-inches above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments.
5. Do not mount instruments below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.
6. Where manual operation of valves or equipment is required, based on an instrument reading, the indicator shall be located adjacent to the valve or equipment local control panel.
7. Confirm instrument mounting locations with the Engineer to ensure accurate process measurements.
8. Any instrument that is not easily accessible for operation or maintenance, or any indicator that is not easily and readily visible shall be relocated as directed by the Engineer at no charge to the Contract.

D. Provide process isolation devices such as valves on instrument lines for maintenance and instrument removal, without disruption to the process.

E. When installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. All enclosure penetrations shall maintain the equipment or panel NEMA and UL rating.

F. Process sample and sensing lines:

1. Instrument sample and sensing lines shall be 1/2-inch (12.7 mm) 316 Stainless-steel, cut and bent by methods and tools recommended by the tubing supplier, with compression type fittings.
2. Install process sensing lines to avoid accumulation of vapor or gas (on liquid service) and accumulation of liquid or condensate (on vapor or gas service), as appropriate. Instruments on liquid service shall be mounted below sensing lines, with process tapping points taken from the side of the process line. Instruments on gas service shall be mounted above the sensing lines, with process tapping points taken from the top of the process line.
3. Protect sample and sensing lines throughout their length and secure to eliminate sagging, by using painted/galvanized angle iron and clips.
4. Avoid sharp bends in lines and coil any excess close to the sensor end. Protect the coiled capillary by clipping instrument stanchion.
5. Locate all drain plugs below the lowest tube fitting, union or valve. Slope horizontal tubing toward drain plug by minimum 1 percent. Provide drain plugs on all tubed instrument systems.

G. Provide cable and sample or sensing line lengths so instrument/transducer could be removed from the process without disconnecting process piping.

H. Provide transducers with stilling wells and mounting hardware.

3.11 - PRE-COMMISSIONING

A. Provide, install, test, calibrate and commission instruments and all peripheral devices necessary in accordance with the Contracts Documents.

B. Install instruments as follows:

1. Install instruments in accordance with the manufacturer's written instructions.
2. Instruments shall be pedestal or wall mounted. Mounting brackets shall not be fastened to process piping or equipment.
3. Mounting brackets, Screws, bolts, nuts and other fasteners shall be 316 Stainless-steel.
4. Do not mount instruments on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration.

C. Locate instruments as follows:

1. Locate instruments and their associated sensors, local isolation valves, isolation switches and other related accessories so that they are readily accessible for operation, maintenance or removal.
2. Orient instrument displays to be easily viewed from a standing position.
3. Position instruments so that they do not block or obstruct walkways or access points and provide space around installation for removal of covers, etc.
4. Unless otherwise indicated in the Contract Documents, mount instruments 55-inches above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments.
5. Do not mount instruments below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.
6. Where manual operation of valves or equipment is required, based on an instrument reading, the indicator shall be located adjacent to the valve or equipment local control panel.
7. Confirm instrument mounting locations with the Engineer to ensure accurate process measurements.
8. Any instrument that is not easily accessible for operation or maintenance, or any indicator that is not easily and readily visible shall be relocated as directed by the Engineer at no charge to the Contract.

D. Provide process isolation devices such as valves on instrument lines for maintenance and instrument removal, without disruption to the process.

E. When installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. All enclosure penetrations shall maintain the equipment or panel NEMA and UL rating.

F. Process sample and sensing lines:

1. Instrument sample and sensing lines shall be 1/2-inch (12.7 mm) 316 Stainless-steel, cut and bent by methods and tools recommended by the tubing supplier, with compression type fittings.
2. Install process sensing lines to avoid accumulation of vapor or gas (on liquid service) and accumulation of liquid or condensate (on vapor or gas service), as appropriate. Instruments on liquid service shall be mounted below sensing lines, with process tapping points taken from the side of the process line. Instruments on gas service shall be mounted above the sensing lines, with process tapping points taken from the top of the process line.
3. Protect sample and sensing lines throughout their length and secure to eliminate sagging, by using painted/galvanized angle iron and clips.

4. Avoid sharp bends in lines and coil any excess close to the sensor end. Protect the coiled capillary by clipping instrument stanchion.

5. Locate all drain plugs below the lowest tube fitting, union or valve. Slope horizontal tubing toward drain plug by minimum 1 percent. Provide drain plugs on all tubed instrument systems.

G. Provide cable and sample or sensing line lengths so instrument/transducer could be removed from the process without disconnecting process piping.

H. Provide transducers with stilling wells and mounting hardware.

3.12 - COMMISSIONING

A. Demonstrate instrument calibration and loop checks. Each loop check shall be witnessed by, and successfully demonstrated to the Engineer for sign-off.

3.13 - MANUFACTURER SERVICES AND CERTIFICATION OF INSTALLATION

A. Provide the services of a trained, qualified manufacturer's representative to test, program and start the instruments to ensure correctness of installation, calibration, testing, start-up, commissioning and training.

B. Manufacturer field services shall be split into three stages: inspection during installation, start up and commissioning, plant operation personnel training.

C. The qualified representative shall:

1. Provide on-site supervision of installation, commissioning and testing for the initial and critical stages of the work as agreed to with the manufacturer/supplier and as required by the Engineer. The Engineer may order additional supervision at no additional cost to the Contract if, in their opinion, procedures are compromised.

2. Provide operation and maintenance instruction to the plant operation personnel.

D. Provide all materials, labor and equipment to make any adjustments to the installation as required by the manufacturer or the Engineer.

E. On completion of installation and testing, provide written certification from the manufacturer confirming that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer.

3.14 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF TEXT

See Attachment A

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ATTACHMENT A

INSTRUMENTS PRODUCT SHEETS

DATA SHEET 416.1	MAGNETIC FLOW METER SPECIFICATION
DATA SHEET 853.1	LEVEL SWITCH (FLOAT TYPE) SPECIFICATION
DATA SHEET 873.1	SUBMERSIBLE WATER LEVEL SENSOR/TRANSMITTER SPECIFICATION
DATA SHEET 1454.1	PRESSURE GAUGE SPECIFICATION
DATA SHEET 1457.1	PRESSURE ISOLATOR RING SPECIFICATION

MAGNETIC FLOW METER SPECIFICATION

DATA SHEET NO. 416.1

GENERAL

1.	Tag No.:	SEE TABLE
2.	Service:	SEE TABLE
3.	P & I D No.:	SEE TABLE
4.	Location:	SEE MECHANICAL DRAWINGS

CONNECTIONS

5.	Line Size:	SEE TABLE
6.	Line Material:	DUCTILE IRON
7.	Conn. Type:	FLANGED
8.	Conn. Material:	CARBON STEEL

PROCESS CONDITIONS

9.	Fluid:	SEE TABLE
10.	Maximum Flow:	SEE TABLE
11.	Max. Flow Velocity:	SEE TABLE
12.	Minimum Flow:	SEE TABLE
13.	Min. Flow Velocity:	SEE TABLE
14.	Operating Temp.:	40 TO 250 °F.
15.	Operating Pressure:	57 PSI

METER

16.	Meter Size:	SEE TABLE
17.	Tube Material:	304 STAINLESS
18.	Housing:	WELDED STEEL
19.	Liner Material:	INJECTION MOLDED HARD RUBBER OR EQUIVALENT
20.	Electrode Type:	FLUSH MOUNT
21.	Electrode Material:	316 STAINLESS OR EQUIVALENT
22.	Terminal Box:	DIE CAST ALUMINUM
23.	Enclosure Class:	NEMA 4X
24.	Power Supply:	120 VAC, 60 HZ
25.	Grounding Type:	STRAP AND RING

TRANSMITTER

26.	Type:	INTELLIGENT, MICROPROCESSOR BASED
27.	Mounting:	WALL MOUNTED
28.	Transmitter Range:	SEE TABLE BASED ON INSTRUMENT SPAN
29.	Enclosure Class:	NEMA 4X
30.	Power Supply:	120 VAC, 60 HZ
31.	Analog Output:	4 - 20 mADC
32.	Elect. Class:	SEE ELECTRICAL DESIGN FOR AREA CLASSIFICATION
33.	System Accuracy:	+/- 0.5% OF FLOW RATE AT VELOCITIES ABOVE 1 FOOT PER SECOND
34.	Sys. Repeatability:	+/- 0.1% OF FULL SCALE
35.	Empty Pipe Detect:	REQUIRED
36.	Local Display:	MULTI-LINE LC FOR MEASURED VARIABLE, DIAGNOSTICS PLUS BAR GRAPH AND KEY PAD
37.	Local Totalizer:	REQUIRED, 6 DIGIT, NON RESET
38.	Cable Length:	APPROX. 50 FEET PROVIDED BY METER MANUFACTURER

MISCELLANEOUS

39.	Manufacturer(s):	SIEMENS
40.	Model No.:	Sitrans MAG 5100, MAG 5000

NOTES.

a. Provide grounding ring from meter manufacturer. Fabricated grounding rings from a third party shall not be accepted.
b. Provide meter manufacturers cable between the meter and the transmitter.
c. Wet calibrate all meters (at 3 points over the specified flow range) by gravimetric or volumetric methods that are traceable to NIST (National Institute Standard Testing).
d. Provide certificate of wet calibration to the engineer/owner prior to meter installation.
e. Provide, by the meter manufacturer, insitu calibration of all meters prior to system acceptance. Submit written calibration report from the manufacturer to the engineer.
f. PROVIDE 316 STAINLESS STEEL MOUNTING HARDWARE including all nuts and bolts connecting the meter to the process pipe.
g. Contractor to provide all power and signal cable in rigid conduit or liquid-tight conduit. See electrical specification for product specifications.
h. Contractor to provide grounding from ground rings to meter and meter to ground, using green size 10 AWG (6mm) ground wire. The Contractor shall install ground as directed by the meter manufacturer or to nearest water pipe. Contractor is responsible for all connections.
i. Remote communication must not interfere with the analog output signal. Use frequency shift keying (FSK) technique for communication.

TAG NO	SERVICE	LINE SIZE (in)	FLUID	MAX FLOW (gpm)	MAX VEL (fps)	Min FLOW (gpm)	Min VEL (fps)	METER SIZE (in)	P&I D
FE/FIT 0405	PUMP STATION 4 EFFLUENT	4	RWW	-	-	-	-	4	04 DI-601

LEVEL SWITCH (FLOAT TYPE) SPECIFICATION

DATA SHEET NO. 853.1

GENERAL

1.	Tag Number:	SEE TABLE BELOW
2.	Service:	SEE TABLE BELOW
3.	P & I D No.:	SEE TABLE BELOW
4.	Location:	SEE ELECTRICAL DRAWINGS

FLOAT

5.	Dimensions:	APPROX. 6 INCH DIAMETER
6.	Material:	POLYPROPYLENE

SWITCH

7.	Type:	MICRO SWITCH STEEL BALL ACTIVATED
8.	Contact:	SPDT
9.	Rating:	5 AMPS AT 120 VAC
10.	Enclosure:	ENCAPSULATED
11.	Open/Close:	CLOSE ON INCREASING, OPEN ON DECREASING
12.	Mounting:	ADJUSTABLE CLAMP ON 1 INCH STAINLESS PIPE
13.	Elec. Class'tion:	SEE ELECTRICAL DRAWINGS

PROCESS CONDITIONS

14.	Operating Temp.:	40 TO 75 DEG. F.
15.	Operating Pressure:	ATMOSPHERIC

MISCELLANEOUS

16.	Interconn. Cable:	REQUIRED APPROX. 50 FEET
17.	Manufacturer(s):	APG
18.	Model No.(s):	KARI (KA)

NOTES

a. Provide 1-inch diameter SCH 40 316L SS pipe to mount the float switch(s).
b. Provide APG, KARI level switches as specified. Other manufacturers shall not be accepted based on performance.
c. Provide detailed instructions for proper installation of switches, enclosures and mounting hardware.
d. Provide 316 SS brackets and hardware to attach pipe to side of well or tank.
e. Provide a minimum of 3 brackets spaced a maximum of 10'-0" OC.
f. Provide all 316 SS mounting hardware to mount float switch(s) to 1-inch pipe. Mounting hardware shall allow for float level adjustment with hand tools.
g. Provide single sealed well/tank penetration for float switch(s) cables.
h. Provide 316 SS NEMA 4X or cast aluminum termination enclosure (based on area electrical classification). The enclosure shall provide termination for the float(s) and include isolation relays and intrinsic safety barriers.
i. Provide termination enclosure mounted on 316 SS UNISTRUT® supports for wall or floor mounting.

TAG NO.	SERVICE	P&ID
LSHH 0404	PUMP STATION 4 HIGH-HIGH LEVEL	04 DI-601
LSLL 0404	PUMP STATION 4 LOW-LOW LEVEL	04 DI-601

SUBMERSIBLE WATER-LEVEL SENSOR/TRANSMITTER SPECIFICATION

DATA SHEET NO. 873.1

GENERAL

1.	Tag Number:	SEE TABLE
2.	Service:	SEE TABLE
3.	P & I D No.:	SEE TABLE
4.	Location:	SEE TABLE

SENSOR AND TRANSMITTER

5.	Type:	HYDROSTATIC HEAD-PRESSURE TRANSDUCER
6.	Wetted Parts:	316 STAINLESS STEEL, VITON OR TITANIUM BASED ON CORROSIVE FLUID
7.	Diaphram:	316 STAINLESS STEEL OR HASTELLOY OR PLATINUM BASED ON CORROSIVE FLUID
8.	Analog Coms:	4 - 20 mADC / 10-30 VDC
9.	Digital Coms:	NONE REQUIRED.
10.	Cable:	PROVIDED BY SENSOR MANUFACTURE
11.	Cable Connection:	WATERTIGHT
12.	Cable Type:	POLYURETHANE
13.	Cable Length:	AS REQUIRED FOR INSTALLATION
14.	Pressure Range:	BASED ON TANK OR VESSEL DIMENSIONS W/ 200% OVER RANGE PROTECTION
15.	Oper. Temperature:	-20 TO 190 DEG. F.
16.	Zero Point Shift:	90% OF MEASURING RANGE

INDICATING DISPLAY

17.	Type:	INDICATING
18.	Display:	LCD
19.	Supply Voltage:	120 VAC
20.	Housing:	CAST ALUMINUM
21.	Calibration:	FIELD
22.	Enclosure:	IP66 NEMA 4X MINIMUM AND AS REQUIRED FOR ELECTRICAL AREA CLASSIFICATION.
23.	Elec. Class:	SEE ELECTRICAL

MISCELLANEOUS

24.	Manufacturer(s):	KELLER (TRANSDUCER), PRECISION DIGITAL (TRANSMITTER)

NOTES.

a. Provide lightning and surge protection

b. Provide manufacturers mounting hardware for transmitter and level transducer mounting. Submit mounting details with shop drawings.

TAG	SERVICE	P&ID
LE/LT 0404	PUMP STATION 4 LEVEL	04 DI-601

PRESSURE GAUGE SPECIFICATION

DATA SHEET NO. 1454.1

GENERAL

1.	Tag Number:	SEE TABLE
2.	Service:	SEE TABLE
3.	P & I D No.:	SEE TABLE
4.	Location:	SEE CONTRACT MECHANICAL PROCESS DRAWINGS.

GAUGE

5.	Type:	GEARLESS DIRECT-DRIVE NON-LIQUID FILLED
6.	Element:	HELICALLY WOUND BOURDON TUBE
7.	Element Material:	INCONEL X-750
8.	Range:	SEE TABLE
9.	Overpress. Limit:	FULL VACUUM AND/OR 150% OF MAX RANGE
10.	Accuracy:	± 0.5% AT MID SCALE
11.	Repeatability:	± 0.025% FULL SCALE
12.	Zero Adjustment:	EXTERNAL
13.	Span:	FACTORY SET
14.	Linearity:	FACTORY SET
15.	Shaft Attachment:	DIRECT SENSING COIL AND POINTER
16.	Shaft Bearing:	SYNTHETIC SAPPHIRE BOTH ENDS
17.	Fittings:	316 SS OR AS REQUIRED BY PROCESS
18.	Joints:	NICRO-BRAZED OR T.I.G. HELIARC WELDED
19.	Case Type:	SWIVEL FITTING WITH MOVEABLE FLANGE
20.	Case Material:	ABS PLASTIC
21.	Case Front:	REAR BLOWOUT
22.	Dial Diameter:	4-1/2 INCHES
23.	Socket Material:	316 STAINLESS STEEL
24.	Process Connection:	½ INCH NPT
25.	Lens:	ACRYLIC
26.	Mounting:	BACK SWIVEL FLANGE

PROCESS CONDITIONS

27.	Fluid:	SEE TABLE
28.	Operating Temp.:	SEE TABLE
29.	Operating Pressure:	SEE TABLE

MISCELLANEOUS

30.	Diaphragm:	PROVIDE EXTERNAL ISOLATION RING, PIPING AND VALVES, AS INDICATED ON THE CONTRACT MECHANICAL PROCESS DRAWINGS AND DETAILS. SEE DATA SHEET 1457.
31.	Snubber:	PROVIDE INTERNAL TO STEM
32.	Pulsation Damper:	INTERNAL TO STEM
33.	Manufacturer(s):	ASHCROFT 1290

TAG NO.	SERVICE	RANGE	FLUID	P & I D
PI 0401	PS4.P-1 DISCHARGE	0-100	RWW	04 DI-601
PI 0402	PS4.P-2 DISCHARGE		RWW	04 DI-601

PRESSURE ISOLATOR RING SPECIFICATION

DATA SHEET NO. 1457.1

GENERAL

1.	Tag Number:	SEE DATA SHEET 1454
2.	Service:	SEE DATA SHEET 1454
3.	P & I D No.:	SEE DATA SHEET 1454
4.	Location:	SEE MECHANICAL DRAWINGS

A. Pressure Sensor Rings
   1. Manufacturers
      a. Ashcroft 80.
   2. 1-inch and Larger: Provide sensor/isolators that fit inside the bolt circle of 150-lb (Class 150).
   3. 3/4-inch and Smaller: Provide sensor/isolators full flange or threaded as specified and indicated. For chemical system provide full flange, threaded connections are not acceptable.
   4. Face to face length of the sensor: Conform to Specification MSS-SP67.
   5. Type: Flow through design with flexible sleeve around full circumference. The center section shall have a cavity behind the sleeve filled with silicone fluid to transfer pressure to the gauge.
   6. Rigidly support all pressure instruments by a post at least 7/8-inch diameter welded to the isolator. On sensor rings with more than one instrument, provide all connections 1/2-inch NPT as a minimum. 1/4-inch NPT fittings are not acceptable.
   7. Provide sensor/isolator rings that do not have any fill plugs or valves that can be inadvertently removed with the resultant loss of fill fluid. Pressure sensor/isolators using valves are not acceptable.
   8. Provide liquid filled sensor/isolators permanently vacuum sealed at the factory with a modular seal consisting of a membrane and needle fitting to allow removal and replacement of pressure instruments without compromising the vacuum fill. Sensor/isolators using valves are not acceptable.
   9. Provide the needle fitting with both 1/4-inch NPTF threads and 1/2-inch NPTM threads.
   10. Provide the pressure sensor/isolator capable of operating under pressure with all pressure instruments removed with no loss of fill fluid and without the need for isolating valves.
   11. Attach pressure instruments to the isolator with a hand tightened lock ring.
   12. It shall be possible to remove or attach pressure instruments to the isolator without requiring the use of any tools.
   13. Permanently fill the pressure sensor with high viscosity silicone instrument oil to damp out surges or pressure spikes without the requirement for a separate snubber.
   14. Pressure rating: 200 psi minimum for all lines tested at 150 psi or less and 600 psi minimum per lines tested above 150 psi.
   15. Materials:
      a. Process water
         (1) Center – 316 stainless
         (2) End Plates – 316 stainless
         (3) Elastomer – EPDM
         (4) Fluid – silicone
         (5) Stinger – 316 stainless
         (6) Pipe – 316L stainless

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SECTION 13331

CONTROL SYSTEM INTEGRATION

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 2
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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Control System Integration as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. The System Integrator (SI) is responsible for making all components of the system operate as a whole. This includes but is not limited to:

1. Configuring equipment software provided under SECTION 13350, SCADA EQUIPMENT.
2. Program all network hardware provided under SECTION 13345, DATA NETWORK.
3. Program the SCADA system to display and control the WWTF and PS4 operation systems.

4. Provide hardware and programming modifications to accommodate the scope of this work at the existing PLC.
5. Provide coordination and support the installation and programming of the instruments, provided under SECTION 13330, PROCESS INSTRUMENTS.
6. Provide witness testing for equipment shop testing and performing field testing as specified.
7. Review of shop drawings submittals of process equipment and PLC based control panels provided under other divisions.
8. Provide configuration direction to the Contractor for all process equipment control panels supplied with equipment.
9. Create HMI screens to replicate screens of the process equipment control panels supplied under other divisions. Provide new HMI screens and modifications to existing HMI screens in the same format and level of detail as existing HMI screens.
10. Provide coordination and support, including control panel shop drawing review, for the instrumentation and control systems for all OEM packages.
11. Provide classroom and hands-on training to the owner's staff on operation of the system.

D. The Contractor shall be responsible for the assistance of the SI with the coordination of equipment furnished in this contract with the overall control system requirements.

E. Design the system and equipment used therein, to resume normal operation without manual intervention, following resumption of power after a power failure.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. "Work" shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Detailed network architecture drawings showing all network components.

2. Submit print outs of all SCADA screens for Owner and Engineer’s review and comment.

3. Submit red-line markup of P&ID that reflects all changes to the design throughout the construction process.

4. Table of IP addresses for all devices.

5. Submit PLC program.6. Submit Network switch, firewall, and gateway configuration files.

7. Record and submit the configuration of each networked devices.

8. Project narrative.

9. HMI screens, showing at a minimum system overview page, alarms page, trends page, and pages for each piece of major process equipment.

9. Test Results

10. Test Plans.

C. All submittals provided by the Contractor shall be reviewed by the System Integrator (SI) prior to submittal to the Engineer. SI comments shall be incorporated into the submittal provided to the Engineer for review and approval. The SI shall provide a statement with each submittal indicating that the submittal has been reviewed, all SI comments have been addressed and that the submittal is reviewed by the SI.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections will result in resection of the entire submittal with no further review and consideration.

E. Operation and Maintenance Manuals:

1. Submit operating and maintenance instructions. Incorporate functional description of entire system.

F. Submit "record copy" of all drawings previously submitted for review within 30 days after completion of system installation as part of operating and maintenance instructions. Show all changes and modifications made during installation. Define special maintenance requirements particular to system along with special calibration and test procedures.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. Where possible, all equipment shall be provided by the same manufacturer.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Work of SI service personnel shall be coordinated by the Contractor.

B. Coordinate with mechanical and electrical systems suppliers to identify any signal isolation, signal boosting devices or auxiliary relays that may be required to complete the system.

C. System energizing not allowed prior to receipt of certified statement from Contractor and SI approving system and authorizing energizing of system.

1.08 - WARRANTY

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. The Contractor shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein.

1.09 - REFERENCES

A. American Petroleum Institute (API):

1. RP 551: Process Measurement Instrumentation

B. International Society of Automation (ISA):

1. S-20: Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

C. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the Work of this Section, verify that the project is ready for this Work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this Work and coordinate the Work with them.

3.02 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided for installation and startup for the equipment as follows:

1. 7 calendar days (via ## separate trips to project site).

3.03 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided for training of Owner's personnel for the equipment at the project site as follows:

1. 3 calendar days (via ## separate trips to project site).

3.04 - SPARE PARTS – Not Used

3.05 - GENERAL INSTALLATION

A. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be coordinated by the contractor and the SI during development and fabrication of systems.

B. Provide PLC programming services and control system integration as specified and indicated.

3.06 - SHOP TESTING

A. The SI shall attend, witness and coordinate shop testing activities of instrumentation and control system equipment as referenced in their respective specification sections.

3.07 - FIELD TESTING

A. All field testing activities shall be coordinated and led by the SI with the Contractor support.

B. Calibration and loop testing.

1. The SI shall provide supervision of all calibration and loop testing by the contractor.

2. Instrument calibration shall be provided by the instrument manufacturer. The field calibration shall be provided with a NIST traceable calibrator. The calibration report shall include;

a. Factory calibration sheet

b. Field (not hand written) calibration sheet

c. Picture of installed instrument

3. The calibration records shall include the instrument serial number and the project instrument tag on all documents. The calibration records shall be submitted electronically so they may be incorporated into the Owners asset data base.

4. The SI shall provide supervision for continuous loop testing. Loop testing shall occur following instrument calibration. The test shall check Continuity of all wiring from devices in the field to the control system IO

terminations. Next send and receive inputs and outputs from the field to the HMI (this does not mean simulate w/ a signal generator). Valves should be opened and closed, analyzers should be placed in known solution strengths and discrete devices cycled on and off. Note - before chemical tanks are filled w/ chemicals their levels should be check with water - this can be completed during the leak testing process.

5. The Loop Diagrams will be included in the loop testing. The loop diagrams will checked against field conditions to confirm:
    a. Analog range
    b. Terminal numbers
    c. All control wiring
    d. Power source, grounding, isolation and lightning protection
    e. Signal ground shield showing cutting and taping in field

C. As a minimum, the control system testing shall include the following:
1. Operational Readiness Test (ORT).
2. Application Software Operational Readiness Test (ASORT).
3. Field Acceptance Test (FAT).

D. The test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied. The SI shall provide a detailed step by step test procedure for review and approval by the Engineer.

E. All tests shall be conducted in accordance with prior Owner and Engineer approved procedures, forms and checklist. Each specific test to be performed and shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

F. Signed copies of the test procedures prepared by SI, forms and checklists will constitute the required test documentation.

G. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.

H. The SI shall coordinate all testing with the Owner and Engineer.

I. The Owner and Engineer reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures with no additional cost.

J. The Owner's and Engineer’s decision shall be final regarding the acceptability and completeness of all testing.

K. The SI shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.

L. Operational Readiness Test (ORT):
1. General: Prior to the Field Acceptance Test, the entire system shall be certified (inspected, tested and documented) that it is READY for operation.
2. Loop/Component Inspections and Tests: The entire system shall be checked for proper installation, calibrated and adjusted on a loop by loop and component by component basis by the SI following field installation, to demonstrate and document the system is in conformance with related submittals and these specifications. The Contractor is required to confirm that the system is properly wired, terminated and tagged from the field wiring nearest to the primary elements or equipment to the PLC I/O.
3. The SI shall maintain the Loop Status Reports and Components Calibration sheets at the jobsite and make them available to the Owner and/or Engineer at all times.
4. The Engineer reserves the right to witness and sign off all tests conducted by the SI. The Engineer shall review and initial all Loop Status Sheets and Component Calibration Sheets and spot check their entries

periodically and upon completion of the tests. Any deficiencies found shall be corrected. Final versions of these test sheets shall be submitted to the Owner and/or Engineer at all times.

M. Application Software Operational Readiness Test (ASORT):

1. During the entire ASORT, all panels and HMI equipment shall be powered, fully interconnected per the approved control system architecture drawing, and ready for testing.
2. The SI shall be responsible for testing all control and monitoring loops by simulation of field inputs and outputs. These inputs/outputs shall be simulated at the point nearest to the field element or equipment after conduit and wire have been installed and tagged as specified and indicated, but prior to transition of the wiring of field devices from the existing control system to the new control system. Field I/O will be simulated as follows:
    a. Discrete Input: Jumper at field input to simulate contact closure.
    b. Discrete Output: Relay and plug-in mounting base with matching coil voltage and indicating light to confirm output signal.
    c. Analog Input: 4-20mADC current source to simulate field analog transmitters.
    d. Analog Output: Multi-meter with mA range to confirm analog output from source.
3. Working with the Contractor's assistance to provide simulated field inputs/outputs as described above, the SI will confirm the PLC programming and HMI configurations and controls for each loop. Closed loop controls, such as wetwell level control, shall be simulated by manual simulation of feedback signal to confirm expected response.
4. The SI shall provide, or coordinate with the Contractor to provide, copies of all approved shop drawings; copies of all as-built drawings; PLC and HMI manufacturer's literature.

N. Field Acceptance Test:

1. Prior to the Field Acceptance Test, the entire installed instrument and control system shall be certified by the SI that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete. The intent of the FAT is for all responsible parties, working together, to prove the installed system operates in accordance with the Specifications. Each party is responsible for verifying the completeness of all system components furnished, installed, and configured by their respective firm or subcontractors.
2. A witnessed Field Acceptance Test shall be performed on the complete system to demonstrate that it is operating and in compliance with these specifications. Each specified function shall be demonstrated on a paragraph by paragraph, loop by loop, and site by site basis.
3. Loop specific and non loop specific tests shall be the same as specified under factory testing, WFT and AST.
4. In the event of rejection of any part or function of a SI furnished system, the Contractor and SI shall perform repairs or replacement within 10 days and at no additional cost to Owner.
5. Updated versions of the documentation specified to be provided for during the field acceptance tests shall be made available to the Owner and Engineer at the job sites both before and during the tests. In addition, one copy of all O & M Manuals shall be made available to the Owner and Engineer at the job sites both before and during testing.

3.08 - FUNCTIONAL START-UP TESTING

A. After completion of the Field Acceptance Test, the Instrumentation and Control System shall be tested as a component of the Functional Start-up Testing. All furnished hardware and software shall operate for a period of 14 consecutive days, under conditions of full plant process operation, without a single non field repairable malfunction.

B. During this test, Owner operations personnel and SI personnel shall be present as required. The Contractor and the SI are expected to provide personnel for this test who have an intimate knowledge of the hardware and the SI provided software of the system. Coordinate staffing requirements during the test to coincide with normal shift operations as much as possible. Off-shift emergencies shall be fully supported by Contractor and SI staff. Provide staff with cell phones and/or pagers to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

C. While the start-up testing is proceeding, the Owner shall have full use of the system.

D. Any malfunction to the system during the tests shall be analyzed and corrected. The Owner shall determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.

E. Any malfunction during the Start-up Testing which cannot be corrected within 24 hours of occurrence, or more than two similar failures of any duration, will be considered as a non field repairable malfunction.

F. Upon completion of repairs, the associated test shall be repeated as specified herein.

G. In the event of rejection of any part or function, perform repairs or replacement within 10 days and at no additional cost to the Owner.

H. The total availability of the system shall be greater than 90% during this test period. Availability shall be defined as:

AVAILABILITY = (TOTAL TIME – DOWN TIME)/(TOTAL TIME) * 100%

I. Upon successful completion of the startup operation test and subsequent review and approval of complete system final documentation, the system shall be considered Substantially Complete, after approval by the Owner and Engineer.

3.09 - TRAINING

A. Upon completion of the start-up, provide competent training personnel for a period of not less than three, 8-hour working days, excluding travel time, for training of personnel in the use, operation and maintenance of the instrumentation and control system. Training to utilize the submitted operation and maintenance manuals and record copy drawings as reference materials. Training to be for 6 personnel in each class. Each class to be of a 4 hour duration.

3.10 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SEE ATTACHED APPENDIX A - CONTROL DESCRIPTIONS

SECTION 13331A

PROCESS CONTROL STRATEGIES

Control strategies for 2022-01 Meetinghouse Pond Area Collection System and Pumping Station have been included in yellow highlight. All other strategies are pre-existing.

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A. GENERAL

The Wastewater Treatment Facility (WWTF) and remote pump stations (RPSs) shall be controlled automatically via a system-wide Supervisory Control and Data Acquisition (SCADA) System. The SCADA System shall include distributed Programmable Logic Controllers (PLCs), including vendor supplied PLCs, each controlling nearby process system(s), redundant SCADA System servers, engineering and operator workstations. At the WWTF, PLCs shall be integrated into a facility wide network in a hub and spoke configuration via copper network cables. Remote sites, including the effluent wick wells and collection system pump stations, will communicate to the SCADA System via fiber optic cables in a ring configuration where practical for increased reliability, and radio telemetry for those more remote sites. The system shall include workstations located in the control room and superintendent's office. Operators shall have the option to access the SCADA System at other remote sites (such as the DPW office) via a Virtual Private Network (VPN) connection. Critical Status and Alarms will be dialed out from the SCADA System to a pager/cell phone via Short Message Service (SMS) so that staff will be alerted to these issues when they are not near the control room or Human-Machine Interface (HMI).

Several systems are equipped with vendor-provided PLCs that provide the control and monitoring for the associated vendor supplied equipment or system as well as interface to facility-wide SCADA System. These PLCs will be connected to the facility wide network via CAT6 cables using Ethernet. The SCADA System shall send and receive signals to and from the vendor PLCs as required and as described in the individual control strategies in order to achieve the desired control and monitoring operation of the vendor supplied equipment or packaged system. The vendor HMIs, including relevant equipment monitoring and control, shall be duplicated on the SCADA System screens to facilitate the remote monitoring and control of the vendor supplied equipment or system from the SCADA System. All signals transmitted between the vendor-PLCs and the SCADA System shall be available and indicated on the SCADA System HMI. References in this document to "Common" signals indicate that one signal is required for the associated signal, whereas "Typical" signals indicate that one signal is required per piece of referenced equipment (pump, conveyor etc.). On loss of communication between the PLCs and the SCADA System network, a "PLC-X Communication Lost" Alarm shall be generated at the SCADA System.

During the normal operation, the facility will be run automatically with minimal operator intervention, as described in this document. All automatic functions are provided with manual controls for trouble shooting, maintenance, and operation during the failure or loss of communication of a PLC.

The switch for Run/Off/Remote (ROR) is at the local panel and the Hand/Off/Auto (HOA) is on the SCADA System screen. When the equipment is in Run mode, control will take place at the VFD, MCC or local control panel. When the equipment is in Remote, the control will take place at the PLC/SCADA System. At the SCADA System HMI, equipment will be provided with a HOA switch. In Auto at the SCADA System, the equipment will run automatically in accordance with the logic described herein. In Hand at SCADA System, the operator will be able to start and stop the equipment, and manually control the speeds (if applicable) at the HMI.

Wet well/pump station HMI screens shall indicate the level in engineering units plus rising/falling indications including having the alarm set-points indicated for operator reference. The displays shall also indicate the field instruments along with their I&C loop numbers.

Normally, pumps will automatically alternate lead/lag/follow or duty/standby, but the operator will have the option to manually assign these roles as well.

B. STATUS AND ALARMS

1. Status and Alarms Overview

All programmable monitoring and alarm setpoints described herein shall be operator adjustable. For each process monitoring instrument (flow meter, pressure transmitter, level transmitter, online analyzer), SCADA System shall generate an “Instrument Failure” signal upon loss of signal from the instrument. All connected equipment will be programmed to provide a runtime history in the SCADA System. For flow signals, the totalized flow will be calculated from the analog flow measurement. All setpoint values shall be adjustable from the SCADA System HMI.

All Status and Alarms shall have an enable/disable bit to allow operators to disable an alarm and prevent it from calling out.

In general, when a field alarm occurs, the alarm is "latched" in the PLC software. For safety reasons, the associated device will not be restarted until the alarm is eliminated. For the alarm to be acknowledged and cleared, two events must occur; the field condition creating the alarm must be corrected, and the alarm must be acknowledged by the operator at the appropriate location (e.g., reset at a MCC, reset at a VFD, etc.). When the PLC commands a piece of equipment to perform a function, the PLC will receive feedback from the equipment or a related piece of equipment to verify whether the function was successful. If verification has not been received within a time allowance, the PLC will generate a failure alarm.

Unless otherwise noted, all pump control strategies shall be provided with fixed and pump alternation call sequences. Pumps that are unavailable shall be skipped in the pump call sequence. Normally, pumps will automatically alternate lead/lag/follow or duty/standby, but the operator will have the option to manually assign these roles as well. The operators should be able to remove any pump from the operating sequence (due to pump maintenance, failure or out of service).

For each pump, if the HOA switch is in the Auto position, the pump is not experiencing a fault, and the emergency stop switch is not activated, the HMI shall indicate that the pump is “Ready”. If any of these conditions are not met, the HMI shall indicate that the pump is “Not Ready.

In general, all of the historically trending Status and Alarms (e.g., analog and digital signals) shall be input into the corresponding PLC SCADA System for indication, trending, totalization, accumulation, reporting via historian server, etc. in the SCADA System.

2. Trending

As a minimum, all analog instrument readings and totalized/calculated values shall be trended in the SCADA System. Refer to each control strategies for process specific trending details.

3. Fault Response

Fault Response Operation describes how equipment is to be controlled when an abnormal or fault condition exists, such as equipment failure, instrument failure or PLC failure. Fault conditions include, but are not limited to, equipment and instrument failures, loss of normal power, communication failure to other equipment or PLCs, loss of process variable (instrument feedback) and hardwired interlocks. Fault Responses are described in each relevant section where it applies.

When pump or valve in AUTO fails, it is automatically switched to HAND mode.

In general, when a PLC communication failure is detected by other PLCs it communicates to, the affected PLCs will continue to operate in its last communicated setting. If a PLC stops, the affected equipment will retain its existing status, based on the configuration of the PLC outputs to hold the last state. In any case, updates to automatic controls, based on monitoring of process parameters, and/or SCADA System operator inputs will be unavailable, and operator intervention will be required. On PLC restart, the system will change its settings based on the new information received.

4. WWTF and Pump Station Communication Network

The WWTF communication system is anchored by several PLCs and SCADA System HMIs located throughout the facility. Remote Pump Stations and WWTF communication system through a combination of fiber and radio network. Communication within the WWTF for the new PLCs and vendor supplied PLCs are provided through new managed Ethernet network switches and connected to the SCADA System servers in Room 116 – Control Room via copper communication cables.

5. Loss of Communication and Monitoring

The PLC communication failure with the WWTF SCADA System is detected through the absence of a "heartbeat" signal from the SCADA System to the PLCs. In the event of PLC communications failure between the PLCs and the SCADA System network, a "PLC-X Communication Lost" alarm shall be generated at the SCADA System.

Refer to other sub-sections of the control strategies for fault responses.

6. PLC Failure

There are four standard faults that are SCADA System monitored based on the status of PLC system variables: PLC stopped, PLC hardware failure, override in memory and battery low. In addition, PLC communication fault is also monitored in the SCADA System. When a PLC communication failure alarm is detected, the associated field equipment will continue to operate in its last communicated setting. If a PLC stops, the affected equipment will retain existing status, based on the configuration of the PLC outputs to hold the last state. In any case, updates to automatic controls, based on monitoring of process parameters, and/or SCADA System operator inputs will be unavailable, and operator intervention will be required. On PLC restart, the system will change its settings based on the new information received.

Refer to other sub-sections of the control strategies for fault response.

7. Power Failure

Electrical power failure is categorized into three different scenarios:

a. Maintenance or field disconnect switch is open;

b. Momentary power glitch and return to normal utility power; and

c. Prolonged utility power failure and transfer to standby power.

Power loss at the device level (e.g., due to a field disconnect), is monitored in the SCADA System as 'Not Available" alarm. Recovery from this condition will require operator's intervention to place the device back into computer automatic mode upon clearing of the field failure, or completion of maintenance activities.

When an area or building electrical power failure occurs, affected equipment on utility power will shut down. Critical equipment, which is supplied with standby power, is required to automatically return to control mode/status that it had prior to the power loss. Refer to other sub-sections of the control strategies for fault response.

C. WWTF CONTROL STRATEGIES

1. General (00) Control Strategies

a. 00-01: WWTF Start-Up Sequence

Objective: WWTF Start Up and Reboot after loss of Power by Process Order.

Description	Process Priority	Description	Process Priority
Disk Filters	1	Headworks	2
Effluent Pumps	1	Odor Control	2
Facility Lighting	1	SBR Air Valves	2
HVAC	1	SBR Blowers	2
Sanitary Pump System	1	SBR Mixers	2
SBR Effluent Valves	1	SBR Waste Valves	2
SBR Panels/Instrumentation	1	Load-out Pumps	3
SBR Transfer Pumps	1	Mixing Blowers	3
SCADA System	1	Post EQ Mixers	3
UV	1	Rotary Drum Thickeners	3
Plant Water System	1	Rotary Drum Thickeners Feed Pumps	3
		Septage Receiving	3

b. 00-02: WWTF Influent Flow Calculation

P&ID: 01 DI-601

I&C Loop Numbers: 0105

PLC: WWTF-PLC

Equipment Location: Pump Station 1

Equipment Tag Nos.: FE/FIT 0105

Objective: Calculate Total WWTF Influent Flow

Programmable Setpoints: N/A

Operation: The Total WWTF Influent Flow shall be calculated as:

Total WWTF Influent Flow = Pump Station 1 Flow (See Control Strategies 01-02)

Total WWTF Influent Flow shall be monitored, totalized, and trended.

Local Indication: N/A

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Flow
Alarms	Instrument Fail (FE/FIT-0105)

Interlocks: N/A

2. 10-01: Influent Screen Isolation Gates

P&ID: 10 DI-601

I&C Loop Numbers: 1003, 1004, 1008, 1009

PLC: WWTF-PLC

Equipment Location: Headworks

Equipment Tag Nos.: See Table

RWW.SG-1	RWW.SG-2	RWW.SG-3
RWW.SG-4		

Objective: Provide isolation to the Influent Screen (RWW.SCR-1) and Manual Bar Rack.

Programmable Setpoints: N/A

Operation: Under normal operation, isolation gates on the upstream (RWW.SG-1) and downstream (RWW.SG-3) sides of RWW.SCR-1 will be open and isolation gates on the upstream (RWW.SG-2) and downstream (RWW.SG-4) side of the Manual Bar Rack will be closed. In the event that RWW.SCR-1 experiences a fault (see Control Strategy 10-02), the gates associated with the manual bar rack shall open and the gates associated with RWW.SCR-1 shall close.

In the event that the level on the upstream side of the isolation gates reaches an operator-adjustable high level setpoint (See Control Strategy 10-02), the isolation gates associated with the manual bar rack shall open, and the isolation gates (RWW.SG-1, RWW.SG-3) associated with RWW.SCR-1 will remain open as well.

Local Indication: Local controls will be provided at the gate actuator.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Gate Open (Green)
	Gate Closed (Red)
	Gate Actuator Not In Remote
Alarms	Gate High Torque

Interlocks: Close RWW.SG-1 and RWW.SG-3 and open RWW.SG-2 and RWW.SG-4 on fault from RWW.SCR-1.

Open RWW.SG-2 and RWW.SG-4 upon an upstream channel "High-High Level" condition measured by LE 1001A.

3. 10-02: Influent Screen

P&ID: 10 DI-601

I&C Loop Numbers: 1001

PLC: RWW.SCR-1-CP

Equipment Location: Headworks

Equipment Tag Nos.: See Table

RWW.SCR-1	LE 1001A	LE 1001B
LIT 1001		

Objective: Provide automatic Influent Screen control (e.g., "start/stop" and "speed control") from either upstream and downstream channel level or timed operation including manual/automatic control.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoint(s)
Minimum Interval (timer)
Upstream Level High (alarm)
Downstream Level High (alarm)
Differential Level High (alarm)

Operation: Influent Screen

The Screen will operate upon the following:

Differential upstream and downstream level

Elapsed time.

The Influent Screen will be automatically or manually operated from the HMI on RWW.SCR-1-CP.

If operating in differential level mode and there is a failure of one of the level instruments the system should provide an alarm and switch to elapsed timer operating mode.

On Screen fault, the fault alarm shall be transmitted to the Facility SCADA System, which will send a command to the Screen isolation gates to close and the Bar Screen isolation gates to open. See Control Strategy 10-01.

The Influent Screen system shall also include multiple Status and Alarms, operating interlocks, etc. which are described below.

Level Instruments

Provide continuous level monitoring upstream and downstream of the Screen isolation gates via ultrasonic level transducers.

Failure of a level instrument shall automatically alarm in the SCADA System and automatically open all channel isolation gates.

Upon an upstream channel "High-High Level" condition measured by LE 1001A, an alarm shall be transmitted to the WWTF SCADA System and open RWW.SG-2 and RWW.SG-4.

Local Indication: The screen shall be provided with a local control panel for control at the Screen. This local control panel shall include a Hand/Off/Auto switch, Emergency Stop pushbutton, and reset pushbutton. The Screen PLC-based control panel shall also have local control and monitoring available at the OIT.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Screen On (Green)
	Screen Off (Red)
	Level Upstream
	Level Downstream
	Upstream and Downstream Level Differential
	Elapsed Run Time
	In Remote
Alarms	Fail to Start
	High Torque
	Screen Blocked
	Motor Overload
	Motor Over Temperature
	Not In Remote
	High-High Level – Upstream
	High Level - Upstream
	Low Level - Upstream
	High Differential Level
	Upstream Level Instrument Loss of Signal
	Downstream Level Instrument Loss of Signal
	Emergency Stop

Status and Alarm Condition(s)
UPS On Battery
UPS Low Battery
PLC Communication Fail
Loss of Power
Vendor PLC Fail
Vendor RPU Communication Fail

Interlocks: Refer to interlock to 10-01

4. 10-03: Influent Sampler

P&ID: 10 DI-601

I&C Loop Numbers: 1002

PLC: WWTF-PLC

Equipment Location: Headworks

Equipment Tag Nos.: See Table

AN 1002

Objective: Automatically draw a sample of screened raw wastewater.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Frequency
Duration
Rate

Operation: The operator shall be able to select at the SCADA System whether the sampler operates in a flow-proportional manner or on a timer.

When the sampling is flow-proportional, the sample rate shall be proportional to PS 1 discharge flow meter (FIT 0105). See Control Strategies 00-02.

Local Indication: Local indication and configuration is available at the sampler.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Sampler On (Green)
	Sampler Off (Red)
Alarms	N/A

Interlocks: Sampler cannot start unless FIT-0105 (PS1) is indicting a flow measurement. See Control Strategies 00-02.

5. 10-04: Pre-Equalization Tanks

P&ID: 10 DI-602

I&C Loop Numbers: 1005, 1006

PLC: WWTF-PLC

Equipment Location: See Table

Equipment Tag Nos.: See Table

Instrument	Pre-Equalization Tank 1	Pre-Equalization Tank 2
Level	LE/LIT 1005A	LE/LIT 1006A
	LE/LIT 1005B	LE/LIT 1006B
pH	AE/AIT 1005A	AE/AIT 1006A
ORP	AE/AIT 1005B	AE/AIT 1006B

Objective: Continuously monitor the level, pH and ORP at Equalization Tank 1 and Equalization Tank 2.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Pump On Level
Pump Off Level
High-High Level
High Level
Low Level
Low-Low Level
High pH
Low pH
Acceptable Error Between Level Instruments
Tank in Operation (No. 1, No. 2 or Both)

Operation: The instruments will continuously monitor the level, pH, and ORP in each Equalization Tank. The measurements will be monitored at the SCADA System. The operator shall select which tanks are in operation (Tank 1 or Tank 2 or Both).

Each tank is provided with redundant level transmitters. The operator shall be able to select at the SCADA System HMI which transmitter is the primary and which is the back up for each tank. The signal from the primary transmitter shall be used to generate the high/low Status and Alarms as described above. The SCADA System shall continuously compare the measured values from each transmitter and if the level difference exceeds an operator-adjustable setpoint, an alarm shall be generated, indicating an error with one of the level transmitters.

Local Indication: Local indication shall be provided at each level transmitter, pH transmitter and ORP transmitter.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Level
	pH
	ORP
Alarms	High-High Level
	High Level
	Low Level
	Low-Low Level
	High pH
	Low pH
	Acceptable Error Between Level Instruments Exceeded
	Level Instrument Loss of Signal
	pH Analyzer Loss of Signal

Interlocks: On Low-Low Level stop 10-05 SBR Transfer Pumps.

On Low-Low Level stop 10-16 Mixing Blowers.

On High-High Level stop 10-18 Septage Receiving.

On High-High Level stop 10-21 Rotary Drum Thickening.

6. 10-05: SBR Transfer Pumps

P&ID: 10 DI-603

I&C Loop Numbers: 1011, 1012, 1013, 1014, 1015

PLC: WWTF-PLC

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

SBR.TP-1	SBR.TP-2	SBR.TP-3
SBR.TP-4	FE/FIT 1015	PI 1011A
PI 1011B	PI 1012A	PI 1012B
PI 1013A	PI 1013B	PI 1014A
PI 1014B	TSH 1011	TSH 1012
TSH 1013	TSH 1014	

Objective: Transfer pumps pump out the wastewater from the pre-equalization tanks to the SBRs for biological treatment.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Pump On (Duty 1) Pre-Equalization Tank Level
Pump On (Duty 2) Pre-Equalization Tank Level
Pump Maximum Speed
Pump Minimum Speed
Pump Run Duration
Pump Mode
Pre-Equalization Tank 1 Low Level
Pre-Equalization Tank 2 Low Level
Pump Off Pre-Equalization Tank Level
Flow Determined by SCADA System Using a Rolling X-hour Average of Collection and internal plant Flows
X-Hour Average
Operator Adjustable Correction Factor to Manually Trim the Rolling Average Derived SP

Operation: SBR transfer pumps transfer flow to the SBRs with one stand-by pump.

Two modes of operation shall be available for selection by the operator: (1) Flow Pacing; and (2) On/Off.

1. Flow Pacing

   Variable Frequency Drives (VFDs) on each pump are controlled through the WWTF's PLC logic (proportional control), which will automatically start and stop the pumps and adjust the pumping rate to match (as close as possible) the flow rate determined by the rolling X-hour average of influent and internal plant flows.

   A mode switch is utilized to select the number of SBRs on-line. If only one is on-line, pumping is only 50 percent of the time so the Rolling X-hour Average of Collection and internal plant Flows will be doubled the initial SP.

   The flow is leveled out by utilizing the rolling average technique. Short term increases in flow will result in short term level variation within the tank.

   If the lead pump can't meet the flow SP, then the PLC sends a signal to the lag 1 pump's VFD to bring it up to a speed and reduce the speed of the lead pump to a level, where the combined flow rate from both pumps matches the setpoint. If the lead pump and lag 1 pump can't meet the flow SP, the same process is repeated with the lag 2 pump.

   If any pump fails, the standby pump will be automatically put in service.

All pumps will shut off when the tank's level reaches the predetermined "Low" level.

Normally, pumps will automatically alternate lead/lag 1/lag 2/standby, but the operator will have the option to manually assign these roles as well.

If a Pre-Equalization tank is taken offline, the SBR Transfer Pumps shall operate to maintain the flow in the online Pre-Equalization tank.

2. On/Off

Lead pump shall turn on when the Tank Level reaches a predetermined level.

The Pump will run at minimum speed for a predetermined duration. The run duration is manually adjusted up or down in response to rising or lowering average levels.

All pumps will shut off when the tank's level reaches the predetermined "Low" level.

Normally, pumps will automatically alternate lead/lag 1/ lag 2/standby, but the operator will have the option to manually assign these roles as well.

A magnetic flow meter monitors the flow to the SBRs. This measurement is also used to pace the sodium hypochlorite and Polyaluminum chloride metering pumps. See Control Strategies10-23 and 10-24, respectively.

Inability to Achieve Setpoint Alarm if lead and lag pumps run for an adjustable time frame and after an adjustable time delay (initially set at 1 hour).

Alarm when pump(s) are running and no flow indication in the SBR flow meter.

Local Indication: Local indication shall be provided at each SBR transfer pump

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	Flow
	Elapsed Run Time
	In Remote
	In Auto
Alarms	Pump High Temperature
	Pump Fault
	Inability to Achieve Setpoint

Status and Alarm Condition(s)
Emergency Stop

Interlocks: Pumps cannot start unless either open limit switches at MOV-1020 or MOV-1030 have been engaged. See Control Strategy 15-01.

Pumps stop on “Low-Low Level” in 10-04 Pre-Equalization Tanks.

7. 10-06: Disk Filter Influent and TSS Measurement

P&ID: 10 DI-604

I&C Loop Numbers: 1050, 1060

PLC: WWTF-PLC

Equipment Location: Filter Room

Equipment Tag Nos.: See Table

AE/AIT-1050 (TSS)	FE/FIT-1050
AE-1056 (TSS)	AE-1066 (TSS)

Objective: Continuously monitor the Total Suspended Solids (TSS) concentration of the SBR Decant entering and filtered water exiting the disk filter, open and close control of disk filter inlet valve and monitor the continuous and accumulated disk filter influent flow.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
High TSS – Upstream
High TSS – Effluent Trough

Operation: The filters will operate in a manual duty/standby manner. Flow will be measured by FE/FIT-1050 in a common pipe upstream of Disk Filter-1 and Disk Filter-2. Upstream TSS will be measured in a common pipe upstream of Disk Filter-1 and Disk Filter-2.

TSS analyzers are provided on the effluent trough of each disk filter to monitor performance. If the effluent TSS exceeds an operator-adjustable value, an alarm shall be generated.

Local Indication: Flow Transmitter and TSS Transmitters will be provided with local indication.

Local controls will be provided at the valve actuator.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Flow
	TSS

	Status and Alarm Condition(s)
Alarms	High TSS

Interlocks: N/A

8. 10-07: Disk Filters

P&ID: 10 DI-604

I&C Loop Numbers: 1051 through 1055, 1061 through 1065

PLC: DF-1-CP, DF-2-CP

Equipment Location: Filter Room

Equipment Tag Nos.: See Table

Disk Filter 1	Disk Filter 2
DF-1	DF-2
SBW.P-1	SBW.P-2
LSHH-1051	LSHH-1061
LE/LIT-1052	LE/LIT-1062
PI/PIT-1055	PI/PIT-1065
MOV-1053	MOV-1063
MOV-1054A	MOV-1064A
MOV-1054B	MOV-1064B
MOV-1054C	MOV-1064C

Objective: SBR decant flows to the Effluent Disk Filters for tertiary filtration prior to Post-Equalization followed by UV treatment to meet the MassDEP requirements regarding coliform limits and for the protection of the effluent discharge Wicks.

The Disk Filters are a complete system for continuously removing particulates from the wastewater flow stream.

The process complements the quality of effluent from the SBR activated sludge treatment process.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Backwash Initiate Level
Backwash Duration (per valve)
Backwash Interval
Sludge Wasting Duration
Sludge Wasting Interval
Backwash Time Between Sludge Waste Cycles

Operation:

The Disk Filter system's operational strategy consists of three modes: Filtration, Backwash, and Solids Wasting.

The influent pipe routes flow to influent trough to the filter basin, where filtration occurs.

The filter basin contains a series of circular disks covered with a basic filtering element, which is unique pile cloth media. Filter segments are fixed on the disc shaft and number of discs are designed to meet the maximum SBR decant rate every six (6) hours based on 2 SBRs operating.

The disks are stationary during normal filtration operation; however, the disks rotate when in backwash mode. As more particulates are deposited on and within the pile cloth media, the pressure required to drive water through the pile cloth media (headloss) increases. This results in a rise in the water level within the filter basin and increased differential pressure on the pile cloth media. Upon reaching a backwash initiate level set point, the PLC automatically initiates the backwash mode to clean the pile cloth media. There are three other scenarios in which a backwash is initiated.

If the HHWL back-up float switch is tripped, a backwash is initiated and an alarm is generated.

The timer, limiting the maximum time between backwashes has elapsed. Backwash is initiated and a warning is generated.

The operator initiates a backwash manually from the SCADA System or the local control panel.

In addition to having backwash sequences, the vendor supplied PLC also initiates a sludge wasting sequence to remove settled materials from the bottom of the filter chamber. A sludge wasting sequence is initiated for every "x" backwash sequences. The number of backwash sequences before a sludge wasting sequence is triggered is an operator adjustable setpoint. There are two other scenarios in which sludge wasting is initiated.

The timer, limiting the maximum time between sludge waste sequences has elapsed.

The operator initiates a sludge waste sequence manually from the SCADA System or the local control panel.

Filtration continues while the filter is in backwash mode to allow continuous filtration while maintaining efficient filter performance. Two Disk Filters configured as manual duty/standby operation to hydraulically treat the peak annual flow when one of the disk filter units is out of service. Each disk filter unit is capable of operating and backwashing independently of the other filter unit. The system shall be designed so that the Effluent Disk Filters will continue to provide filtration during backwash periods. Operators will be able to manually switch between filters and/or operate both filters simultaneously. Filtration is controlled by a vendor supplied PLC for continuous operation without any interruption.

Local Indication: HMI panel located on each disk filter

Status and Alarms:

The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Filter On (Green)
	Filter Off (Red)
	Basin Level
	MOV Open (Green)
	MOV Closed (Red)
	Backwash On (Green)l
	Backwash Off (Red)
	Backwash Time
	Sludge Wasting On (Green)
	Sludge Wasting Off (Red)
	Sludge Wasting Time
	Elapsed Run Time
	In Auto
Alarms	Backwash/Waste Pump Vacuum High
	Backwash/Waste Pump Vacuum Out of Range
	Drive Motor Fail
	Backwash/Waste Pump Vacuum Fail
	H-O-A Controls Not In Auto for Backwash
	Backwash Valve Failed to Open (Each Valve)
	Backwash Valve Failed to Close (Each Valve)
	Solids Waste Valve Failed to Open
	Solids Waste Valve Failed to Close
	Basin High Level
	Basin Level too Low for Backwash
	Basin Level too Low for Solids Waste
	Basin Level Tank Level Transmitter vs. High Level Switch Mismatch
	Basin Level Out of Range
	PLC-SCADA Communication Fail
	PLC Battery Low

Status and Alarm Condition(s)
PLC Output Power Fail
PLC Detected Power Loss
PLC Input Power Fail

Interlocks: N/A

9. 10-08: Post Equalization Tank Level

P&ID: 10 DI-605

I&C Loop Numbers: 1070

PLC: WWTF-PLC

Equipment Location: Post-Equalization Tank

Equipment Tag Nos.: See Table

LE/LIT 1070	LSHH 1070	LSLL 1070

Objective: Continuously monitor the Post Equalization Tank level

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Pump On Level
Pump Off Level
High Level
Low Level
Mixer Start Level
Mixer Stop Level

Operation: Provide continuous monitoring of the post equalization tank level via level transducer with dedicated float switches to detect high-high and low-low level Status and Alarms in the tank.

Tank Status and Alarms include low-low and high-high Status and Alarms for local and remote indication.

The floats shall provide backup control and alarming for the level transducers.

The level instrument will continuously monitor the post equalization tank level and transmit a variable level signal to the PLC.

Upon tank “High Level” condition or “Low Level” condition from the level transducer, an alarm shall be transmitted to the SCADA System.

Upon tank “High-High Level” condition or “Low-Low Level” condition from the level switch, an alarm shall be transmitted to the SCADA System.

The level measurement will provide input into the effluent pump control loop. See Control Strategy 10-10.

Local Indication: Local indication shall be provided for the level transmitter.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Level
Alarms	High-High Level
	High Level
	Low Level
	Low-Low Level

Interlocks: Start 10-10 effluent duty pump on preselected level.

Start 10-10 standby effluent pump on High-High Level.

Stop 10-10 effluent pumps on Low-Low Level.

Start and Stop 10-09 mixers at pre-selected level.

10. 10-09: Post Equalization Tank Mixers

P&ID: 10 DI-605

I&C Loop Numbers: 1071, 1072

PLC: WWTF-PLC

Equipment Location: Post-Equalization Basin

Equipment Tag Nos.: See Table

EQ.MIX-1	EQ.MIX-2
MSH 1071	MSH 1072
TSH 1071	TSH 1072
HS 1071	HS 1072

Objective: Constant speed mixers ensure that particles remain constantly suspended and uniform mixing inside the tank.

Programmable Setpoints: N/A

Operation: Mixers run continuously at a constant speed, to maintain solids in suspension.

The mixers shall start/stop when the levels reach their respective predetermined levels.

If the level in the post equalization tank drops below an operator-adjustable low level setpoint, the mixers shall stop.

Temperature and moisture detection are provided for each mixer. Temperature and/or moisture detection shall stop the mixer.

Shut down Mixer on Motor High Temperature.

Shut down Mixer on Seal Leak.

Local Indication: A local Run/Off/Remote switch is provided at each mixer for local control. Mixer running and fault status shall be provided at the MCC.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Mixer On (Green)
	Mixer Off (Red)
	Elapsed Run Time
	In Remote
Alarms	Mixer High Temperature
	Mixer Seal Leak
	Mixer Fault

Interlocks: Shut down Mixer(s) on Tank Preselected Level (see 10-08 Post Equalization Tank Level).

11. 10-10: Effluent Pumps

P&ID: 10 DI-606

I&C Loop Numbers: 1081, 1082, 1083, 1084, 1085

PLC: WWTF-PLC

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

Pump 1	Pump 2	Pump 3
EFF.P-1	EFF.P-2	EFF.P-3
PSH1081	PSH1082	PSH1083
PI1081A	PI1082A	PI1083A
PI1081B	PI1082B	PI1083B
TSH 1081	TSH 1082	TSH 1083
HS 1081	HS 1082	HS 1083
AE/AIT-1084 (TSS)	FE/FIT-1085	

Objective: Effluent pumps to pump out the flow controlled and uniform effluent wastewater from the post-equalization tanks for UV Treatment.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Tank Target Low Level (at the end of each cycle)

Programmable Setpoints
Quantity of SBRs Online (For flow calculation to know how much time it has before next decant)
Discharge Pressure High Level

Operation:

Each effluent pump is sized to handle 50 percent of the Phase 1 max flow along with one future pump for additional Phase 2 flows.

Two pumps are configured to operate as operator selectable lead/lag/standby configuration.

Each online SBR receives flow for 3-hours out of every 6-hour cycle and begins to empty (decant) at a predetermined time within the last 2-hours of the cycle. With two SBRs online, the cycles are offset by exactly 3 hours. An algorithm within the SCADA System will determine the volume in the next SBR to be decanted.

The effluent pump flow will be calculated by the impending volume of the next decant, determined by tank level minus Tank Target Low Level SP, divided by the amount of time before the next decant (3-hours with two SBRs on, 6-hours with one SBR on). This calculation will be applied at the start of the decant period and will hold until the following decant period where it will be recalculated.

An HOA switch in the SCADA System will allow the operator to override this logic and set a flow rate manually.

If the lead pump is operating at full speed and cannot maintain the calculated flow rate, the lag pump shall start. The lead pump speed shall be reduced to match the lag pump's speed and both pumps shall operate together to maintain the calculated flow rate. The pumps should be operated so that each pump has approximately equal run time. Pump alternation will be automatic via the SCADA System, with the option for the operator to manually alternate the pumps.

Alarm when pump(s) are running while there is no flow indication in the effluent flow meter.

Effluent water flow and TSS are measured on the discharge header of the effluent pumps, prior to entering UV Treatment.

Shut down effluent pumps on Pump High Temperature and Pump Discharge High Pressure.

Local Indication:

The Flow and TSS transmitters will be provided with local indication. Run/Off/Remote switches are provided for each pump at the MCC.

Status and Alarms:

The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	Flow

Status and Alarm Condition(s)	
	TSS
	Pump Speed
	Discharge Pressure
	Elapsed Run Time
	In Remote
	In Auto
Alarms	Pump High Temperature
	Pump Discharge High Pressure
	VFD Fault
	Emergency Stop
	Inability to Achieve Calculated Flow Rate
	No Flow

Interlocks: Shut down effluent pumps on Low-Low Level in the Post Equalization Tank (10-08).

When effluent pumps called to run, turn UV lamps on for a predetermined duration before pumps can start (10-11).

12. 10-11: UV Treatment

P&ID: 10 DI-607

I&C Loop Numbers: 1091, 1092

PLC: WWTF-PLC, UV-PLC

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

UVR-1	UVR-2	AIT 1091
AIT 1091B	AIT 1092B	
TSH 1091	TSH 1092	

Objective: UV disinfection is the primary method in order to clean effluent to achieve disinfection standards, prior to treated effluent from being discharged to the Wicks and Plant Water Storage Tank.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
UV Intensity – High
UV Intensity – Low
Wiping Cycle Interval

Programmable Setpoints
Wiping Cycle Duration
UV Bank Temperature
UV Transmittance – Low
No Flow Duration
UV Chamber High Temperature

Operation:

Two UV reactors are provided and operated on a duty/standby mode.

UV banks have a common UV transmittance instrument, and are each equipped with dedicated instruments to measure UV Intensity and UV chamber temperature for control and monitoring. Effluent from post-equalization tanks is introduced to the UV disinfection system via effluent pipes which branched into two UV banks, which can be isolated by manual butterfly valves. The control logic via Vendor PLC determines the UV intensity and varies power of the banks depending on the measured flow (FIT 1085) and upstream common UV Transmittance (AIT 1091).

Each UV reactor will have a H-O-A selector switch located at the manufacturer's panel. In Hand, the UV reactor will be manually operated. In Auto, the UV reactor intensity will modulate to achieve the operator-adjustable setpoints or flow-based intensity via the vendor PLC.

During normal operation, UV bank with minimum run hours will be operating based on operator adjustable time delays to prevent unnecessary cycling of the UV banks.

Each UV reactor shall be equipped with an automatic sleeve wiping system which can also be operator started. The operator sets the interval and duration of the cleaning cycle. When the preselected UV Transmittance reaches the "low" setpoint, the UV sleeve wiping cycles will start.

Local Indication:

The manufacturer's control panel will provide status and control for UV Transmittance, UV Intensity, High Chamber Temperature, Wiping Unit Status

Status and Alarms:

The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	System On (Green)
	System Off (Red)
	System Warming
	UV Transmittance
	UV Intensity
	Elapsed Time Meter
	In Auto

	Status and Alarm Condition(s)	
		In Remote
	Alarms	Individual Lamp Fail
		Multiple Lamp Fail
		End of Lamp Life Hours
		Low UV Intensity
		Low UV Transmittance
		No UV Transmittance Signal
		Low UV Dose
		UV PLC Communication Fail
		Wiper Fault
		Wiper Home Alarm
		Wiper Revolution Alarm
		Wiper High Pressure Alarm
		Wiper Limit Switch Alarm
		Ballast Fault
		High Flow Alarm
		No Flow Alarm
		SCADA Communication Fail
		High Temperature

Interlocks: Shut down UV if no flow from FIT 1085 after an operator-adjustable duration.

When effluent pumps called to run (10-10), turn lamps on for a predetermined duration before pumps can start.

13. 10-12: UV Treatment – Pressure Indicator and Water Sampler

P&ID: 10 DI-607

I&C Loop Numbers: 1093, 1094

PLC: WWTF-PLC

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

PE/PIT-1093	AN-1094

Objective: To collect sample for analyzing the effluent conforming to the discharge requirements

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Sampling Frequency
Sampling Duration
Sampling Rate
Pressure High

Operation: The sampler may be configured to be either time-based or flow paced (based on flow from FE/FIT 1085), to collect sample for analyzing the effluent conforming to the discharge requirements.

Local Indication: An operator interface is provided at the auto sampler, and the pressure transmitter provides local indication of the pressure measurement.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Sampler On (Green)
	Sampler Off (Red)
Alarms	High Pressure

Interlocks: Shut down effluent pumps on high pressure measurement.

Sampler cannot start unless Magnetic Flow Meter FE/FIT 1085 is indicting a flow measurement (reference 10-10 Effluent Pumps).

14. 10-13: Plant Water Tank

P&ID: 10 DI-608

I&C Loop Numbers: 1100

PLC: WWTF-PLC

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

MOV-1100A	MOV-1100B	LSHH-1100	LSLL-1100
LE/LIT-1100			

Objective: The Plant Water Storage Tank holds water to be used for various application points throughout the facility. The Plant Water Storage Tank may be filled either by effluent water downstream of UV Treatment or by town water (W2).

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Effluent Fill On (Opens MOV-1100A)
Effluent Fill Off (Closes MOV-1100A)

Programmable Setpoints
Town Water Fill On (Opens MOV-1100B)
Town Water Fill Off (Closes MOV-1100B)
High Level
Low Level

Operation:

Normally, MOV-1100A and MOV-1100B are closed and UV treated water flows to the Wicks. The plant water pumps and the foam spray pump draw from the Plant Water Storage Tank to send water to the various application points throughout the facility.

When the effluent pumps are operating, the Plant Water Storage Tank shall be filled with effluent in a fill/draw manner via MOV-1100A.

When the plant water demand is greater than the available effluent flow, the Plant Water Storage Tank shall be filled with W2 via MOV-1100B.

When the level (LE/LIT-1100) in the Plant Water Storage Tank reaches the Effluent Fill On Level, MOV-1100A opens and the level in the tank rises. When the level in the tank reaches the Effluent Fill Off Level, MOV-1100A closes.

When the level (LE/LIT-1100) in the Plant Water Storage Tank reaches the Town Water Fill On Level, MOV-1100B opens and the level in the tank rises. When the level in the tank reaches the Town Water Fill Off Level, MOV-1100B closes.

In the event that the plant water storage tank level exceeds the tank capacity, the overflow will flow via 12-inch drain line to the site infiltration basin.

Local Indication:

The level transmitter at the water storage tank is provided with local level indication.

Status and Alarms:

The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Level
	MOV Open (Green)
	MOV Closed (Red)
	MOV Not In Remote
Alarms	High-High Level
	High Level
	Low Level
	Low-Low Level
	Tank level rate of change
	High Torque (MOVs)

Interlocks:

Stop plant water pumps and foam spray pump on Low-Low Level in the Plant Water Storage Tank.

15. 10-14: Plant Water Pumps

P&ID: 10 DI-608

I&C Loop Numbers: 1101, 1102, 1103, 1104, 1105

PLC: PW-CP

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

W3.P-1	W3.P-2	W3.P-3
PI 1101A	PI 1102A	PI 1103A
TSH 1101	TSH 1102	TSH 1103
PI 1101B	PI 1102B	PI 1103B
PIT-1104A	PIT-1104B	FE/FIT 1105

Objective: Plant water pumps (W3.P-1, W3.P-2, W3.P-3) pump plant water from the Plant Water Storage Tank.

Plant water is pumped throughout the facility to provide water for hose stations and wash water connections to various process equipment.

The pumps' VFD speed is controlled to maintain a pressure setpoint in the plant water discharge header.

The plant water flow is measured.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Operating System Pressure
High System Pressure (Greater than 10 PSI Difference)
Low System Pressure (Greater than 10 PSI Difference)

Operation: Each plant water pump will have a local R-O-R Remote switch. In Run, the pump speed will be manually operated. In Remote, the pump speed will modulate to achieve the operator-adjustable pressure setpoints.

The three pumps will operate in a lead/lag/standby configuration. The lead pump will begin pumping and as the demand increases, the lag pump will start. The lead pump VFD speed will drop to match the lag pumps speed and both pumps will operate to achieve the required pressure setpoint.

The pump switch status run time and Status and Alarms shall be reported to the SCADA System.

The pumps should be operated so that each pump has approximately equal run time. Pump alternation will be automatic via the SCADA System, with the option for the operator to manually alternate the pumps.

Local Indication: The following information is provided at the plant water control panel (PW-CP):

R-O-R Switch
OFF Status Lights (Red)
ON Status Lights (Green)
Local Speed Controllers
Elapsed Run Time Meter Indicators
VFD Fault

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	Pump Speed
	Flow
	System Pressure
	Elapsed Run Time
	In Remote
Alarms	VFD Fault
	Pump Fail
	High System Pressure
	Low System Pressure
	Emergency Stop
	PW-PLC Communication Fail
	Pressure Transducer Fail
	Motor Over Temperature

Interlocks: Stop pump on Low-Low level in the Plant Water Storage Tank.

16. 10-15: Foam Spray Pump

P&ID: 10 DI-608

I&C Loop Numbers: 1106, 1107

PLC: WWTF-PLC

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

FS.P-1	FE/FIT 1107	PI 1106A	PI 1106B
TSH 1106	HS 1106		

Objective:

The foam spray pump pumps plant water from the Plant Water Storage Tank.

Foam spray water is pumped to the SBRs for foam control.

The pump's VFD speed is controlled to maintain a flow setpoint at the pump discharge, measured by a downstream flow meter.

Programmable Setpoints:

The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Flow
Duration
High Flow
Low Flow

Operation:

The foam spray pump will have a R-O-R selector switch at the MCC. In Run, the pump speed will be manually operated. In Remote, the pump speed will modulate to achieve the operator-adjustable flow setpoint.

The pump switch status run time and Status and Alarms shall be reported to the SCADA System.

Stop pump on low flow from FE 1107.

Shut down pump on high temperature and VFD fault.

Local Indication:

The following information is provided at the MCC (MCC-10):

R-O-R Switch
OFF Status Light (Red)
ON Status Light (Green)
Local Speed Control
Elapsed Run Time Meter Indicator

Status and Alarms:

The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	Pump Speed
	Flow
	Elapsed Run Time
	In Remote
Alarms	VFD Fault
	Pump Fail

	Status and Alarm Condition(s)
	Emergency Stop High Temperature

Interlocks: Stop pump on Low-Low Level in the 10-13 Plant Water Storage Tank.

17. 10-16: Mixing Blowers

P&ID: 10 DI-609

I&C Loop Numbers: 1111, 1112, 1113, 1114

PLC: WWTF-PLC

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

MIX.BLW-1	MIX.BLW-2	MIX.BLW-3
MIX.BLW-4	TSH 1111A	TSH 1112A
TSH 1113A	TSH 1114A	TSH 1111B
TSH 1112B	TSH 1113B	TSH 1114B
PSH 1111	PSH 1112	PSH 1113
PSH 1114		

Objective: Mixing air to maintain suspension of solids to maintain a homogenous liquid/solids content.

Air also has some oxygen transfer to reduce septic conditions which can contribute to odor and the formation of compounds that can be harmful to the treatment process.

A gauge in the blower discharge pipe shall measure the pressure in the line.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints	
Setpoints:	Constraints:
Air Density (SP1)	MIX.BLW-1 & MIX.BLW-2: 10<=SP1<=30 MIX.BLW-3: 40<=SP1<=75 MIX.BLW-4: 20<=SP1<=40
Blower Off Level (SP2)	MIX.BLW-1 & MIX.BLW-2: SP2 >= 0 MIX.BLW-3: SP2 >= 0 MIX.BLW-4: SP2 >= 0
Maximum Blower Speed (VFD Speed, %) (SP3)	All: 80<=SP3<=100
Minimum Blower Speed (VFD Speed, %) (SP4)	All: 60<=SP4<=SP3

Programmable Setpoints	
Hand Speed (VFD Speed in Hand, %)(SP5)	All: SP4<=SP5<=SP3
Quantity of Tanks (SP6)	MIX.BLW-1 & MIX.BLW-2: 1 or 2 MIX.BLW-4: 1 or 2
High Discharge Pressure	
High Discharge Temperature	

Operation:

The mixing blowers will operate with a dedicated blower for each of the following services:

MIX.BLW-1 - Pre-equalization Tank 1

MIX.BLW-2 - Pre-equalization Tank 2

MIX.BLW-3 - Thickened Sludge Storage Tank

MIX.BLW-4 - Waste Sludge Storage Tanks 1 & 2

Each blower has a H-O-A selector switch at SCADA. In Auto, the SCADA System determines the volume in each tank (from respective level indication), multiplies by the air density setpoint to get target air flow setpoint to adjust the VFD speed.

A switch at the SCADA System to confirm which Pre-Equalization Tank and which Waste Storage Tank is online. Only online tank levels will contribute to the calculation for the air requirements. A setpoint for quantity of tanks (applicable to the Pre-equalization and Waste Sludge Storage tanks only) is for specifying if one or two tanks are in use. A SCADA algorithm will convert “Air Density” to “VFD Speed” as Hz.

MIX.BLW-1 & MIX.BLW-2 (Pre-equalization Tank 1 & 2):

Hz = [93365 x Air Density SP1/1000 (SCFM/ft^3) x Quantity of Tanks SP6 x Level (LE 1005A/B or LE 1006A/B, ft) + 8400] / 1292

MIX.BLW-3 (Thickened Sludge Storage Tank):

Hz = [36210 x Air Density SP1/1000 (SCFM/ft3) x Level (LE 1170A/B, ft) + 4652] / 764

MIX.BLW-4 (Waste Sludge Storage Tank 1 & 2):

Hz = [57510 x Air Density SP1/1000 (SCFM/ft3) x Quantity of Tanks SP6 x Level (LE 1141A/B or LE 1142A/B, ft) + 8400] / 1051

The blowers will turn off when the tank level has reached below a setpoint level as measured by the level instruments.

The maximum blower speed is a setpoint based on the maximum allowable VFD speed as a percent of 60 Hz. The blower speed will not exceed 100% VFD speed.

The minimum blower speed is a setpoint based on the minimum allowable VFD speed as a percent of 60 Hz. The blower speed will not be less than 60% VFD speed. When the algorithm calculates a VFD speed less than 60%, the blower speed will be fixed at the minimum set point.

In Hand Speed, the allowable VRD speed cannot be less than the Minimum Blower Speed SP or higher than the Maximum Blower Speed SP.

Stop blowers on Alarm Conditions.

Local Indication: Each blower is provided with various local indication as shown

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Blower On (Green)
	Blower Off (Red)
	Blower Speed
	Elapsed Run Time
	In Remote
	In Hand
Alarms	High Discharge Pressure
	High Discharge Temperature
	Motor High Temperature
	VFD Fault
	Emergency Stop
	Not In Remote

Interlocks: Pre-Equalization Tank Level and Tank Quantity in Operation (10-04)

Waste Sludge Storage Tank Level and Tank Quantity in Operation (10-19)

Thickened Sludge Storage Tank Level (10-22)

18. 10-17: Aeration (SBR) Blowers

P&ID: 10 DI-610

I&C Loop Numbers: 1121, 1122, 1123, 1124, 1125

PLC: SBR-1-CP

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

SBR.BLW-1	SBR.BLW-2	SBR.BLW-3
SBR.BLW-4	FE/FIT-1125	TSH 1121
TSH 1122	TSH 1123	TSH 1124
	PSH 1121	PSH 1122
PSH 1123	PSH 1124	

Objective: Aeration air to maintain DO in each SBR tank to satisfy the requirements of the microorganisms responsible for wastewater treatment.

A gauge in the blower discharge pipe shall measure the pressure in the line.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
DO
High DO (Shutoff)
Low DO (On)
Minimum Speed
High Pressure

Operation: During phase 1, the four blowers will operate in a lead/lag 1/lag 2/standby manner. One SBR tank to be aerated at a given time based on the DO reading to directly control the blower system. SBR-1-CP will control the blower speed on/off sequencing based on the flow and DO requirements of the online SBR.

Stop blower on Alarm Conditions.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Blower On (Green)
	Blower Off (Red)
	Blower Speed
	Blower Flow Rate
	Elapsed Run Time
	In Remote
	In Auto
Alarms	High Discharge Pressure
	High Discharge Temperature
	Motor High Temperature
	VFD Fault
	Emergency Stop
	SBR PLC Communication Fail
	Failed to Run
	MCP Trip
	Exceeded three starts per hour

Local Indication: Each blower is provided with various local indication as shown.

Interlocks: Blowers start only if one of the associated MOVs (MOV-1025 or MOV-1035) is open.

19. 10-18: Septage Receiving

P&ID: 10 DI-611

I&C Loop Numbers: 1130, 1131, 1132, 1133, 1134,1135, 1136, 1137, 1138

PLC: SEP-CP

Equipment Location: Septage Receiving Area

Equipment Tag Nos.: See Table

FE/FIT-1130	LIT-1132
10-OHD-1	10-OHD-2

Objective: Receive and screen septage to protect downstream process equipment and pumps by removing large debris, rocks, and other harmful materials that are often found in septage waste and further distribute the screened wastewater and waste sludge for treatment within WWTF.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Exit door 10-OHD-2 (east-side of building) close time

Operation: Vendor supplied PLC control panel to control and monitor the operation of the septage receiving station at WWTF.

Total volume to be measured using the vendor supplied flowmeter reported to the SEP-CP.

Received septage will be screened and discharged into the WAS Tanks with the Pre-Equalization Tanks as a secondary discharge point. Screening will be bagged and placed into a dumpster.

Septage Hauler Operation

Upon approaching the Wastewater Treatment Facility Site, the hauler shall use the call station at the main entrance gate to communicate with the WWTF staff who will remotely open the entrance gate (the Town has decided that the main gate will be closed at all times throughout the day).

Upon entering the Wastewater Treatment Facility Site, the hauler shall enter his/her individual code in the exterior mounted Hauler Station Control Panel, which will open the entrance Truck Bay door (west-side of building) 10-OHD-1.

Once the Truck Bay entry door (10-OHD-1) is fully open, the hauler can enter the Truck Bay.

Once the haul truck is fully within the Truck Bay, the hauler shall connect the haul truck discharge hose into the Septage Receiving Station.

The hauler shall use the interior mounted septage receiving local control station (SEP-LCS-2), which will close the Truck Bay door

(10-OHD-1) via the hardwired contacts from SEP-LCS-2 to SEP-CP and network connection to the Hauler Station Control Panel.

Once the Truck Bay door (10-OHD-1) is fully closed, the Septage Receiving Station will activate (i.e., the influent motorized valve will open and the Septage Receiving Station will be energized);

The hauler must collect a sample of the load and leave it at the Office at the Wastewater Treatment Facility.

The hauler can now discharge the contents of the pump truck into the Septage Receiving Station.

The Septage Receiving Station has a Magnetic Flow Meter that will measure the volume of septage discharged.

Once the haul truck has been emptied, the hauler shall disconnect from the Septage Receiving Station and presses Transaction End pushbutton on the SEP-LCS-2. Upon activation, the Septage Receiving Station shall deenergize and the influent motorized valve will close.

The discharge area shall be cleaned of all debris and rinsed thoroughly by the hauler prior to leaving the site.

The hauler shall open the door to leave by using the interior mounted SEP-LCS-2, which will open the exit Truck Bay door (east-side of building) 10-OHD-2 via the hardwired contacts from SEP-LCS-2 to SEP-CP and network connection to the Hauler Station Control Panel. The Truck Bay Door (10-OHD-2) shall close using a 1 to 5 minute timer (adjustable at the SEP-CP).

If both overhead garage doors in the Truck Bay are not closed (10-OHD-1 and 10-OHD-2), the Septage Receiving Station will not energize.

Local Indication: Septage station tank level and septage flow. 10-OHD-1 and 10 OHD-2 and transaction push button located at SEP-LCS-2. Hand switches for screen, grit collector, grit discharge, and influent valve located at SEP-LCS-1.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	System On (Green)
	System Off (Red)
	Elapsed Run Time
	10-OHD-1 Open
	10-OHD-2 Open
Alarms	Emergency Stop
	Screen Fault
	Motor Overload
	Fail to Start
	Septage PLC Communication Fail

Interlocks: When the selector switch is in the WAS Tank 1 or WAS Tank 2 position and a high-level condition exists in the selected WAS Tank, the Septage Receiving Station will not energize. When the selector switch is in the Pre-Equalization Tank 1 or Pre-Equalization Tank 2 position and a high-level condition exists in the Pre-Equalization Tank, the Septage Receiving Station will not energize.

If a H2S, LEL, Low O2, CO and/or High NO2 alarm exists in the Truck Bay, the Septage Receiving Station will not energize (99-02).

While the Septage Receiving Station is energized and a H2S, LEL Low O2, CO and/or High NO2 alarm is activated in the Truck Bay, the Septage Receiving Station shall deenergize (99-02).

20. 10-19: Waste Sludge Storage Tanks

P&ID: 10 DI-612

I&C Loop Numbers: 1140, 1141, 1142

PLC: WWTF-PLC

Equipment Tag Nos.: See Table

LE/LIT 1141A	LE/LIT 1142A	FE/FIT 1140
LE/LIT 1141B	LE/LIT 1142B	

Objective: Measure the waste sludge flow into the waste sludge storage tanks. Continuously monitor the level at Waste Sludge Tank 1 and Waste Sludge Tank 2.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
High Level
High-High Level
Low Level
Low-Low Level
Acceptable Error Between Level Instruments
Tank in Operation (No. 1, No. 2 or Both)

Operation: Waste sludge from the SBRs is stored in the waste sludge storage tanks. The operator shall select which tanks are in operation (Tank 1 or Tank 2 or Both).

Flow Meter (FE/FIT 1140) monitors the flow of waste sludge from the SBRs.

Septage discharge from the septage receiving unit can be stored in the waste sludge storage tanks.

Level instruments continuously monitor the level in each Waste Sludge Tank. The measurements will be monitored at the SCADA System.

Each tank is provided with redundant level transmitters. The operator shall be able to select at the SCADA System HMI which transmitter is the primary and which is the back up for each tank. The signal from the

primary transmitter shall be used to generate the high/low Status and Alarms as described above.

The SCADA System shall continuously compare the measured values from each transmitter, and if the level difference exceeds an operator-adjustable setpoint, an alarm shall be generated, indicating an error with one of the level transmitters.

Only the online tank(s) will be utilized to stop the Sludge Transfer Pumps on Low-Low Level in the Waste Sludge Storage Tanks.

Local Indication: Local indication shall be provided at the flow transmitter and at each level transmitter.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Tank Level
	Flow
Alarms	High-High Level
	High Level
	Low Level
	Low-Low Level
	Acceptable Error Between Level Instruments
	Level Instrument Loss of Signal

Interlocks: Stop Sludge Transfer Pumps on Low Level in the Waste Sludge Storage Tanks (10-20).

Stop SBR Wasting on High Level in the Waste Sludge Storage Tanks.

Deenergize septage receiving station on High Level in the Waste Sludge Storage Tanks.

21. 10-20: Sludge Transfer Pumps

P&ID: 10 DI-613

I&C Loop Numbers: 1151, 1152

PLC: WWTF-PLC

Equipment Location: Pump Room

Equipment Tag Nos.: See Table

SL.TP-1	SL.TP-2	HS 1151
TSH 1151	TSH 1152	HS 1152
PI 1151A	PI 1152A	
PI 1151B	PI 1152B	

Objective: Waste sludge pumps to pump the waste sludge from the Waste Sludge Tanks to the Rotary Drum Thickeners.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Start Time
Stop Time
Pump Speed (Minimum 40%, Maximum 75%)
Tank Level
Tank in Operation (No. 1, No. 2 or Both)

Operation: Two Sludge Transfer Pumps operate on a duty/standby mode. The operators select the start time, end time and pump speed for the Sludge Transfer Pumps.

If any one of these pumps is taken out for service or prolonged failure, the second pump will be manually configured with valving upstream of the two pumps to receive discharge from both tanks.

Shut down pump on fault.

Shut down pump on high temperature.

Shut down pumps on emergency stop.

Local Indication: Local indication shall be provided at each waste sludge transfer pump

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	In Remote
	In Auto
Alarms	Pump High Temperature
	Pump Fault
	Emergency Stop

Interlocks: Pump start permissive from the SCADA System (RDT Ready)

Shut down pumps on WAS tank low-low.

Shut down pumps on TWAS tank high-high.

Polymer Blend Units to turn on when Sludge Transfer Pumps turn on and flow is indicated in FE/FIT-1160 and/or FE/FIT-1170

22. 10-21: Rotary Drum Thickening

P&ID: 10 DI-614

I&C Loop Numbers: 1160, 1161, 1162, 1164, 1170, 1171, 1172, 1173, 1174

PLC: RDT-1-CP, RDT-2-CP

Equipment Location: Truck Bay/Septage Receiving Room (Room 101)

Equipment Tag Nos.: See Table

RDT-1	RDT-2
FE/FIT-1160	FE/FIT-1170
HS 1162	HS 1172
LIT 1162	LIT 1172
ZSL 1162	ZSL 1172
PSL 1164	PSL 1174

Objective: The Rotary Drum Thickeners equipment is intended to thicken waste sludge generated by the WWTF to reduce off-site hauling costs for dewatering and disposal/reuse. A dual-drum Rotary Drum Thickener will be housed in the drive-through truck bay (Room 101), constructed over the waste sludge storage tank and adjacent to the Administration Building.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Polymer Solution Mixture
Polymer Dose
Drum Speed

Operation: Vendor supplied PLC based control panel for each Rotary Drum Thickener (RDT) will control the thickening process as well as communicate to the SCADA System. The RDTs are intended to thicken waste sludge generated by the WWTF to reduce off-site hauling costs for dewatering and disposal/reuse. Multi-stage progression of the sludge to be thickened achieved with the inclined installation of the thickener and the internal helical screw. Brushes will be provided on the conveyor screw to clean the screen, preventing sludge from sticking at the inside of the wedge wire with the help of a rotating spray bar. The screw conveyor speed shall be adjusted to the individual requirements of the sludge to be thickened, from 0 to 7 rpm through a VFD. The screw conveyor shall be the only rotating part of the RDT. These RDTs will be housed in the drive-through truck bay (Room 101), constructed over the waste sludge storage tanks. The Control Panel for the Rotary Drum Thickeners will be located in the garage (Room 102). The waste sludge conditioning tank will be served by in-line venturi mixers to mix the feed slurry with made down polymer solution in order to obtain flocculated feed slurry. “Made down” is defined as diluting the polymer from its original state to a desired percentage (e.g., 0.35%) solution mixture. Depending on the type of sludge and the molecular weight and charge of the polymer solution, the amount of mixing required in the venturi mixer will vary. The mixing intensity is varied by adding or removing weight on the mixing arm. The amount of mixing intensity is measured by the pressure gauge mounted to the injection polymer manifold.

One (1) in-line mixer per thickener, provide each mixer with a weighted adjustable mixing device.

Discharge lines at top of the tank to provide conditioned sludge feed to the RDT.

Stop RDT on Thickener Drive Fault.

Shut down the RDT upon Emergency Stop activation.

Local Indication: Vendor specific

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	RDT On (Green)
	RDT Off (Red)
	Spray Bar Status (on/off)
	Drum Thickener Drive Running
	Polymer System Running
Alarms	Drum Thickener Drive Fault
	Emergency Stop Pushbutton
	Emergency Stop Pull Cords
	RDT PLC Communication Fail
	Drum Zero Speed
	High TWAS Level
	Low Wash Water Pressure
	Sludge Pump Failure
	Polymer Pump Failure
	PLC Low Battery
	UPS Power Off
	CPU in Fault

Interlocks: RDT start permissive from the SCADA System.

Shut down Waste Sludge Feed Pumps and RDT at High Level in Thickened Sludge Storage Tank.

Start RDT Shut down sequence at Low Level of waste activated sludge storage tank.

Shut down RDT on High-High Level of 10-04 Pre-Equalization Tanks

23. 10-22: Thickened Sludge Storage and Pumping

P&ID: 10 DI-615

I&C Loop Numbers: 1170, 1171, 1172, 1173

PLC: WWTF-PLC

Equipment Location: Pump Room and Thickened Sludge Loading Station

Equipment Tag Nos.: See Table

TSL.P-1	TSL.P-2	FE/FIT-1173
LE/LIT-1170A	LE/LIT-1170B	
TSH 1171	TSH 1172	
PI 1171A	PI 1172A	
PI 1171B	PI 1172B	
HS 1171	HS 1172	

Objective: Under normal conditions, sludge from the thickened sludge storage tank is removed intermittently and transferred to off-site sludge disposal.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Thickened Sludge Pump Run Time
Thickened Sludge Pump Speed
High Level High-High Level
Low Level Low-Low Level
Acceptable Error Between Level Instruments

Operation: The thickened sludge pumps are VFD driven and have Run/Off switches located at the MCC, Thickened Sludge Loading Station and at the pumps. When in run mode, the pumps will be controlled at the Thickened Sludge Loading Station. The pumps run time and VFD speed will be operator programmable.

The operator shall be able to select which pump to be discharging from the thickened sludge storage tank. The valving for this selection is manual.

Thickened sludge discharge flow is measured and totalized.

Local Indication: Location 1

At the MCC (MCC-10-1) the following information is provided for each pump:

- Pump Run/Off/Remote Selector Switch
- Run/Off Status
- Common Pump Fault Indicators
- Pump Speed
- Run Time

Location 2

At the Thickened Sludge Loading Station Control Panel (TSL.P-LCP) the following information is provided for each pump:

- Pump Run/Off Remote Selector Switch

Run/Off Status

Common Pump Fault Indicators

Pump Speed

Run Time

An emergency stop switch is provided at each pump and at the thickened sludge loading station.

Local indication of the measured variable is provided at the level transmitters and the flow transmitter.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green Light)
	Pump Off (Red Light)
	Pump Speed
	Flow
	Tank Level
	In Remote
Alarms	Tank Low Level
	Tank High Level?
	Pump High Temperature
	VFD Fault
	E-Stop Activated (Thickened Sludge Loading Station)

Interlocks: Shut down the pump on low level in the thickened sludge storage tank.

Shut down Waste Sludge Feed Pumps and RDT at High Level in Thickened Sludge Storage Tank.

Shut down the Pump on high temperature.

Shut down the Pump on VFD failure.

Shut down the Pump on Emergency Stop activation.

24. 10-23: Sodium Hypochlorite

P&ID: 10 DI-616

I&C Loop Numbers: 1181, 1182, 1183

PLC: WWTF-PLC

Equipment Location: Chemical Room - Sodium Hypochlorite Area

Equipment Tag Nos.: See Table

SH.MP-1	SH.MP-2	FI-1183

PI/PSH-1181	PI/PSH-1182

Objective: Sodium Hypochlorite will be dosed at the SBR Influent to control filaments.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Pump Flow Rate
Hypo Dose
Hypo Strength, %

Operation: Bulk sodium hypochlorite will be stored in totes.

Sodium hypochlorite dosed at one location. Metering pump SH.MP-1 and SH.MP-2 configured as duty/standby to dose influent to SBR.

Chemical Dosage shall be based on: (a) feed rate where operator inputs a desired flow rate; or (b) dose control where the operator inputs a desired Cl2 dose in mg/l.

During dose control, the SCADA System take flow rate from FE going to SBRs and adjust the pump speed proportional to the SBR influent flow. The pump will begin pumping, and as the demand increases, pump speed will increase.

Each pump will have a Hand/Off/Remote switch and will only run when the SBR Transfer pumps are running. In Hand, the pump speed will be manually operated. In Remote, the pump speed will be set by the SCADA System.

Leak detection is provided integral to the pump, and pump will automatically shut down when a leak is detected.

The pump, run time and Status and Alarms shall be reported to the SCADA System.

The pumps should be operated so that each pump has approximately equal run time. Pump alternation will be manual, by the operator. Upon pump failure, operator will manually adjust the pump valving and start the standby pump.

A high-pressure switch is provided on the discharge of the pumps. On high-pressure contact is sent to the SCADA System and the pump pacing signal is driven to 4mA (zero speed) to effectively shut down the pump.

Dilution water is provided to the pump discharge header with the dilution water flow rate manually set in the field. The flow is controlled by a solenoid valve. When either metering pump is running, the FI-1183 associated solenoid valve shall open. When the pump turns off, the valve will close.

Local Indication: The chemical feed pumps have controls at the pump. These local interfaces include pump trouble, pump running, and speed indication.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	Flow Rate
	In Remote
Alarms	Pump Fault
	Pump Leak
	Pump High Discharge Pressure

Interlocks: Start and Stop Pumps based on operation of the SBR Transfer Pumps.

Stop pump on fault.

Stop pump on leak detection.

Flow rate based on FE/FIT-1015 on 6" SBI from 10-05 SBR Transfer Pumps

Solenoid to open when SH.MP-1 or SH.MP-2 turn on, solenoid valve to close when SH.MP-1 or SH.MP-2 turn off

25. 10-24: Polyaluminum Chloride

P&ID: 10 DI-617

I&C Loop Numbers: 1191, 1192, 1193

PLC: WWTF-PLC

Equipment Location: Chemical Room - Polyaluminum Chloride Area

Equipment Tag Nos.: See Table

PACL.MP-1	PACL.MP-2	PSH-1191
PSH-1192	LS 1191	LS 1192
		FI-1193

Objective: Polyaluminum Chloride (PACL), "neat" pre-polymerized solution will be stored in 250 gal totes. It will be used as a coagulant for direct injection into SBR feed by two pumps (PACL.MP-1, PACL.MP-2) in a duty/standby configuration.

PACL will be dosed into SBR feed at the following location:

SBR Influent (port downstream of SBR feed pumps)

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Polyaluminum Chloride Dosing Ratio

Operation: Bulk Polyaluminum Chloride will be stored in totes.

Polyaluminum Chloride dosed at the discharge of the SBR feed pumps. Metering pump PACL.MP-1 and PACL.MP-2 configured as duty/standby. The pump speed will be flow paced, proportional to the

SBR feed flow, using an operator adjustable dose setpoint in the SCADA System. The pump will begin pumping, but as the demand increases, pump speed will increase.

Each pump will have a Hand/Off/Remote switch. In Hand, the pump speed will be manually operated. In Remote, the pump speed will be set by the SCADA System. Leak detection is provided integral to the pump, and pump will automatically shut down when a leak is detected.

The pump, run time and Status and Alarms shall be reported to the SCADA System.

The pumps should be operated so that each pump has approximately equal run time. Pump alternation will be manual, by the operator. Upon pump failure, the operator must adjust the valving and manually start the standby pump.

A high-pressure switch is provided on the discharge of the pumps. On high pressure a contact is sent to the SCADA System and the pump pacing signal is driven to 4mA (zero speed) to effectively shut down the pump.

Dilution water is provided to the pump discharge header with the dilution water flow rate manually set in the field. The flow is controlled by a solenoid valve. When either metering pump is running, the FI-1193 associated solenoid valve with that line shall open. When the pump turns off, the valve will close.

Local Indication: The chemical feed pumps have controls at the pump. These local interfaces include pump trouble, pump running, and speed indication.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	In Remote
	Flow Rate
Alarms	Pump Fault
	Pump Leak
	Pump High Discharge Pressure

Interlocks: These chemical feed pumps shall have the following process operating interlocks (Note: that additional interlocks shall be provided as determined necessary during construction phase coordination):

Stop pump on fault.

Stop pump on leak detection.

SBR feed flow as permissive from the SCADA System.

Flow rate based on FE/FIT-1015 on 6” SBI from 10-05 SBR Transfer Pumps

Solenoid to open when PACL.MP-1 or PACL.MP-2 turn on, solenoid valve to close when PACL.MP-1 or PACL.MP-2 turn off

26. 10-25: Polymer Blend Units

P&ID: 10 DI-618

I&C Loop Numbers: 1201, 1202

PLC: RDT-1-PLC

Equipment Location: Polymer Room

Equipment Tag Nos.: See Table

POL.BU-1	POL.BU-2

Objective: Provides polymer feed from a neat polymer drum to the individual unit processes. The polymer system (PBU) provides dilution, mixing, aging and feed rate control.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Provide input of chemical feed rate based on a ratio to the unit process flow rate

Operation: During normal operation, each PBU is dedicated to one RDT.

Polymer will be dosed to the online RDT at a flow rate proportional to the RDT influent flow. At the OIT, the operator must select which PBU will serve each location and confirm that the valving has been set accordingly. The services and corresponding pacing are as follows:

Service	Paced by
Rotary Drum Thickener Feed	FE/FIT-1160
Rotary Drum Thickener Feed	FE/FIT-1170

Each PBU includes a local control panel (POL.BU-X-LCP).

The operator may manually operate the PBU from the LCP for maintenance.

Normal operations will be through the RDT PLC.

Local Indication: The LCP indicate running state and Status and Alarm Condition(s)

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Unit On (Green)
	Unit Off (Red)
	In Remote
Alarms	PBU Fault

Interlocks: PBU will shut down on PBU Fault

SCADA System Permissive

PBU PLC Communication Fail

Polymer Blend Units to turn on when Sludge Transfer Pumps turn on and flow is indicated in FE/FIT-1160 and/or FE/FIT-1170

27. 10-26: Odor Control System

P&ID: 10 DI-619

I&C Loop Numbers: 1211, 1212, 1213

PLC: WWTF-PLC

Equipment Location: Odor Control

Equipment Tag Nos.: See Table

OC.F-1	OC.EF-1	DPI 1011
DPSH 1011	TSH-1014	

Objective: Provide continuous odor control from various locations throughout the facility.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Filter High Differential Pressure

Operation: A constant speed fan draws air from various locations throughout the facility and filtered through a mist and grease filter prior to entering the odor control vessel. The fan forces air through the carbon filter, after which the cleaned air passes to the atmosphere. A differential pressure switch monitors the pressure across the mist and grease filter to determine if the filter media is dirty.

Local Indication: The odor control system is equipped with a local control panel (OC-CP) with a Hand/Off/Auto switch and other controls as shown on the P&ID.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	System On (Green)
	System (Off)
	In Remote
Alarms	Fault
	High Differential Pressure (Mist/Grease Filter)
	Emergency Stop

Interlocks: Shut down Odor Control System on fault from either fan.

Shut down Odor Control System upon Emergency Stop activation.

28. 15-01: SBRs Valve Control

P&ID: 15 DI-601

I&C Loop Numbers: 1020, 1026, 1027, 1028, 1030, 1035, 1036, 1037, 1038

PLC: WWTF-PLC

Equipment Location: Sequencing Batch Reactor-1, Sequencing Batch Reactor-2

Equipment Tag Nos. See Table

Service	SBR-1	SBR-2
SBR Influent	MOV-1020	MOV-1030
SBR Decant Flow Control	MOV-1026	MOV-1036
Foam Spray Water	MOV-1028	MOV-1038
Sludge Flow Control	MOV-1027	MOV-1037
Air Flow	MOV-1025	MOV-1035

Objective: The SBRs provide advanced secondary treatment in stages, controlled by the vendor-provided PLC.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Decant Flow Adjustment Factor
Sludge Wasting Flow
Sludge Wasting Duration
Foam Spray Water Valve Position

Operation: Controls for the SBR influent valves (open/close), WAS Valves (modulating), Decant Valves (modulating), Foam Spray Water (open/close), and air supply valves (open/closed) will be provided by WWTF-PLC over the network.

Foam Spray Water

Each SBR is equipped with a foam spray system, with a corresponding isolation valve - MOV-1028 (SBR-1) and MOV-1038 (SBR-2). They shall be able to be remotely opened/closed from SCADA while in Remote.

Influent Valve Control

Upon receiving signal from the SBR PLC that a given SBR has entered its Mixed/Fill phase, the corresponding influent valve shall open MOV-1020 (SBR-1), MOV-1030 (SBR-2). The valve shall remain open until the SBR PLC signals that the given SBR has entered React phase, at which time it will close.

Air Flow Control

Each SBR is equipped with one motorized (open/close) air supply valve, and each diffuser grid is supplied with a manual balancing

valve. During periods of aeration, MOV-1025(35) will open to allow air flow to the SBR that is in one of its aeration phases. Upon receiving the signal from the SBR PLC that a given SBR has reached its React/Fill phase, the plant PLC will direct the corresponding valve to open. Upon receiving the signal from the SBR PLC that a given SBR has reached its Settle phase, the plant PLC will direct the corresponding valve to close. While under aeration, the air flow rate will be controlled by the SBR PLCs DO control algorithm, which controls the SBR blowers.

SBR Decant Flow Control

Normal operation

MOV-1026 and MOV-1036 are designed to utilize the time available (75 minutes) in the decant phase of each cycle to modulate flow to the downstream disk filters. Upon an SBR entering the DECANT phase of its cycle, the SBR PLC will open the decanter associated with that SBR. When the decanter hits it's open limit switch, the SBR shall issue a signal to the plant PLC to open and begin control of MOV-1026 and MOV-1036. Plant SCADA will then calculate a desired flow for the valve using the following relationship.

Using SBR-1 as an example, the desired flow SP for MOV-1026 to control to is found, using the tanks level at the start of the decant phase defined by LE-1021, as follows.

Flow SP, gpm = (Tank level at Decant Start (feet) – 14.5)

x 291.7 x Decant Flow Adjustment Factor

The Decant Flow Adjustment Factor is to provide operators with an adjustable safety factor on the calculation to adjust for meter/instrument bias. A PID controller shall control the valve to the setpoint calculated above until the MOV is called to close.

The valve should be issued a close order upon the corresponding LE reaching a level of 14.5 feet or receiving notification from the SBR PLC that the decant cycle has timed out and a new cycle is about to begin. Upon MOV-1026 reaching its closed position, the plant PLC shall issue a valve closed signal to the SBR PLC. The SBR PLC will then close the actuator after a suitable time delay as determined by the SBR manufacturer.

The algorithm is the same for SBR-2, with MOV-1036 and LE 1031 being used.

Storm Mode(s)

Storm mode is a mode the SBR PLC switches to if it detects levels in the SBR are rising too quickly. There are different degrees of storm mode, depending on the severity of the water level rise rate, but all of them alter the normal duration of some or all of the various phases of the SBR cycle. This would normally be in response to

a major wet weather event. The Orleans WWTF is equipped with substantial upstream flow equalization so this is anticipated to happen rarely if ever, however the decant logic needs to accommodate it's possibility.

The sequence of operation and coordination between the plant and SBR PLCs shall be the same as if the SBR was in normal mode. The only difference is that while open, MOV-1026 and MOV-1036 for the SBR in decant shall be controlled by the plant PLC to a setpoint of 2,700 gpm.

SBR Sludge Wasting Control

Normal operation

MOV-1027 and MOV-1037 are designed to waste settled sludge by gravity from the bottom of each SBR to the waste sludge storage tank(s) during the decant phase. An operator setpoint is used to define waste duration and desired flow rate. Because the amount of wasting required does not typically require the full 75 minutes available in the Decant Phase, it is desired to allocate the wasting period towards the end of the decant phase, when the sludge will have its maximum compaction and concentration. Upon receiving the signal from the SBR PLC that a given SBR is in Decant Phase, a timer shall start and count down until the required duration is left in the Decant Phase, at which time MOV-1027 or MOV-1037 will be called to open. A PID controller within the plant PLC will control the sludge flow to the desired setpoint until the Decant Phase is over, at which time the valve will be called to close.

Timer = 75 – Sludge Wasting Duration SP

As an example, if the desired duration SP is 35 minutes for SBR-1, the timer will be set at 75 – 35 = 40 minutes. Upon receiving the signal from the SBR PLC that SBR-1 is in Decant Phase, the timer will start counting down. After the timer counts down the 40 minutes, MOV-1027 will open and sludge wasting will commence for the remainder of time in the Decant phase, which will be the 35 minutes the operator desired, at the flow rate the operator desired. MOV—1027 will close upon receiving the signal from the SBR PLC that SBR-1 has entered into the next phase.

Storm Mode(s)

Under any of the Storm Mode conditions, SBR wasting will be suspended. Storm Mode conditions are expected to happen very infrequently, and typically the higher solids wash out accompanied by storm flow conditions obviates the need for wasting.

SCADA to alarm WAS Pinch Valve Fail to Close when decanting has stopped and FE/FIT-1140 is measuring flow.

Local Indication: Local controls will be provided at the valve actuators and the decanters. Local indication will be provided

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Valve Open (Green) (Open/Close)
	Valve Closed (Red) (Open/Close)
	Valve Position (Modulating)
	In Remote
Alarms	Valve Fail to Open
	Valve Fail to Close
	Valve High Torque
	WAS Pinch Valve Fail to Close

Interlocks: Shut down SBR Transfer pumps upon failure of MOV-1020 or MOV-1030 to open.

Shut down Decent upon failure of MOV-1026 or MOV-1036 to open.

Shut down Froth Spray Pump upon failure of MOV-1028 or MOV-1038 to open.

Shut down SBR Blowers upon failure of MOV-1025A or MOV-1035A to open.

29. 15-02: SBRs

P&ID: 15 DI-601

I&C Loop Numbers: 1021, 1023, 1024, 1031, 1033, 1034

PLC: SBR-PLC

Equipment Location: Sequencing Batch Reactor-1, Sequencing Batch Reactor-2

Equipment Tag Nos.: See Table

Service	SBR-1	SBR-2
SBR Tank Level	LE/LIT 1021	LE/LIT 1031
SBR Tank High Level	LSH 1021	LSH 1031
Decanter	SBR.DEC-1	SBR.DEC-2
SBR Mixer	SBR.MIX-1	SBR.MIX-2
pH Analyzer	AE/AIT 1021A	AE/AIT 1031A
ORP Analyzer	AE/AIT 1021B	AE/AIT 1031B
Ammonia Analyzer	AE/AIT 1021C	AE/AIT 1031C
Nitrate Analyzer	AE/AIT 1021D	AE/AIT 1031D
TSS Analyzer	AE/AIT 1021E	AE/AIT 1031E
DO Analyzer	AE/AIT 1021F	AE/AIT 1031F

Objective: Provide treatment of wastewater via two separate tanks which provide for continuous flow-through such that one tank receives the wastewater flow filling the tank while the other tank processes the wastewater. Each tank is provided with aeration system, retrievable diffused air equipment, level instruments provided for continuous level measurement, back up float switches for high level alarm, DO probes to provide DO control and decanter assemblies.

SBR reactors provide sufficient oxygen in the SBR reactors during aerobic segments of the treatment cycle; suspend and maintain in suspension normal mixed liquor solids; provide sufficient solids separation via settling; allow sufficient anoxic treatment time per cycle; and decant treated wastewater directly to the disk filters.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Operational Stage: (1) Mix Fill, (2) React Fill, (3) React, (4) Settle and (5) Decant (sludge wasting and idle).
Duration and Cyclic Clock Time
High Level
Low Level
pH High
pH Low

Operation: Vendor supplied PLC based controller with local operator interface panel to interface with the Effluent Disk Filter control system and the SCADA System. The SBR PLC will provide controls for the overall SBR process, including the DO levels, mixing and decanting.

There are five operational steps in the SBR process (1) Mix Fill, (2) React Fill, (3) React, (4) Settle and (5) Decant (sludge wasting and idle).

Based on the SCADA System operator selection of the SBR tank for filling operation, corresponding inlet valves for raw wastewater and air diffusers will be open to allow the filling operation. At the completion of the filling operation, all the inlet valves will close.

DO probes will directly control through the vendor PLC to control the blowers. Operator adjustable Dissolved Oxygen (DO) levels in the tank to be maintained so that sufficient air will only be provided in quantity to satisfy the requirements of the microorganisms responsible for wastewater treatment.

The DO measurement will be input to the SBR-CP to provide feedback for the blower controls. The DO measurement shall be transmitted to the SCADA System PLC for trending and monitoring.

Mixing for solids suspension is provided by a down draft floating mixer which provided the additional benefit of minimizing foam build-up on the tank surface.

Fine bubble diffusers are employed in the SBR tanks to provide better oxygen transfer.

Operator adjustable, cycle configuration/duration for various cycles.

Analyzers for pH, ORP, Ammonia, Nitrate, and TSS will be connected to the SCADA System for monitoring. These values will be trended and archived.

If the influent flow exceeds the maximum design, the manufacturer's PLC will respond to the rate of change in the SBR basin levels and adjust the SBR cycles and durations as needed to process the additional flow with minimal effect on effluent quality. The manufacturer's PLC will adjust the cycles in different ways depending on the magnitude and duration of the peak flow condition.

Local Indication: The SBR LCP indicate running and alarm states of SBR mixers, open/close statuses and Status and Alarms of decanters and valves as well as high level Status and Alarms and continuous reading of pH, ORP, NH3, NO3, TSS, DO and tank level.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Operational Stage: (1) Mix Fill, (2) React Fill, (3) React, (4) Settle and (5) Decant (sludge wasting and idle).
	Tank Level
	DO
	pH
	ORP
	Ammonia
	Nitrate
	TSS
Alarms	High-High Level
	High Level
	Low Level
	Level out of range
	Level Sensing Fault
	Level Not Dropping During Decant
	pH High
	pH Low
	pH out of range
	Mixer Fault (Fail to Run)
	Decanter Weir Fault (Fail to Open or Close)

Status and Alarm Condition(s)
Decant Valve Position Out of Range
DO Out of Range
ORP Out of Range
TSS Out of Range
NH3 Out of Range
NO3 Out of Range
Storm Mode 1 Initiated
Storm Mode 2 Initiated
Storm Mode 3 Initiated
Emergency Stop
SBR Common Failure
SBR PLC Communication Fault

Interlocks: N/A

30. 25-01: In-Plant Pump Station

P&ID: 25 DI-601

I&C Loop Numbers: 2501

PLC: WWTF-PLC

Equipment Location: In-Plant Pump Station

Equipment Tag Nos.: See Table

SAN.P-1	SAN.P-2

Objective: Sanitary flows are collected and pumped to the Headworks.

Programmable Setpoints: N/A

Operation: All level monitoring and pump control will take place within the vendor-supplied local control panel (SAN.P-LCP). The panel will send a general fault alarm to the SCADA System on pump failure, high level, or other Status and Alarm Condition(s).

Local Indication: Local indication shall be provided at the local control panel.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

	Status and Alarm Condition(s)
Status	Pump On (Green)
	Pump Off (Red)
Alarms	General Fault

Interlocks: N/A

31. 30-01: Flow Control to Wicks

P&ID: 30 DI-601

I&C Loop Numbers: 3001, 3002, 3003, 3004, 3005

PLC: WDV-PLC

Equipment Location: Wick Distribution Vault

Equipment Tag Nos.: See Table

Wick 1	Wick 2	Wick 3
FE/FIT-3001	FE/FIT-3002	FE/FIT-3003
FCV-3001	FCV-3002	FCV-3003

Wick 4	Wick 5
FE/FIT-3004	FE/FIT-3005
FCV-3004	FCV-3005

Objective: Provides flow measurement and control of the UV treated effluent water from WWTF for distribution into the Wicks.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Number of Wicks in Operation
Wick Selection
Cycling Order
Time
Volume

Operation:

General

Valves in the Wick Distribution Vault are either open or closed.

Flow control performed at the WWTF via the effluent pumps.

Operator has the ability to adjust the effluent going into a Wick by: (a) time; and (b) volume.

Each flow instrument's signal shall be input into the WDV-PLC indication, trending, totalization, accumulation, reporting, etc.

Normal Operation

The Wick Vault flow meters will measure the WWTF effluent. This measurement will be used to control the effluent distribution to the Wicks by controlling the corresponding Wick valve.

The Operator inputs the order of the operation of the Wicks into the SCADA System (e.g., 1 - 2 -3 - 4 - 5).

Time - The Operator inputs the time duration (e.g., one week) that effluent will be discharged into a single Wick. Upon reaching the

preset value, the SCADA System will change the Wick discharge location by opening the next Wick valve and closing the current Wick valve based on the inputs.

Volume - The Operator inputs the volume of effluent (e.g., 1,000,000 gallons) to be discharged into a single Wick. Upon reaching the preset value, the SCADA System will change the Wick discharge location by opening the next Wick valve and closing the current Wick valve based on the inputs.

Emergency Operation

The Operator assigns a high-water level (HWL) set point at the into the SCADA System (See Control Strategy (30-02).

If the HWL reaches the set point, the SCADA System will open the next Wick valve and close the Wick value with the HWL reading.

The Wick with the HWL reading will be removed from the alternation sequence and locked out until the HWL condition is cleared and acknowledged by the operator.

Local Indication: Local controls will be provided at the gate actuators.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Wick Valve Position (Modulating)
	In Remote
	Flow
Alarms	Wick High Level (30 DI -602)
	Valve High Torque
	No Wick Valve Open
	Loss of Power
	Wick Distribution Vault PLC Communication Fail

Interlocks: If a Wick is in a HWL condition, associated valve shall close.

Stop Effluent Pumps upon No Wick Valve Open Alarm.

All valves fail open upon loss of power (FCV-3001, 3002, 3003, 3004, 3005).

On Wick High Level see 30-02: Wick Leveling Monitoring.

32. 30-02: Wick Level Monitoring

P&ID: 30 DI-602

I&C Loop Numbers: 3011, 3012, 3013, 3014, 3015

PLC: WDV-PLC

Equipment Location: Wick Distribution Vault

Equipment Tag Nos.: See Table

LE/LT-3011	LE/LT-3012	LE/LT-3013
LE/LT-3014	LE/LT-3015	

Objective: Measure the Wick level to control the distribution of WWTF effluent discharge into Wicks.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Wick Level High

Operation: Each Wick level instrument's signal will be input into WDV-PLC for indication, trending, totalization, accumulation, reporting, etc.

Local Indication: Wick Level

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Wick Level
Alarms	High Level

Interlocks: If a Wick is in a HWL condition, associated valve shall close.

See Control Strategy 30-01.

33. 99-01: Headworks Gas Monitoring

P&ID: 99 DI-601

I&C Loop Numbers: 1311

PLC: WWTF-PLC

Equipment Location: Headworks Area

Equipment Tag Nos.: See Table

AE/AIT-1311A (LEL)	AE/AIT-1311B (H2S)	AE/AIT-1311C (O2)

Objective: Provide monitoring of hydrogen sulfide, oxygen, and combustible gas in the headworks.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Warning/High Combustible Gas
Warning (Operator Adjustable): XX ppm; XX% LEL
Alarm (Hard Coded): XX ppm; XX% LEL
Warning/High H2S Level
Warning (Operator Adjustable): XX ppm

Programmable Setpoints
Alarm (Hard Coded): XX ppm
Low O2 Level (Oxygen Depletion): Alarm: XX%

Operation: Gas monitoring equipment will be located in the Headworks area.

A Gas Monitoring Control Panel will be located outdoors, at the main entrance (door 118A) to the Headworks building and gas monitoring horns and strobes will also be located inside of the Headworks building. Upon high measurement from any of the gas monitors, a contact will be tripped at the monitor to the gas monitoring control panel which will activate the horn and strobe at the gas monitoring control panel as well as the other sets of horns and strobes.

A gas alarm shall be transmitted to the SCADA System.

Local Indication: Visual and audible “gas alarm” and “no gas alarm” indications. The Gas Monitoring Panel will display the continuous LEL, H2S and O2 levels, as well as go (green) and no-go (red) lights at the entrance to the Headworks area to inform the operator if gas levels are safe to enter the areas or to remain in the areas.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	LEL Level
	H2S Leve/
	O2 Level
Alarms	In Alarm (High LEL and H2S Level and/or Low O2 Level)

Interlocks: N/A

34. 99-02: Truck Bay Gas Monitoring

P&ID: 99 DI-601

I&C Loop Numbers: 1312

PLC: WWTF-PLC

Equipment Location: Truck Bay

Equipment Tag Nos.: See Table

AE/AIT-1312A (LEL)	AE/AIT-1312D (LEL)
AE/AIT-1312B (H2S)	AE/AIT-1312E (H2S)
AE/AIT-1312C (O2)	AE/AIT-1312F (O2)
AE/AIT-1331B (NO2)	AE/AIT-1330B (NO2)
AE/AIT-1331A (CO)	AE/AIT-1330A (CO)

Objective: Provide monitoring of hydrogen sulfide, oxygen, and combustible gas in the truck bay east and west areas.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Warning/High Combustible Gas
Warning (Operator Adjustable): XX ppm; XX% LEL
Alarm (Hard Coded): XX ppm; XX% LEL
Warning/High H2S Level
Warning (Operator Adjustable): XX ppm
Alarm (Hard Coded): XX ppm
Low O2 Level (Oxygen Depletion): Alarm: XX%
Warning (Operator Adjustable): XX ppm
Alarm (Hard Coded): XX ppm
Warning/High NO2 Level
Warning (Operator Adjustable): XX ppm
Alarm (Hard Coded): XX ppm
Warning/High CO Level
Warning (Operator Adjustable): XX ppm
Alarm (Hard Coded): XX ppm

Operation: Gas monitoring equipment will be located in Truck Bay area.

A Gas Monitoring Control Panel will be located at the main entrance to the truck bay. Gas monitoring horns and strobes will also be located in the Truck Bay as noted on the drawings. Upon high measurement from any of the gas monitors, a contact will be tripped from the monitor to the gas monitoring control panel which will activate the horn and strobe at the gas monitoring control panel as well as the other sets of horns and strobes.

Local Indication: Visual and audible “gas alarm” and “no gas alarm” indications. The Gas Monitoring Panel will display the continuous LEL, H2S, O2, CO and NO2 levels, as well as go (green) and no-go (red) lights as indicated on the drawings to inform the operator if gas levels are safe to enter the areas or to remain in the areas.

Gas detection, and alarm information shall be continuously provided to the SCADA System.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)
Status
LEL Level (Truck Bay West)
H2S Level (Truck Bay West)
O2 Level (Truck Bay West)
CO Level (Truck Bay West)

Status and Alarm Condition(s)	
	NO2 Level (Truck Bay West)
	LEL Level (Truck Bay East)
	H2S Level (Truck Bay East)
	O2 Level (Truck Bay East)
	CO Level (Truck Bay East)
	NO2 Level (Truck Bay East)
Alarms	In Alarm (High LEL, H2S, NO2 and/ or CO Level and/or Low O2 Level)

Interlocks: N/A

35. 99-03: Basement Gas Monitoring

P&ID: 99 DI-601

I&C Loop Numbers: 1313, 1314

PLC: WWTF-PLC

Equipment Location: Basement

Equipment Tag Nos.: See Table

AE/AIT-1313 (LEL)

Objective: Provide monitoring of combustible gas in the basement.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Warning/High Combustible Gas
Warning (Operator Adjustable): XX ppm; XX% LEL
Alarm (Hard Coded): XX ppm; XX% LEL

Operation: Gas monitoring equipment will be located in the basement.

Gas monitoring horns and strobes will also be located inside the basement as noted. Upon high measurement of combustible gas, a contact will be tripped at the monitor which will activate the horn and strobe in the basement as well as the other set of horn and strobe at the basement stairs.

Local Indication: Visual and audible “gas alarm” and “no gas alarm” indications. The gas monitor will display the continuous LEL level, as well as go (green) and no-go (red) lights at the entrance to the basement to inform the operator if gas levels are safe to enter or to remain in the basement.

Gas detection, and alarm information shall be continuously provided to the SCADA System.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

	Status and Alarm Condition(s)
Status	N/A
Alarms	High LEL

Interlocks: N/A

36. 99-04: ATC Panel Monitoring

P&ID: 99 DI-601

I&C Loop Numbers: 1314

PLC: WWTF-PLC

Equipment Location: 10.ATC-01: Mechanical Room

10.ATC-02: Garage

Equipment Tag Nos.: 10.ATC-01, 10.ATC-02, GMH-1314A, GMS-1314B, GMS-1314C, GMH-1314D, GMS-1314E, GMS-1314F

Objective: Provide monitoring of the ATC system and provide status to the ATC system for high LEL in the basement. Provide Odor Control Fan running status to the ATC. ATC monitoring includes no flow status for 10-SF3A/3B in the Truck Bay and 10-SF-7 in the Headworks.

Programmable Setpoints: N/A

Operation: The SCADA System will monitor various parameters of the ATC panel, and interlocks as required between the ATC system and process equipment and devices. As discussed in Control Strategy 99-03, the ATC panel shall receive a “High LEL in Basement” alarm from the SCADA System upon high LEL from AE/AIT 1313. Upon receipt of this signal, the ATC will initiate high speed ventilation.

The ATC will also monitor the flow switch status from HVAC exhaust fan 10-EF-1 and HVAC supply fan 10-SF-1 serving the basement. On “No Flow” from either of those switches, an alarm shall be sent to the SCADA System.

The ATC system is interlocked with the odor control system for the Truck Bay and Headworks. The SCADA System provides an “Odor Control Fan Running” contact to the ATC panel, which will trigger the ATC panel to start HVAC supply fans as described on the contract drawings (10-SF-3A, 10-SF-3B, and 10-SF-7). When the odor control fan stops, the HVAC supply fans will stop. The HVAC supply fans must run while the odor control fan is running. Therefore, when the ATC panel sends a “No Flow” signal from any of the HVAC supply fans (10-SF-3A, 10-SF-3B, and 10-SF-7), while the odor control fan is running, the SCADA System will shut down the odor control fan. The ATC system will also send a general “fault’ signal to the SCADA System.

Local Indication: 10.ATC-01: Mechanical Room

10.ATC-02: Garage

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	
Alarms	10-SF-3A/3B No Flow
	10-SF-7 No Flow
	General Fault
	10 EF-1 or 10-SF-1 No Flow

Interlocks: HVAC fans 10-SF-3A, 10-SF-3B, and 10-SF-7 to turn on when "Odor Control Fan Running" alarm occurs in either the Truck Bay or Headworks.

HVAC fans 10-SF-3A, 10-SF-3B, and 10-SF-7 turn off when odor control fans turn off in either the Truck Bay or Headworks.

Odor control fan to turn off when ATC sends "No Flow" signal from any of the HVAC supply fans (10-SF-3A, 10-SF-3B, and 10-SF-7).

Upon high LEL in basement and/or "No Flow" status from 10-EF-1/10-SF-1, basement pump room and basement stair gas monitoring horns and no-go indication to be activated.

37. 99-05: Carbon Monoxide and NO2 Monitoring

P&ID: 99 DI-601

I&C Loop Numbers: 1315

PLC: WWTF-PLC

Equipment Location: See Table

Equipment Tag Nos.: See Table

Location	Tag and Loop Number
Garage	XA-1315A
Equipment Storage Facility	XA-1315B

Objective: Provide monitoring of CO and NO2 in the Garage and Equipment Storage Facility.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
N/A

Operation: Upon high measurement of CO or NO2 in the Garage or Equipment Storage Facility, a dry contact will be tripped from the respective Carbon Monoxide Panel and an alarm will be sent to the SCADA System and ATC.

Local Indication: As defined in the HVAC specification.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	CO Level
	NO2 Level
Alarms	High CO Gas
	High NO2 Gas

Interlocks: Upon High CO or High NO2 alarm, the ATC will override normal operation and run 10 SF-4 and 10 EF-4 in the Garage to purge the area.

Upon High CO or High NO2 alarm, the ATC will override normal operation and run 20-EF-1 in the Equipment Storage Facility to purge the area.

38. 99-06: Room Temperature Monitoring

P&ID: 99 DI-601

I&C Loop Numbers: 1316

PLC: WWTF-PLC

Equipment Location: See Table

Equipment Tag Nos.: See Table

Location	Tag	Loop Number
Basement	TIT	1316A
Electrical Room	TIT	1316B
SH and PACL Room	TIT	1316C
Polymer Room	TIT	1316D
Soda Ash Room	TIT	1316E

Objective: Provides monitoring and alarm of area temperatures

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
High Temperature
Low Temperature

Operation: Alarm on high or low temperature. Operator can adjust temperature locally within High and Low Temperature Setpoints. Low temperature alarms for the Sodium Hypochlorite and PACL Room and the Polymer Room are 50 degrees Fahrenheit. Normal setpoint temperature for the Sodium Hypochlorite and PACL Room is 60 degrees Fahrenheit and normal setpoint temperature for the Polymer Room is 68 degrees Fahrenheit. The Electrical room High Temperature Alarm shall be at 95 degrees Fahrenheit. The Basement High Temperature Alarm shall be at 110 degrees Fahrenheit.

Local Indication: Provide local temperature indication on the instrument

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Temperature
Alarms	High Temperature Alarm
	Low Temperature Alarm

Interlocks: None

39. 99-07: SWBD Monitoring

P&ID: 99 DI-601

I&C Loop Numbers: 1318, 1319

PLC: WWTF-PLC

Equipment Location: Electrical Room

Equipment Tag Nos.: See Table

SWBD-10.1

Objective: Indicates switchboard breaker position – Opened, Closed, or Tripped.

Switchboard provides breaker positions for both the main utility breaker and the Stand-by Generator breaker.

Programmable Setpoints: N/A

Operation: Indicate switchboard breaker position

Local Indication: Breaker position is visible at the equipment

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status - SWBD	Main Utility Breaker Open
	Main Utility Breaker Closed
	Main Utility Breaker in Maintenance Mode
	Stand-by Generator Breaker Open
	Stand-by Generator Breaker Closed
	Stand-by Generator Breaker In Maintenance Mode
	Main Breaker Open
	Main Breaker Closed
	Main Breaker Trip

Status and Alarm Condition(s)	
Alarms	Main Utility Breaker Trip Stand-by Generator Breaker Trip Switchboard Loss of Power ATO Failure to Transfer ATO Fault

Interlocks: None

40. 99-08: Heat Tracing

P&ID: 99 DI-601

I&C Loop Numbers: 1328, 1329

PLC: WWTF-PLC

Equipment Location: See Table

Equipment Tag Nos.: See Table

Location	Tag	Loop Number
Odor Control (Exterior East Wall of Chemical Storage Room)	HT.OC-1-CP	XA-1328
SBR Tank No. 2 (South Wall)	15.HT-CP-1A	XA-1329A
SBR Tank No. 2 (West Wall)	15.HT-CP-1B	XA-1329B
SBR Tank No. 1 (North Wall)	15.HT-CP-2A	XA-1329C
SBR Tank No. 1 (West Wall)	15.HT-CP-2B	XA-1329D

Objective: Indicates heat trace control panel fault status

Programmable Setpoints:

Programmable Setpoints
High Temperature
Low Temperature

Operation: N/A

Local Indication: Visible at heat trace control panel

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Running
Alarms	Fault

Interlocks: None

41. 99-09: Security System

P&ID: 99 DI-601

I&C Loop Numbers: 1327

PLC: WWTF-PLC

Equipment Location: See Table

Equipment Tag Nos.: See Table

Location	Tag	Loop Number
Electrical Room	SSCP.10-1	XA-1327

Objective: Indicates security system control panel fault status

Programmable Setpoints: N/A

Operation: N/A

Local Indication: Visible at security system control panel

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	N/A
Alarms	Fault

Interlocks: None

42. 99-10: Emergency Eyewash/Shower Monitoring

P&ID: 99 DI-602

I&C Loop Numbers: 1321

PLC: WWTF-PLC

Equipment Location: See Table

Equipment Tag Nos.: See Table

Location	Tag	Loop Number
Truck Bay/Septage Receiving	EWS-1	FSH 1321A
Sodium Hypochlorite/PACL Room	EWS-2	FSH 1321B
Laboratory	EWS-3	FSH 1321C
Polymer Room	EWS-4	FSH 1321D
Soda Ash Room	EWS-5	FSH 1321E
Disk Filter Room	EWS-6	FSH 1321F

Objective: Monitor the flow switches integral to the eye wash showers and alarm at the SCADA System if one is activated.

Programmable Setpoints: N/A

Operation: When an emergency eyewash/shower is activated, the integral flow switch is engaged and an alarm is sent to the SCADA System.

Local Indication: Horn/strobe local to eyewash/shower

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	N/A
Alarms	Flow Indication (strobe and horn on)

Interlocks: None

43. 99-11: Sump Pump Control Panel Monitoring

P&ID: 99 DI-602

I&C Loop Numbers: 1322

PLC: WWTF-PLC

Equipment Location: See Table

Equipment Tag Nos.: See Table

Location	Tag	Loop Number
Basement Pump Room	10-SP-1/1A	1322A
Basement Pump Room	10-SP-2/2A	1322B
Basement Pump Room	10-SP-3	1322C
Basement Pump Room	10-SP-2 Flood	LSH 1322B

Objective: Provides pump running status and sump pump fault alarm in the SCADA System.

Programmable Setpoints: N/A

Operation: Sump pumps will automatically start on high level in the sump.

A pump running status will be sent to the SCADA System for each sump pump.

If the pumps fault or the level in the sump(s) rise to a high level, a fault alarm will be generated and sent to the SCADA System.

A float switch located in Sump No. 2 is designated to identify flood conditions and an alarm will be sent to the SCADA system.

Local Indication: N/A

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Sump Pump On (Green)
	Sump Pump Off (Red)

Status and Alarm Condition(s)	
Alarms	High Level
	Sump Pump Control Panel Fault
	Flood Conditions (specific to LSH 1322B float switch in Sump No. 2)

Interlocks: None

44. 99-12: Fire Alarm Control

P&ID: 99 DI-602

I&C Loop Numbers: 1325, 1326

PLC: WWTF-PLC

Equipment Location: See Table

Equipment Tag Nos.: See Table

Location	Tag	Loop Number
Electrical Room	FACP.10-1	1325
Electrical Room	FACP.20-1	1326

Objective: Provide fire alarm status to SCADA.

Programmable Setpoints: N/A

Operation: N/A

Local Indication: Visible at fire alarm control panel.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	N/A
Alarms	Trouble Status
	Fault

Interlocks: None

45. 99-13: Generator Monitoring

P&ID 99 DI-602

I&C Loop Numbers: 1324

PLC: WWTF-PLC

Equipment Location: WWTF

Equipment Tag Nos. GEN.10-1

Objective Operation of the generator is monitored.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Exercise Time
Exercise Duration

Operation: Various Status and Alarm Condition(s), as described below, and fuel tank level are provided from the Generator Control Panel to the WWTF PLC, the Generator Annunciator Panel (GACP.10-1) and the Switchboard (SWBD.10-1 ATO).

Local Indication: Local indication is provided at the Generator Control Panel.

Status and Alarms: The following Status and Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Normal Power Available
	Generator On (Green)
	Generator Off (Red)
	Not in Automatic
	In Exerciser Mode
	Fuel Tank Level
Alarms	Low Oil Pressure
	Sub-Base Oil Tank Rupture
	Low Tank Level
	Fuel Tank Leak
	Battery Malfunction
	Low Battery Voltage
	Common Fault
	E-Stop Activated
	Low Coolant Level
	Loss of Power

Interlocks:

D. PUMP STATIONS

1. Pump Station No. 1 – Old Colony Way

a. 01-01: Pump Station 1 (PS1)

P&ID: 01 DI-601

I&C Loop Numbers: 0101, 0102, 0103, 0104

PLC: WW.PS-1-PLC

Equipment Location: Pump Station 1

Equipment Tag Nos.: See Table

PS1.LE/LT-0104	PS1.LSHH-0104	PS1.LSLL-0104
PS1.P-1	PS1.P-2	PS1.P-3
PI 0101	PI 0102	PI 0103

Objective: Wastewater at the pumping station to be stored in the wet well.

The level in the wet well is monitored by the level transmitter with back-up of float switches for high-high level and low-low level monitoring.

The pumps at the pump station transfer the raw sewage to the WWTF via force main.

Pump discharge header pressure is monitored via dedicated pressure gauges.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
High-High Level
High Level
Low Level
Low-Low Level
Lead Pump On
Lag Pump On
Standby Pump On
Lead Pump Off
Lag Pump Off
Standby Pump Off
Target Wet Well Level (Level Control Mode)
VFD High Speed
VFD Low Speed

Operation: The number of pumps is designed to handle Phase 1 and Phase 2 accumulated flow received at the station, with one (1) pump to handle Phase 1 flow; two (2) pumps to handle for Phase 1 and Phase 2 flows; and a third pump as standby.

Provide continuous monitoring of the wet well level and raw sewage pump control. Monitoring in the wet well shall be via hydrostatic pressure level transducer with backup float switches.

Alarms include low-level and high-level alarms for local and remote indication via the level transducer.

Dedicated float switches detect high-high level and low-low level Status in the wet well. Alarms include low-low and high-high for local and remote indication via floats for backup control and alarming for the level transducer.

The level instrument will continuously monitor the wet well level and transmit a variable level signal to the PLC. Upon a wet well "high" level condition or "low" level condition from the level transducer, an alarm shall be transmitted to the SCADA System.

Operation in the "Auto" mode (at both the HMI and the LOA switch) shall be selected as either "On-Off" or "Level Control" selected by the Operator.

On-Off Mode

The operator will determine the pumps "On" and "Off" wet well level set-points.

The duty pump will be put into service when the wet well level reaches the predetermined "On" level.

The second duty pump will be put into service when the wet well level reaches the predetermined "On" level.

The standby pump will be put into service when the wet well level reaches the predetermined "High" level.

If either duty pump fails, the standby pump will be put in service.

Each pump will shut off when the wet well level reaches their respective off SP.

Level Control Mode

The operator will determine the pumps "On" and "Off" and target wet well level set-points.

Variable Frequency Drives (VFDs) on each pump are controlled through the station's PLC logic (proportional control), which will automatically start and stop the pumps and adjust the pumping rate to match (as close as possible) the flow rate of incoming wastewater from the collection system.

The PLC accomplishes the adjustments through the liquid level transducer in the wet well. The more rapid the wet well fill time the faster or greater the pump rate.

If the duty pump can't keep up with the incoming sewage flow, then the PLC sends a signal to the second duty pump's VFD to bring it up to a speed and reduce the speed of the lead pump to a level, where the combined flow rate from both pumps matches that of the incoming wastewater flow.

If either duty pump fails, the standby pump will be put in service.

All pumps will shut off when the wet well level reaches the predetermined "Off" level.

At the end of the pump cycle, the pumps will automatically alternate unless the pump operates continuously. An automatic/manual software switch in the SCADA System will allow the operator to select whether the pumps alternate automatically.

In the event that the level transducer fails, the pumps shall start on high-high level and stop on low-low level from the level switches.

The pump's primary automatic controls shall also include multiple Status and Alarms, and operating controls as described below. The operators should be able to remove any pump from the operating sequence (due to pump maintenance or failure).

Stop all pumps on low-low level

Stop pump on high discharge pressure

Stop pump on VFD Fault

Stop pump on motor high temperature

Stop pump on moisture

Stop pump on emergency stop (hardware logic)

Pump start permissive from the SCADA System.

Local Indication:

The wet well level transmitter display screen shall indicate the level in engineering units plus rising/falling indication including alarm "set-points" indication for operator reference. The displays shall also indicate the field instruments along with their I&C loop numbers.

The wet well levels, VFD, status and alarm information shall be continuously provided to the SCADA System.

The level transmitter will provide local level indication.

A Safety Stop switch is provided at each pump.

At each raw sewage pump VFD, the following information is provided:

VFD Information
HOA Selector Switch
Pump On (Green)
Pump Off (Red)
Pump Failure Indicator
Local Speed Control
Elapsed Run Time Meter
Pump Speed
High Temperature Indication
Moisture Indication

All pumps (controls, status, alarm) and wet well level information shall also be connected to the SCADA System for both monitoring and control.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	Pump Speed
	Wet Well Level
	In Remote
Alarms	Wet Well Level High-High
	Wet Well Level High
	Wet Well Level Low
	Wet Well Level Low-Low
	Pump Motor High Temperature
	Pump Motor Moisture
	E-Stop Activated
	VFD Fault
	Level Instrument Fail

Interlocks:
Stop all pumps on low-low level
Stop pump on VFD Fault
Stop pump on motor high temperature
Stop pump on moisture
Stop pump on emergency stop (hardware logic)

b. 01-02: Pump Station 1 Flow Monitoring

P&ID: 01 DI-601

I&C Loop Numbers: 0105

PLC: WW.PS-1-PLC

Equipment Location: Pump Station 1 Valve Vault

Equipment Tag Nos.: See Table

FE/FIT-0105

Objective: Provide flow measurement of the wastewater discharged from Pump Station 1 to the WWTF.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Flow Range

Operation: Provide flow monitoring, totalizing, and trending for Pump Station 1 flow.

Flow value shall be input into the SCADA System to equal the WWTF influent flow. See Control Strategy 00-02.

Local Indication: The flow transmitter shall have an instantaneous flow digital display.

The meter OIT will display the total daily flow.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Flow
Alarms	Instrument Fail

Interlocks: Refer to Control Strategy 10-03 for sampler interlock.

c. 01-03: Pump Station 1 Odor Control System

P&ID: 01 DI-602

I&C Loop Numbers: 0110

PLC: WW.PS-1-PLC

Equipment Location: Pump Station 1 Valve Vault

Equipment Tag Nos.: See Table

PS1.OC.F-1	PS1.PDI-0110	PS1.OC-1
PS1.OC-1-LCS	PS1.OC-1-MS	

Objective: Provide continuous odor control for wet well.

Programmable Setpoints: N/A

Operation: A constant speed fan draws odorous air from the wet well and forces the odorous air through the carbon filter, after which the cleaned air passes to the atmosphere.

A Run/Off/Remote switch is provided at the odor control exhaust fan. When in the “Run” position, the odor control exhaust fan shall start and run continuously. When in the “Off” position, the odor control exhaust fan shall not operate. When in the “Remote” position, the odor control exhaust fan shall start and run continuously.

A differential pressure gauge measures the pressure across the carbon filter to determine if the filter media is dirty.

Local Indication: Fault and Run indication are provided at the motor starter (PS1.OC-1-MS) located in the electrical enclosure.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Odor Control Fan On (Green)
	Odor Control Fan Off (Red)
	Odor Control Fan In Remote
Alarms	Fault

Interlocks: N/A

d. 01-04: Pump Station 1 Valve Vault Exhaust Fan

P&ID: 01 DI-601

I&C Loop Numbers: 0115

PLC: WW.PS-1-PLC

Equipment Location: Pump Station 1 Valve Vault

Equipment Tag Nos.: See Table

PS1.EF-1	PS1.EF-1-MS	PS1.EF-1-LCS

Objective: Provide ventilation from the valve vault

Programmable Setpoints: N/A

Operation: A constant speed fan draws air from the valve vault and passes the air to the atmosphere.

A Run/Off/Remote switch is provided at the exhaust fan. When in the “Hand” position, the exhaust fan shall start and run continuously. When in the “Off” position, the exhaust fan shall not operate. When in the “Auto” position, the exhaust fan shall start and stop when the valve vault hatch is opened or closed.

Local Indication: Fault and Run indicate are provided at the motor starter (PS1.EF-1-MS) located in the electrical enclosure.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Exhaust Fan On (Green)
	Exhaust Fan Off (Red)
	Exhaust Fan In Remote
Alarms	Fault

Interlocks: Exhaust Fan turns on when the valve vault hatch is opened.

Exhaust Fan turns off when the valve vault hatch is closed.

2. Pump Station No. 2 – Snow Library

a. 02-01: Pump Station 2 (PS2)

P&ID: 02 DI-601

I&C Loop Numbers: 0201, 0202, 0203

PLC: WW.PS-2-PLC

Equipment Location: Pump Station 2

Equipment Tag Nos.: See Table

PS2.LE/LT 0203	PS2.LSHH 0203	PS2.LSLL 0203
PS2.P-1	PS2.P-2	PI 0201
PI 0202		

Objective: Wastewater at the pumping station to be stored in the wet well.

The level in the wet well is monitored by the level transmitter with back-up of float switches for high-high level and low-low level monitoring.

The pumps at the pump station transfer the wastewater to the Pump Station 1 tributary collection system.

Pump discharge header pressure is monitored via dedicated pressure gauges.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
High-High Level
High Level
Lead Pump On
Standby Pump On
Lead Pump Off
Standby Pump Off
Low Level
Low-Low Level
VFD High Speed
VFD Low Speed
Target Wet Well Level (Level Control Mode)

Operation: The number of pumps is designed to handle the flow received at the station, with one pump to handle the flow; and a second pump as standby.

Provide continuous monitoring of the wet well level and raw sewage pump control. Monitoring in the wet well shall be via hydrostatic pressure level transducer with backup float switches.

Alarms include low-level and high-level alarms for local and remote indication via the level transducer.

Dedicated float switches detect high-high level and low-low level Status in the wet well. Alarms include low-low and high-high for local and remote indication via floats for backup control and alarming for the level transducer.

The level instrument will continuously monitor the wet well level and transmit a variable level signal to the PLC. Upon a wet well "high" level condition or "low" level condition from the level transducer, an alarm shall be transmitted to the SCADA System.

Operation in the "Auto" mode (at both the HMI and the LOA switch) shall be selected as either "On-Off" or "Level Control" selected by the Operator.

On-Off Mode

The operator will determine the pumps "On" and "Off" wet well level set-points.

The duty pump will be put into service when the wet well level reaches the predetermined "On" level.

The standby pump will be put into service when the wet well level reaches the predetermined "High" level.

If the duty pump fails, the standby pump will be put in service.

All pumps will shut off when the wet well level reaches the predetermined "Off" level.

Level Control Mode

The operator will determine the pumps "On" and "Off" wet well level set-points.

Variable Frequency Drives (VFDs) on each pump are controlled through the station's PLC logic (proportional control), which will automatically start and stop the pumps and adjust the pumping rate to match (as close as possible) the flow rate of incoming wastewater from the collection system.

The PLC accomplishes the adjustments through the liquid level transducer in the wet well. The more rapid the wet well fill time the faster or greater the pump rate.

If the duty pump can't keep up with the incoming sewage flow, the PLC sends a signal to the second pump's VFD to bring it up to a speed and reduce the speed of the lead pump to a level, where the combined flow rate from both pumps matches that of the incoming wastewater flow.

If the duty pump fails, the standby pump will be put in service.

All pumps will shut off when the wet well level reaches the predetermined "Off" level.

At the end of the pump cycle, the pumps will automatically alternate unless the pump operates continuously. An

automatic/manual software switch in the SCADA System will allow the operator to select whether the pumps alternate automatically.

In the event that the level transducer fails, the pumps shall start on high-high level and stop on low-low level from the level switches.

The pump's primary automatic controls shall also include multiple Status and Alarms, and operating controls as described below. The operators should be able to remove any pump from the operating sequence (due to pump maintenance or failure).

Stop all pumps on low-low level

Stop pump on high discharge pressure

Stop pump on VFD Fault

Stop pump on motor high temperature

Stop pump on moisture

Stop pump on emergency stop (hardware logic)

Pump start permissive from the SCADA System

Local Indication:

The wet well level transmitter display screen shall indicate the level in engineering units plus rising/falling indication including alarm "set-points" indication for operator reference. The displays shall also indicate the field instruments along with their I&C loop numbers.

The wet well levels, VFD, status and alarm information shall be continuously provided to the SCADA System.

The level transmitter will provide local level indication.

A Safety Stop switch is provided at each pump.

At each raw sewage pump VFD, the following information is provided:

VFD Information
HOA Selector Switch
Pump On (Green)
Pump Off (Red)
Common Pump Failure Indicators
Local Speed Control
Elapsed Run Time Meter
Pump Speed

All pumps (controls, status, alarm) and wet well level information shall also be connected to the SCADA System for both monitoring and control.

Status and Alarms:

The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	Pump Speed
	Wet Well Level
	In Remote
Alarms	Wet Well Level High-High
	Wet Well Level High
	Wet Well Level Low
	Wet Well Level Low-Low
	Pump Motor High Temperature
	Pump Motor Moisture
	E-Stop Activated
	VFD Fault
	Level Instrument Fail

Interlocks: N/A

b. 02-02: Pump Station 2 Flow Monitoring

P&ID: 02 DI-601

I&C Loop Numbers: 0204

PLC: WW.PS-2-PLC

Equipment Location: Pump Station 2 Valve Vault

Equipment Tag Nos.: See Table

PS2.FE/FIT-0204

Objective: Provide flow measurement of the wastewater discharged from Pump Station 2 to the Pump Station 1 tributary collection system.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Flow Range

Operation: Provide flow monitoring, totalizing, and trending for Pump Station 2 flow.

Flow value shall be input into the SCADA System to equal the WWTF influent flow. See Control Strategy 00-02.

Local Indication: The flow transmitter shall have an instantaneous flow digital display.

The meter OIT will display the total daily flow.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Flow
Alarms	Instrument Fail

Interlocks: N/A

c. 02-03: Pump Station 2 Odor Control System

P&ID: 02 DI-602

I&C Loop Numbers: 0210

PLC: WW.PS-2-PLC

Equipment Location: Pump Station 2 Valve Vault

Equipment Tag Nos.: See Table

PS2.OC.F-1	PS2.PDI-0210	PS2.OC-1-LCS
PS2.OC-1-MS		

Objective: Provide continuous odor control for wet well.

Programmable Setpoints: N/A

Operation: A constant speed fan draws odorous air from the wet well and forces the odorous air through the carbon filter, after which the cleaned air passes to the atmosphere.

A Run/Off/Remote switch is provided at the odor control exhaust fan. When in the “Run” position, the odor control exhaust fan shall start and run continuously. When in the “Off” position, the odor control exhaust fan shall not operate. When in the “Remote” position, the odor control exhaust fan shall start and run continuously.

A differential pressure gauge measures the pressure across the carbon filter to determine if the filter media is dirty.

Local Indication: Fault and Run indication are provided at the motor starter (PS2.OC-1-MS) located in the electrical enclosure.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Odor Control Fan On (Green)
	Odor Control Fan Off (Red)
	Odor Control Fan In Remote

	Status and Alarm Condition(s)
Alarms	Fault

Interlocks: N/A

d. 02-04: Pump Station 2 Valve Vault Exhaust Fan

P&ID: 02 DI-601

I&C Loop Numbers: 0215

PLC: WW.PS-2-PLC

Equipment Location: Pump Station 2 Valve Vault

Equipment Tag Nos.: See Table

PS2.EF-1	PS2.EF-1-MS	PS2.EF-1-LCS

Objective: Provide ventilation from the valve vault

Programmable Setpoints: N/A

Operation: A constant speed fan draws air from the valve vault and passes the air to the atmosphere.

A Hand/Off/Auto switch is provided at the exhaust fan. When in the "Hand" position, the exhaust fan shall start and run continuously. When in the "Off" position, the exhaust fan shall not operate. When in the "Auto" position, the exhaust fan shall start and stop when the valve vault hatch is opened or closed.

Local Indication: Fault and Run indicate are provided at the motor starter (PS2.EF-1-MS) located in the electrical enclosure.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

	Status and Alarm Condition(s)
Status	Exhaust Fan On (Green)
	Exhaust Fan Off (Red)
	Exhaust Fan In Remote
Alarms	Fault

Interlocks: Exhaust Fan turns on when the valve vault hatch is opened.

Exhaust Fan turns off when the valve vault hatch is closed.

3. Pump Station No. 3 – Cranberry Plaza

a. 03-01: Pump Station 3 (PS3)

P&ID: 03 DI-601

I&C Loop Numbers: 0301, 0302, 0303

PLC: WW.PS-23-PLC

Equipment Location: Pump Station 3

Equipment Tag Nos.: See Table

PS3.LE/LT 0303	PS3.LSHH 0303	PS.LSLL 0303
PS3.P-1	PS3.P-2	PI 0301
PI 0302		

Objective: Wastewater at the pumping station to be stored in the wet well.

The level in the wet well is monitored by the level transmitter with back-up of float switches for high-high level and low-low level monitoring.

The pumps at the pump station transfer the wastewater to the Pump Station 2 tributary collection system.

Pump discharge header pressure is monitored via dedicated pressure gauges.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
High-High Level
High Level
Lead Pump On
Standby Pump On
Lead Pump Off
Standby Pump Off
Low Level
Low-Low Level
VFD High Speed
VFD Low Speed
Target Wet Well Level (Level Control Mode)

Operation: The number of pumps is designed to handle the flow received at the station, with one pump to handle the flow; and a second pump as standby.

Provide continuous monitoring of the wet well level and raw sewage pump control. Monitoring in the wet well shall be via hydrostatic pressure level transducer with backup float switches.

Alarms include low-level and high-level alarms for local and remote indication via the level transducer.

Dedicated float switches detect high-high level and low-low level Status in the wet well. Alarms include low-low and high-high for local and remote indication via floats for backup control and alarming for the level transducer.

The level instrument will continuously monitor the wet well level and transmit a variable level signal to the PLC. Upon a wet well "high" level condition or "low" level condition from the level transducer, an alarm shall be transmitted to the SCADA System.

Operation in the "Auto" mode (at both the HMI and the LOA switch) shall be selected as either "On-Off" or "Level Control" selected by the Operator.

On-Off Mode

The operator will determine the pumps "On" and "Off" wet well level set-points.

The duty pump will be put into service when the wet well level reaches the predetermined "On" level.

The standby pump will be put into service when the wet well level reaches the predetermined "High" level.

If the duty pump fails, the standby pump will be put in service.

All pumps will shut off when the wet well level reaches the predetermined "Off" level.

Level Control Mode

The operator will determine the pumps "On" and "Off" wet well level set-points.

Variable Frequency Drives (VFDs) on each pump are controlled through the station's PLC logic (proportional control), which will automatically start and stop the pumps and adjust the pumping rate to match (as close as possible) the flow rate of incoming wastewater from the collection system.

The PLC accomplishes the adjustments through the liquid level transducer in the wet well. The more rapid the wet well fill time the faster or greater the pump rate.

If the duty pump can't keep up with the incoming sewage flow then the PLC sends a signal to the second pump's VFD to bring it up to a speed and reduce the speed of the lead pump to a level, where the combined flow rate from both pumps matches that of the incoming wastewater flow.

If the duty pump fails, the standby pump will be put in service.

All pumps will shut off when the wet well level reaches the predetermined "Off" level.

At the end of the pump cycle, the pumps will automatically alternate. An automatic/manual software switch in the SCADA System will allow the operator to select whether the pumps alternate automatically.

In the event that the level transducer fails, the pumps shall start on high-high level and stop on low-low level from the level switches.

The pump's primary automatic controls shall also include multiple Status and Alarms, and operating controls as described below.

The operators should be able to remove any pump from the operating sequence (due to pump maintenance or failure).

Stop all pumps on low-low level

Stop pump on high discharge pressure

Stop pump on VFD Fault

Stop pump on motor high temperature

Stop pump on moisture

Stop pump on emergency stop (hardware logic)

Pump start permissive from the SCADA System.

Local Indication:

The wet well level transmitter display screen shall indicate the level in engineering units plus rising/falling indication including alarm “set-points” indication for operator reference. The displays shall also indicate the field instruments along with their I&C loop numbers.

The wet well levels, VFD, status and alarm information shall be continuously provided to the SCADA System.

The level transmitter will provide local level indication.

A Emergency Stop switch is provided for each pump.

At each raw sewage pump VFD, the following information is provided:

VFD Information
HOA Selector Switch
Pump On (Green)
Pump Off (Red)
Common Pump Failure Indicators
Local Speed Control
Elapsed Run Time Meter
Pump Speed
High Temperature Indication
Moisture Indication

All pumps (controls, status, alarm) and wet well level information shall also be connected to the SCADA System for both monitoring and control.

Status and Alarms:

The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)

Status and Alarm Condition(s)	
	Pump Speed
	Wet Well Level
	In Remote
Alarms	Wet Well Level High-High
	Wet Well Level High
	Wet Well Level Low
	Wet Well Level Low-Low
	Pump Overload
	Pump Motor High Temperature
	Pump Motor Moisture
	Pump Discharge Pressure High
	E-Stop Activated
	VFD Fault
	Level Instrument Fail

Interlocks: N/A

b. 03-02: Pump Station 3 Flow Monitoring

P&ID: 03 DI-601

I&C Loop Numbers: 0304

PLC: WW.PS-3-PLC

Equipment Location: Pump Station 3 Valve Vault

Equipment Tag Nos.: See Table

PS3.FE/FIT-0304

Objective: Provide flow measurement of the wastewater discharged from the Pump Station 3 to the Pump Station 2 tributary collection system.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Flow Range

Operation: Provide flow monitoring, totalizing, and trending for Pump Station 3 flow.

Flow value shall be input into the SCADA System to equal the WWTF influent flow. See Control Strategy 00-02.

Local Indication: The flow transmitter shall have an instantaneous flow digital display.

The meter OIT will display the total daily flow.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Flow
Alarms	Instrument Fail

Interlocks: N/A

c. 03-03: Pump Station 3 Odor Control System

P&ID: 03 DI-602

I&C Loop Numbers: 0310

PLC: WW.PS-3-PLC

Equipment Location: Pump Station 3 Valve Vault

Equipment Tag Nos.: See Table

PS3.OC.F-1	PS3.PDI-0310	PS3.OC-1-LCS
PS3.OC-1-MS		

Objective: Provide continuous odor control for wet well.

Programmable Setpoints: N/A

Operation: A constant speed fan draws odorous air from the wet well and forces the odorous air through the carbon filter, after which the cleaned air passes to the atmosphere.

A Run/Off/Remote switch is provided at the odor control exhaust fan. When in the “Run” position, the odor control exhaust fan shall start and run continuously. When in the “Off” position, the odor control exhaust fan shall not operate. When in the “Remote” position, the odor control exhaust fan shall start and run continuously.

A differential pressure gauge measures the pressure across the carbon filter to determine if the filter media is dirty.

Local Indication: Fault and Run indication are provided at the motor starter (PS3.OC-1-MS) located in the electrical enclosure.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Odor Control Fan On (Green)
	Odor Control Fan Off (Red)
	Odor Control Fan In Remote

	Status and Alarm Condition(s)
Alarms	Fault

Interlocks: N/A

d. 03-04: Pump Station 3 Valve Vault Exhaust Fan

P&ID: 03 DI-601

I&C Loop Numbers: 0315

PLC: WW.PS-3-PLC

Equipment Location: Pump Station 3 Valve Vault

Equipment Tag Nos.: See Table

PS3.EF-1	PS3.EF-1-MS	PS3.EF-1-LCS

Objective: Provide ventilation from the valve vault

Programmable Setpoints: N/A

Operation: A constant speed fan draws air from the valve vault and passes the air to the atmosphere.

A Hand/Off/Auto switch is provided at the exhaust fan. When in the "Hand" position, the exhaust fan shall start and run continuously. When in the "Off" position, the exhaust fan shall not operate. When in the "Auto" position, the exhaust fan shall start and stop when the valve vault hatch is opened or closed.

Local Indication: Fault and Run indicate are provided at the motor starter (PS3.EF-1-MS) located in the electrical enclosure.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

	Status and Alarm Condition(s)
Status	Exhaust Fan On (Green)
	Exhaust Fan Off (Red)
	Exhaust Fan In Remote
Alarms	Fault

Interlocks: Exhaust Fan turns on when the valve vault hatch is opened.

Exhaust Fan turns off when the valve vault hatch is closed.

4. Pump Station No. 4 – Meetinghouse Pond

d. 04-01: Pump Station 4 (PS4)

P&ID: 04 DI-601

I&C Loop Numbers: 0401, 0402, 0404

PLC: WW.PS-4-PLC

Equipment Location:	Pump Station 4
Equipment Tag Nos.:	See Table

PS4.LE/LT 0403	PS4.LSHH 0403	PS4.LSLL 0403
PS4.P-1	PS4.P-2	PS4.P-3 (Future)
PI 0401	PI 0402	PI 0403 (Future)

Objective: Wastewater at the pumping station to be stored in the wet well.

The level in the wet well is monitored by the level transmitter with back-up of float switches for high-high level and low-low level monitoring.

The pumps at the pump station transfer the wastewater to the Pump Station 1 tributary collection system.

Pump discharge header pressure is monitored via dedicated pressure gauges.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
High-High Level
High Level
Lead Pump On
Standby Pump On
Lead Pump Off
Standby Pump Off
Low Level
Low-Low Level
VFD High Speed
VFD Low Speed
Target Wet Well Level (Level Control Mode)

Operation: The number of pumps is designed to handle the flow received at the station, with one pump to handle the flow; and a second pump as standby. The third pump will be installed in future collection system Phases when the ADF to the pump station has increased. With future phases, the three pumps will operate as two (2) duty, and one (1) standby.

Provide continuous monitoring of the wet well level and raw sewage pump control. Monitoring in the wet well shall be via hydrostatic pressure level transducer with backup float switches.

Alarms include low-level and high-level alarms for local and remote indication via the level transducer.

Dedicated float switches detect high-high level and low-low level Status in the wet well. Alarms include low-low and high-high for

local and remote indication via floats for backup control and alarming for the level transducer.

The level instrument will continuously monitor the wet well level and transmit a variable level signal to the PLC. Upon a wet well "high" level condition or "low" level condition from the level transducer, an alarm shall be transmitted to the SCADA System.

Operation in the "Auto" mode (at both the HMI and the LOA switch) shall be selected as either "On-Off" or "Level Control" selected by the Operator.

On-Off Mode

The operator will determine the pumps "On" and "Off" wet well level set-points.

The duty pump will be put into service when the wet well level reaches the predetermined "On" level.

The standby pump will be put into service when the wet well level reaches the predetermined "High" level.

If the duty pump fails, the standby pump will be put in service.

All pumps will shut off when the wet well level reaches the predetermined "Off" level.

Level Control Mode

The operator will determine the pumps "On" and "Off" wet well level set-points.

Variable Frequency Drives (VFDs) on each pump are controlled through the station's PLC logic (proportional control), which will automatically start and stop the pumps and adjust the pumping rate to match (as close as possible) the flow rate of incoming wastewater from the collection system.

The PLC accomplishes the adjustments through the liquid level transducer in the wet well. The more rapid the wet well fill time the faster or greater the pump rate.

If the duty pump can't keep up with the incoming sewage flow, the PLC sends a signal to the second pump's VFD to bring it up to a speed and reduce the speed of the lead pump to a level, where the combined flow rate from both pumps matches that of the incoming wastewater flow.

If the duty pump fails, the standby pump will be put in service.

All pumps will shut off when the wet well level reaches the predetermined "Off" level.

At the end of the pump cycle, the pumps will automatically alternate unless the pump operates continuously. An automatic/manual software switch in the SCADA System will allow the operator to select whether the pumps alternate automatically.

In the event that the level transducer fails, the pumps shall start on high-high level and stop on low-low level from the level switches.

The pump's primary automatic controls shall also include multiple Status and Alarms, and operating controls as described below. The operators should be able to remove any pump from the operating sequence (due to pump maintenance or failure).

Stop all pumps on low-low level

Stop pump on high discharge pressure

Stop pump on VFD Fault

Stop pump on motor high temperature

Stop pump on moisture

Stop pump on emergency stop (hardware logic)

Pump start permissive from the SCADA System

Local Indication:

The wet well level transmitter display screen shall indicate the level in engineering units plus rising/falling indication including alarm "set-points" indication for operator reference. The displays shall also indicate the field instruments along with their I&C loop numbers.

The wet well levels, VFD, status and alarm information shall be continuously provided to the SCADA System.

The level transmitter will provide local level indication.

A Safety Stop switch is provided at each pump.

At each raw sewage pump VFD, the following information is provided:

VFD Information
HOA Selector Switch
Pump On (Green)
Pump Off (Red)
Common Pump Failure Indicators
Local Speed Control
Elapsed Run Time Meter
Pump Speed

All pumps (controls, status, alarm) and wet well level information shall also be connected to the SCADA System for both monitoring and control.

Status and Alarms:

The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Pump On (Green)
	Pump Off (Red)
	Pump Speed

Status and Alarm Condition(s)	
	Wet Well Level
	In Remote
Alarms	Wet Well Level High-High
	Wet Well Level High
	Wet Well Level Low
	Wet Well Level Low-Low
	Pump Motor High Temperature
	Pump Motor Moisture
	E-Stop Activated
	VFD Fault
	Level Instrument Fail

Interlocks: N/A

e. 04-02: Pump Station 4 Flow Monitoring

P&ID: 04 DI-601

I&C Loop Numbers: 0405

PLC: WW.PS-4-PLC

Equipment Location: Pump Station 4 Valve Vault

Equipment Tag Nos.: See Table

PS4.FE/FIT-0404

Objective: Provide flow measurement of the wastewater discharged from Pump Station 4 to the Pump Station 1 tributary collection system.

Programmable Setpoints: The following programmable setpoints shall be available to the SCADA System:

Programmable Setpoints
Flow Range

Operation: Provide flow monitoring, totalizing, and trending for Pump Station 4 flow.

Flow value shall be input into the SCADA System to equal the WWTF influent flow. See Control Strategy 00-02.

Local Indication: The flow transmitter shall have an instantaneous flow digital display.

The meter OIT will display the total daily flow.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

	Status and Alarm Condition(s)
Status	Flow
Alarms	Instrument Fail

Interlocks: N/A

f. 04-03: Pump Station 4 Odor Control System

P&ID: 04 DI-602

I&C Loop Numbers: 0410

PLC: WW.PS-4-PLC

Equipment Location: Pump Station 4 Valve Vault

Equipment Tag Nos.: See Table

PS4.OC.F-1	PS4.PDI-0410	PS4.OC-1-LCS
PS4.OC-1-MS		

Objective: Provide continuous odor control for wet well.

Programmable Setpoints: N/A

Operation: A constant speed fan draws odorous air from the wet well and forces the odorous air through the carbon filter, after which the cleaned air passes to the atmosphere.

A Run/Off/Remote switch is provided at the odor control exhaust fan. When in the “Run” position, the odor control exhaust fan shall start and run continuously. When in the “Off” position, the odor control exhaust fan shall not operate. When in the “Remote” position, the odor control exhaust fan shall start and run continuously.

A differential pressure gauge measures the pressure across the carbon filter to determine if the filter media is dirty.

Local Indication: Fault and Run indication are provided at the motor starter (PS4.OC-1-MS) located in the electrical enclosure.

Status and Alarms: The following Status and Alarm Condition(s) shall be reported to the SCADA System:

	Status and Alarm Condition(s)
Status	Odor Control Fan On (Green) Odor Control Fan Off (Red) Odor Control Fan In Remote
Alarms	Fault

Interlocks: N/A

d. 04-04: Pump Station 4 Valve Vault Exhaust Fan

P&ID:	04 DI-601
I&C Loop Numbers:	0415
PLC:	WW.PS-4-PLC
Equipment Location:	Pump Station 4 Valve Vault
Equipment Tag Nos.:	See Table

PS4.EF-1	PS4.EF-1-MS	PS4.EF-1-LCS

Objective:	Provide ventilation from the valve vault
Programmable Setpoints:	N/A
Operation:	A constant speed fan draws air from the valve vault and passes the air to the atmosphere. A Hand/Off/Auto switch is provided at the exhaust fan. When in the "Hand" position, the exhaust fan shall start and run continuously. When in the "Off" position, the exhaust fan shall not operate. When in the "Auto" position, the exhaust fan shall start and stop when the valve vault hatch is opened or closed.
Local Indication:	Fault and Run indicate are provided at the motor starter (PS4.EF-1-MS) located in the electrical enclosure.
Status and Alarms:	The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Exhaust Fan On (Green)
	Exhaust Fan Off (Red)
	Exhaust Fan In Remote
Alarms	Fault

Interlocks:	Exhaust Fan turns on when the valve vault hatch is opened. Exhaust Fan turns off when the valve vault hatch is closed.

5. 99-01: Pump Stations MCB Monitoring

P&ID:	99 DI-601, 04 DI-603
I&C Loop Numbers:	0111, 0211, 0311, 0411
PLC:	WW.PS-1-PLC, WW.PS-2-PLC, WW.PS-3-PLC, WW.PS-4-PLC
Equipment Location:	Electrical Enclosure
Equipment Tag Nos.:	See Table

MCB.01-1	MCB.02-1	MCB.03-1 MCB.04-1

Objective:	Indicates MCB breaker position – Opened, Closed, or Tripped
Programmable Setpoints:	N/A

Operation:	Indicate MCB breaker position
Local Indication:	Breaker position is visible at the equipment
Status and Alarms:	The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Main Open
	Main Closed
Alarms	Main Trip

Interlocks:	None

6. 99-02: Miscellaneous Signals – Pump Stations Automatic Transfer Switch (ATS)

P&ID:	99 DI-601, 04 DI-603
I&C Loop Numbers:	0112, 0212, 0312, 0412
PLC:	WW.PS-1-PLC, WW.PS-2-PLC, WW.PS-3-PLC, WW.PS-4-PLC
Equipment Location:	Electrical Enclosure
Equipment Tag Nos.:	See Table

ATS.01-1	ATS.02-1	ATS.03-1
		ATS.04-1

Objective:	Indicates ATS Status
Programmable Setpoints:	N/A
Operation:	ATS operates during the utility failure to switch the power source from Utility to the Stand-by Generator. The following signals are transmitted to the SCADA signal: Utility Power, Standby Power, Fault
Local Indication:	ATS (Stand-by Generator breaker) position is visible at the equipment
Status and Alarms:	The following Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Standby Power
	Utility Power
Alarms	ATS Fault

Interlocks:	Stand-by Generator Mode

7. 99-03: Miscellaneous Signals – Pump Stations Stand-by Generator

P&ID:	99 DI-601, 04 DI-603
I&C Loop Numbers:	0113, 0213, 0313, 0413
PLC:	WW.PS-1-PLC, WW.PS-2-PLC, WW.PS-3-PLC, WW.PS-4-PLC

Equipment Location: Outdoors at the respective pump stations

Equipment Tag Nos.: See Table

GEN.01-1	GEN.02-1	GEN.03-1 GEN.04-1

Objective: Indicates Stand-by Generator Statuses and Status and Alarms

Programmable Setpoints: N/A

Operation: Indicate Stand-by Generator operation due to utility power failure as well as routine Stand-by Generator cycling operation.

Local Indication: Stand-by Generator Status and Status and Alarms, operator controls visible at the Stand-by Generator and control panel.

Status and Alarms: The following statuses and Status and Alarm Condition(s) shall be reported to the SCADA System:

Status and Alarm Condition(s)	
Status	Stand-by Generator Not in Auto
	Stand-by Generator in Exerciser Mode
	Stand-by Generator Running
Alarms	Stand-by Generator E-Stop Activated
	Stand-by Generator Fail
	Battery Charger Malfunction

Interlocks: ATS Position

SECTION 13340

PLC CONTROL PANELS

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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide PLC Control Panels as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide all equipment, installation, services, and appurtenances to achieve a complete, integrated, and fully operational system.

D. Test all components individually as well as in a system as specified and recommended by the manufacturer.

E. Design the system and equipment used therein, to resume normal operation without manual intervention, following resumption of power after a power failure.

F. Ambient Conditions for control panels:

1. Minimum Temperature: 50 degrees F
2. Maximum Temperature: 90 degrees F
3. Relative Humidity: 95% Non-condensing

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

C. Include with the submittal a copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

1. Failure to include a copy of the marked-up specification sections with result in rejection of the entire submittal with no further review and consideration.

D. The submittal shall include:

1. Table of contents
2. Loop diagrams on 11 inch by 17 inch sheets.
3. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, surfaces continuing instruments, internal panel wiring and internal panel layout.
4. Complete Bill of Materials indicating manufacturer’s part numbers.
5. Power and control schematics including external connections. Show wire and terminal numbers and color coding.

6. Panel electrical load data used with UPS sizing.
7. Catalog sheets for each piece of equipment to be included in the equipment.
8. Panel temperature control documentations.
9. Shop test plan as specified herein.

E. Submit the following prior to equipment shipment:

1. Certified shop test reports.

F. Submit the following prior to field start-up and testing:

1. As-built drawings incorporating all changes made during the manufacturing process.
2. Installation information including equipment anchorage provisions.
3. Any additional information required for equipment installation.

G. Submit the following after installation:

1. Field tests and inspection reports.
2. Certified statement from Contractor and equipment supplier approving system and authorizing energizing of system.

H. Submit and include the following in the operations and maintenance (O&M) manuals:

1. Submit "record copy" of all drawings previously submitted. Show all changes and modifications made during installation.
2. Define special maintenance requirements particular to system along with special calibration and test procedures.
3. Data sheet describing each element in detail, including manufacturer, part number, calibration values, and all information pertaining to the element. Include a brief description of each device.
4. Manufacturer catalog sheets for each element. All specification sheets shall be properly annotated to indicate particular device supplied.
5. Complete spare parts list.
6. All information shall be in one submittal.
7. Provide manufacturer's certified statement of installation approval.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE:

A. Provide UL listed materials and equipment.

B. All panels shall be UL 508A listed.

C. System energizing not allowed prior to receipt of certified statement from Contractor and supplier approving system and authorizing energizing of system.

D. Replace damaged materials or equipment as determined by the Engineer at no additional cost to the Owner.

E. Engineer and/or Owner shall inspect and observe the testing of the equipment at its site of manufacture, fabrication or assembly. Equipment shall include cabinets, control devices, computerized equipment, panel equipment and field equipment. No equipment shall be shipped without Engineer's approval. Provide 21 days written notice for Engineer's inspection.

1.08 - WARRANTY

A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

B. The Contractor shall be provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. The Warranty shall be secured by a Performance Bond issued jointly to the CONTRACTOR and the OWNER for 100 percent of the PROPOSAL price. The Contractor agrees to furnish a Warranty in the sum of the full amount of the Proposal price and duly executed by the said Contractor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the OWNER, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Contractor. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

C. The Warranty shall be for a period of four (4) years from Substantial Completion of the construction contract. The Contractor will be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor’s responsibility to resolve any and all warranty claims.

E. The Warranty shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bond will be summarily rejected and returned to the Contractor without further review and consideration.

F. The Contractor shall warrant that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

G. The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guides and as specified herein.

1.09 - REFERENCES

A. National Fire Protection Association: NFPA 70.

B. The International Society of Automation (ISA) S5.2, S5.3 and S5.4, Instrument Loop Diagrams, standard.

C. National Electrical Manufacturers Association (NEMA) Publication, General Standards for Industrial and Control Systems, ICS1 and Industrial Controls and Systems ICS2.

D. UL Standard for Industrial Control Panels: UL 508A

1.10 - FACTORY-TRAINED SERVICE TECHNICIAN

A. Provide services of factory-trained Service Technician, specifically trained on the type of equipment specified:

1. Service Technician must be present on site for all items listed below and shall be available during the entire installation of the equipment to assist in placing the load break switch in operation and to correct deficiencies in installation, equipment, or material. Person-day requirements listed are minimum values, exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

a. Installation: Provide support during equipment installation:

(1) 2 person-days per panel

b. Startup: Provide support during equipment startup:

(1) 2 person-days per panel

c. Functional Testing: Perform a functional test. Tests to include all items specified.

(1) 2 person-days per panel

d. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

(1) 2 person-days.

2. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

3. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 - GENERAL

A. Equipment, cabinets and other devices furnished hereunder shall be for continuous use in the intended application.

B. The system shall consist of current production products.

2.02 - CONTROL PANELS

A. Control Panel Enclosure

1. Size enclosures to fit all required equipment, run all field wires and provide adequate working space.

2. Panels shall be in accordance with the Electrical Area Classification Schedule.

3. Provide panels doors:

a. Extending the full width for full access to panel-rear mounted components

b. With adequate internal bracing for structural rigidity and strength

c. Formed of sheet metal

d. With 180° stainless steel hinges,

e. Gasketed to preserve NEMA rating

f. With a drawing pocket to hold as-built and service documentation.

4. Provide Latching:
    a. Flush Type, 3 point locking latches with keys.
    b. Fabricated from Type 304 stainless steel.
    c. That maintains NEMA rating.

B. Surge Protection
1. Provide UL508 Surge Protection Devices (SPDs) for Panel as follows:
    a. For each power feed into the control panel.
    b. Rated a minimum of 10 kilo amps (kA)
    c. With light indicating fault
    d. Mount SPD inside control panel
    e. Minimize lead length of SPD
    f. SPD manufactured by Dehn or equal.
2. Provide UL508 surge protection for analog signals as follows:
    a. For signals originating in a structure outside the one housing the control panel or greater than 200 feet from the control panel.
    b. Surge protection shall be: two-stage common-mode protection by means of arrestor reactor and varistor in combination and differential mode protection by means of gas arrestor, reactor and zener diode in combination.
    c. Rated a minimum of 10 kilo amps (kA)
    d. Manufactured by Dehn or equal.

C. Power Supplies
1. Provide panel with 120 VAC to DC redundant power supplies with automatic redundancy switchover module to provide power to DC fed equipment, including DC powered field instruments.

D. Courtesy Equipment
1. Provide in each panel section with:
    a. A 1600 lumen LED fixture powered from120 VAC and activated by switch that closes when enclosure door opens.
    b. External panel mounted programming port directly connected to the PLC hardware allowing panel external access to the PLC programming without the need to open the panel enclosure doors.

E. Power to Remote Instruments
1. Provide all instrument power from the instrument panel or termination panel for the control system unless otherwise indicated or specified.
2. Provide power to the instruments from the same panel that receives the instrument’s signal.
3. Provide each instrument requiring 120 VAC power or DC power with an individual fused disconnect or circuit breaker.

F. Mounting

1. Mount all panel components to allow easy access for servicing, calibration, adjustments, testing and removal, without the removal of other equipment.

2. Provide internal panel components mounted directly on removable plates made of the same material and finish as the panel, of a thickness to provide rigid support for mounted components.

3. Mount all equipment on wall of panel enclosure. Loose equipment on the floor of enclosure is not acceptable.

G. Labeling

1. Attach identification labels to all internal components.

2. Provide lamicoid nameplates, white with black background engraved legends. Provide nameplates attached with clear pressure sensitive tape for continuous bond equal to 3M VHB tapes.

3. Provide identification for all wiring to panel components powered externally from the panel power circuit breaker inside the panel.

4. Label all disconnects and fused disconnect or circuit breaker for instrument power with circuit numbers or device tag names.

5. Number wiring in accordance with the numbering system used on the instrument submittal drawings.

6. Provide wire numbers on wires at terminal blocks and all connections.

7. Any component identification on the wire trough covers shall be repeated on the sub-panel to allow component identification with snap-on cover not in place.

8. Provide terminal strips numbered with the signal termination number plus additional characters to identify each individual conductor.

a. Analog inputs and outputs: Provide the character + appended to the terminal number for the positive signal wire. Provide the character – appended to the terminal number for the negative signal wire. Provide the character S appended to the terminal number for the signal shield.

b. Digital inputs: Provide the character C appended to the terminal number for the unpowered (common) conductor. For inputs identified as having a CONTACT TYPE of OPEN, provide the character NC appended to the terminal number for the conductor to be powered. For inputs identified as having a CONTACT TYPE of CLOSED, provide the character NO appended to the terminal number for the conductor to be powered.

c. Digital outputs: Digital outputs have 1 to 4 contacts per signal point. Provide the character C appended to the common terminal for single contact outputs. Provide the character C followed by a number 1 thru 4 appended to the common terminal for each contact output of multiple contact outputs. Provide the character P appended to the powered terminal for single contact outputs. Provide the character P followed by a number 1 thru 4 appended to the powered terminal for each contact output of multiple contact outputs.

H. Switching

1. Unless specified otherwise, pushbuttons shall be of oil-tight, heavy-duty momentary contact pushbuttons, rated for 10 amperes at 120 volts ac unless specified otherwise. Supply with the quantity of poles required for the application.

2. Unless specified otherwise, rotary selector switches used for controlling 120 volts ac, shall be oil-tight, heavy-duty, maintained contact type rated for 10 amperes at 120 volts ac. Rotary switches used for low level control signals shall have gold or other precious metal contacts rated for "dry contact" duty.

I. Indicating Lights

1. Provide oil-tight, heavy-duty, LED cluster type pilot lights, with average life of 40,000 hours, minimum, unless otherwise specified.
2. Lights shall be Red for “OFF” position, Green for “ON” position and Amber for “Alarms”.
3. 1/4" (6.4 mm) diameter, colored as selected by the Engineer
4. Lamps to be replaceable from panel front; 10% spares for LED type.

J. Control Relays

1. Provide sealed relays DIN rail mounted with indicating light to indicate its operation. Contacts shall be rated for 10 amperes at 120 volts, ac. Life expectancy shall be 50 million operations, minimum.
2. Provide electronic timer delay of the plug-in, digital type with output contacts rated for 10 amperes @ 120 volts ac. Life expectancy shall be 20 million operations.
3. Provide all relays from a single manufacturer.

K. Termination Points

1. Provide terminal blocks for every input/output wire. Include terminals for signal cable shields.
2. Provide 25% spare terminal blocks for each type of signal.
3. Terminal numbers will be sequential on the terminal blocks.
4. Arrange the terminal blocks into functional groups
5. Use only one side of each terminal block row for internal wiring. Use the other side for field wiring. Do not locate terminal blocks within 6 inches (150 mm) of any right angle panel surface.
6. Provide terminal blocks of corrosion proof material such as nickel plated copper. Provide AC and DC control terminals suitable for 12 AWG (4 mm) or larger wire. Provide terminals for DC analog signals suitable for 16 AWG (1.5 mm) wire.

L. Wires

1. Provide shielded cable pairs for all analog signals internal and external to the panels. Provide minimum conductor size of 16 AWG (1.5 mm) for analog wiring internal to the panel.
2. Provide 16 AWG (1.5 mm), panel wire, type THHN/THWN stranded, and insulated for 600 volts minimum unless otherwise specified.

M. Wiring Methods

1. Grounding
   a. Individually connect ground wires for all surge protectors to a common ground.
   b. Run grounding wires with special care to provide the least possible resistance.
2. Wire Troughs
   a. Provide internal wiring troughs of the plastic, open-side type with snap-on covers.
   b. Wiring troughs shall not be filled to greater than 60% capacity. Provide snap-on covers marked to identify their locations.
3. Wire Path
   a. Group wiring within the panel according to function, and harness together, or place within ducts and secured to the panel structure.
   b. Remote instrument power shall not be commingled with panel power for other panel devices.

c. Power and low-level signal wires shall be routed in separate wireways or harnesses. Crossings of the two system's wires shall be at right angles. Parallel runs of the two system's wires shall be separated by a minimum of 12 inches.

d. Partition intrinsically safe wiring separately from all other wiring. Provide a protective cover with labeling to cover the intrinsically safe wires.

4. Wire colors shall be assigned as follows:

a.	AC Power	Black
b.	AC Neutral or Common	White
c.	AC Control	Red
d.	DC Control	Blue
e.	Equipment or Panel Ground	Green
f.	Externally Powered Circuits	Yellow

5. Wire connectors shall be the hook-fork type, with non-insulated barrel to allow easy inspection of crimp integrity.

N. Signal Management

1. Design all instrumentation equipment to operate on 24VDC, except as specifically noted. Provide power supplies, regulators, and constant-voltage transformers to allow compliance with the above.

2. Provide electronic type solid-state instrumentation utilizing linear transmission signals of 4-20mADC, (milliampere direct current), except as specifically noted.

3. Provide 4-20mADC outputs capable of driving a 750 ohm load from all transmitters, controllers, and signal processing devices. Inputs to controllers, recorders, indicators, signal processing devices shall be 4-20mADC.

4. Convert nonstandard signals into compatible standard signals at their source. Zero based signals are not acceptable.

5. Direct interlock of equipment without auxiliary relaying shall not be allowed.

6. For all signals to be transferred to/from another panel, provide current isolators (analog) or dry relay contacts (discrete) wired out to terminal blocks.

O. Operator Interface Terminal (OIT)

1. The OIT shall match the standards established in Contract 2019-02.

P. Programmable Logic Controller (PLC)

1. The PLC shall be Allen Bradley CompactLogix to coordinate with the client’s standard.

Q. Uninterruptible Power Supply (PLC)

1. Provide UPS system such that upon failure of the UPS feeder, batteries provided with UPS immediately take over as the power source.

2. Provide external bypass switch with three circuit breakers Make-Before-Break system. Provide bypass to isolate the UPS equipment for maintenance. Provide bypass with switch test so the switch may be tested without the risk of dropping the load caused by static switch failure.

3. Provide static transfer switch to transfer load upon loss of power at the output of the UPS.

4. Provide UPS sizing documentations in the shop drawing submittal. UPS shall supply power to PLCs, RIOs, SCADA severs, Thin Client nodes, network communications equipment workstations and field instruments. Provide sizing documentations analysis which are based on required load plus minimum of 10% spare capacity.

5. Provide space and all necessary connections for UPS to be located within PLC cabinet.

6. Manufacturer's: Eaton, Best, Sola, APC, or equal.

2.03 - NETWORK COMPONENTS

A. Provide a managed industrial Ethernet switch with at least four (4) ports, installed with the panel in order to connect the panel to the plant SCADA system. Managed Ethernet switch shall be Allen Bradley Stratix 8000 or approved equal.

B. CAT6 CABLE:

1. Provide twisted-pair cable, connectors and appurtenances that make up the copper CAT6 cable segments.

2. Cable segments shall meet the requirements of the TIA/EIA-568-B specification for Category Six (CAT6), Unshielded Twisted Pair (UTP) cable.

3. Cable Segments shall meet or exceed the following minimum requirements:

a. The cable shall be tested up to 200 MHz with a guaranteed performance that meets or exceeds the ANSI/TIA/EIA-568B/ISO/IEC 11801 horizontal cable requirements for PS-NEXT, attenuation, structural return loss, and attenuation-to-crosstalk ratio (ACR).

b. The cable shall be constructed from 0.54mm (24AWG), bare copper wire insulated, UTP, UL/NEC CMR rated, with a white, gray, blue or yellow plenum-rated PVC jacket. Two insulated conductors twisted together to form a pair and four pairs laid up to form the basic unit.

c. The cable shall be jacketed in flame-retardant PVC. Cable run in conduit shall meet or exceed FT4 rating. Cable not run in conduit shall meet or exceed FT6 rating.

d. Cable jacketing shall be lead-free. Cable shall be supplied on wooden reels or in reel-in-box. Cable shall be UL listed under file number E138034. CAT6.

C. Provide radio in accordance with radio path survey. Provide Yagi Antenna TELEWAVE ANT220Y7-WR or approved equal. Coordinate antenna height with radio path survey. Provide CalAMP Viper SC+200 radio modem or approved equal. Provide hardware, cabling and accessories to connect the radio antenna to the associated PLC.

D. Provide all other networking equipment to create networks indicated and specified.

2.04 - SPARE PARTS AND TEST EQUIPMENT

A. Spare Parts:

1. Provide spare parts of the type and quantity as specified herein or as specified with the equipment in Attachment A.

2. Spare parts equal to at least 25% of the field replaceable system components (minimum of two) shall be supplied.

3. Provide the following as at a minimum:

a. 1 - PLC processor unit

b. 1 – Redundancy unit

c. 1 – Analog input card of each type provided

d. 1 – Analog output cards of each type provided

e. 1 – Digital input cards of each type provided

f. 1 – Digital output cards of each type provided

g. 1 - PLC power supplies

h. 1 – 24VDC power supplies of each type provided

4. All spare parts shall be carefully packed in cartons, labeled with indelible markings, and suitable for prolonged storage. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which part is to be used shall be supplied with the required parts. The spare parts shall be delivered and stored in a location by the Owner.

5. Provide an itemized price list of the delivered spares for the purchase of additional components. Prices shall be honored for a period of one year from substantial completion of the system.

2.05 - SHOP TESTING

A. Conduct a Witnessed Shop Test (WST) that will be attended by the System Integrator and may be attended by the Engineer and/or Owner.

B. The equipment supplier, prior to the WST, shall make the completed control panel and a work space available to the System Integrator to upload and test the programming, configuration files and SCADA system operation. Coordinate time requirements with the System Integrator.

C. Coordinate the shop testing with the Contractor, System Integrator, Owner and Engineer.

1. Notify the Owner in writing that the system is ready for the WFT and allow the Owner to schedule a test date within 21 days of receipt of the "Ready To Test" letter.

2. At the time of notification, submit any revisions to the detailed test procedure previously approved by the Owner/Engineer.

D. The following documentation shall be made available to the Owner and/or Engineer at the test site both before and during the WST:

1. All drawings and specifications, addenda and change orders and approved shop drawings.

2. Master copy of the test procedure.

E. Test Procedure:

1. Provide a shop test plan outlining the procedures for testing all the panels at the factory prior to shipment. This plan shall demonstrate the system performs as specified and as indicated.

2. All tests shall be conducted in accordance with prior Owner and Engineer approved procedures, forms and checklist.

3. Test procedure shall include a checklist of items to be confirmed by the testing.

4. Submit the shop test plan prior to the shop testing for review as specified.

5. Each specific test to be performed shall be described and a space provided after it for sign off by the appropriate party after its satisfactory completion.

6. All test data and procedures followed during testing shall be logged, and certified copies of the logs shall be provided to the Engineer and Owner.

7. Copies of these signed off test procedures forms and checklists will constitute the required test documentation.

F. The WST shall include:

1. All panels, consoles and assemblies shall be inspected and tested to verify that they are in conformance with related shop drawing submittal, and these specifications and contract documents.

2. Prior to the WST all equipment shall be set up and allowed to operate for at least five days continuously trouble free to verify the system is capable of continuous operation.

3. To perform the shop test, the entire PLC and SCADA network shall be assembled in the shop. All panels shall be networked with the network switches to be used in the field. In addition, to demonstrate its operation with the control panels, the SCADA system shall be set up including the SCADA server, thin client server and historian.

4. For each type of networked discrete instrument provide an example transmitter, wire it into the appropriate PLC panel to demonstrate its operation.

5. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of monitoring devices/functions and control devices/functions.

6. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide an approved means of simulation. Define these simulation techniques in the test procedures.

7. Provide all special testing materials and equipment including all temporary cables including fiber optic and copper network cable, necessary to connect all control system components including communication components for use during factory testing.

8. Perform a check of all I/O to the interface terminal blocks and verification of all communications networks.

    a. Test the functionality of each selector switch and push-button.

    b. Test the functionality of each indicator light and annunciator point.

    c. I/O verification includes confirming accurate signaling at each analog indicator, recorder controller and PLC at zero, ten, fifty, ninety, and one hundred percent of range.

    d. I/O verification includes testing each digital signal at its zero and one state.

    e. Each test shall be in the cause and effect format. Initiate an input (cause) upon the system or subsystem producing the correct result (effect). When the correct effect is observed the specific test requirement will have been satisfied.

    f. The System Integrator shall test each communications network link using an Engineer-approved test configuration to verify successful completion of required communications paths including: sending data to and receiving data from a PLC, (PC to PLC communications), sending data to and receiving data from another PLC or control system (PLC or control system to PLC communications), sending data to and receiving data from another PC (PC to PC communications), and sending data to all printers.

G. WST Identified Deficiencies:

1. All deficiencies identified during these tests shall be corrected and retested prior to completion of the WST as determined by the Owner and/or Engineer.

2. The Engineer and Owner reserves the right to test or retest all specified functions whether or not explicitly stated in the prior approved Test Procedures without additional cost.

3. The Owner’s decision shall be final regarding the acceptability and completeness of all testing.

4. No equipment shall be shipped until the Owner has received all test results and approved the system is ready for shipment.

PART 3 - EXECUTION

3.01 - GENERAL INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer's printed instructions and approved shop drawings.

B. All work shall be executed in full accordance with codes and these contract documents. Should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and at no additional cost to the Owner.

C. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as indicated on the Electrical Drawings for the locations.

3.02 - CONTROL PANEL INSTALLATION

A. As part of the installation process the equipment manufacturer shall provide a field technician to support this activity and as necessary to successfully complete the installation.

B. Once installed, remove lifting rings from cabinets/assemblies. Permanent plugs shall be provided for the holes of the same material and color as the cabinet.

C. For installation of fiber optic cable within control panels or control assemblies, follow cable manufacturer's specification for bend radius. Use cable breakout assembly as recommended by the cable manufacturer. Provide wire basket, strain relief to meet manufacturer's strain requirements.

3.03 - FIELD TESTING

A. Provide field start up and testing in accordance with Specification SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM – GENERAL.

B. As part of the start-up and testing process described in Specification SECTION 13331, CONTROL SYSTEM INTEGRATION, the equipment manufacturer shall provide a field technician to support this activity and as necessary to successfully complete the specified testing.

C. The Owner's and/or Engineer's decision shall be final regarding the acceptability and completeness of all testing.

3.04 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, QUALITY ASSURANCE.

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SECTION 14300

HOISTING EQUIPMENT

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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of the flush mounted base for the davit crane as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide and test hoisting equipment, motors, gear reducers, controls and appurtenances as indicated and in compliance with Contract Documents.

1. Rail and supporting beams included in building structure, refer to structural drawings.

2. Hoist capacities and operating data are indicated in the Hoisting Schedule.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the previously provided costs for the addition of the one Portable Davit Crane Base and therefore, shall be utilized to cover the cost of the discrepancy between the Shop Drawing and this section.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data regarding hoisting equipment characteristics and performance:
2. Operating and maintenance instructions and parts lists.
3. Listing of reference installations as specified with contact names and telephone numbers.
4. Qualifications of field service engineer.
5. Recommendations for short and long-term storage.
6. Shop and field testing procedures, equipment to be used.
7. Number of service person-days provided and per diem field service rate.
8. Manufacturer’s product data, specifications and color charts for shop painting.
9. The latest ISO 9001 series certification.
10. Provide Certificate of Responsibility and Certificate of Design. See SECTION 01300, SUBMITTALS for Certificate Forms.
11. Material Certification:

a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

D. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

E. Hoists shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

F. Welding: In accordance with American Welding Society Code D1.1.

G. Provide shop tests as specified.

H. Hoisting equipment manufacturer shall provide hoists, motors, gear reducers, switches, and controls regardless of manufacturer as a complete integrated package to ensure coordination, compatibility and operation of the systems.

I. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

J. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping and electrical:

a. 2 person-days.

3. Functional Testing: Calibrate, check alignment and perform a functional test. Tests to include all items specified.

a. 2 person-days.

4. Performance Testing: Field performance test equipment specified.

a. 2 person-days.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

a. 1 person-days.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer’s published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

K. Manufacturer of hoisting equipment shall have a minimum of five (5) operating installations with hoists of the size specified and in the same service as specified operating for not less than five (5) years.

1.07 - REFERENCES

A. American Bearing Manufacturers Association (ABMA):

1. 9: Load Ratings and Fatigue Life for Ball Bearings.

2. 11: Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of mechanical Engineers (ASME):

1. B30.16: Overhead Hoists (Underhung) Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

C. American Welding Society (AWS):

1. D1.1: Structural Welding Code Aluminum.

D. National Electric Code (NEC).

E. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

F. Occupational Safety and Hazard Association (OSHA):

1. 29 CFR 1910.179: Overhead and Gantry Cranes.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 – MANUFACTURERS

A. The Owner has standardized on Portable Davit Crane Base as manufactured by Thern.

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - SYSTEM DESCRIPTION

A. Hoisting equipment capacities and operating data are indicated in the Hoist Schedule.

2.03 - SEISMIC DESIGN REQUIREMENTS

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

2.04 - PORTABLE DAVIT (DAV.HST-1)

A. Portable davit crane flush mounting base. The crane to be capable of rotating 360 degrees. The boom shall telescope to four indexed positions, boom height shall be capable of adjustment under load, and crane shall be capable of being taken apart for storage or transport.

B. Provide flush bases as indicated on the Mechanical Process drawings. Provide a plastic cap for each base.

1. Mount each base with 316 stainless steel anchors.

C. Materials:

2. Base: Type 316 stainless steel

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

3.02 - INSTALLATION

A. Install items in accordance with manufacturer's printed instructions and as indicated and specified.

B. Check horizontal and vertical alignment of track and rails.

C. Erect rack level throughout, with section ends machined fitted and spliced with web-type couplings to provide flush level connections. Maximum gap between adjacent ends not exceeding 1/16-inch.

D. Do not use cast fittings.

3.03 - PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions and as specified.

C. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

D. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

E. After installation and testing, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.05 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein.

3.06 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided as specified herein.

3.07 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.08 - SPARE PARTS

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

3.09 - FIELD TESTING

A. Provide as specified herein. Perform all tests with instrumentation controls and motor controls. Perform testing in accordance with OSHA 29 CFR 1910.179 and as specified herein.

B. After installation of hoist equipment, and after inspection, operation, testing and adjustment have been completed by manufacturer's field service technician, conduct test for each hoist in presence of the Engineer to determine its ability to operate at rated speeds and capacity under conditions specified and indicated. During tests, observe and record, capacity and motor inputs. Promptly correct or replace all equipment not conforming to the requirements of this section revealed by or noted during tests, at no additional cost to the Owner, and repeat tests until specified results are obtained. Contractor to provide all labor, weights and materials for conducting tests.

1. Provide a 60-minute test for each hoist.

2. Running test shall consist of moving hoist and trolley through two complete cycles. The first cycle will be with no load. For the second cycle, the unit will be loaded with 100 percent of the specified load rating.

3. Test and simulate all limit switches, locking and safety devices.

C. Make all adjustments to place equipment in specified working order at time of above tests.

D. After three (3) unsuccessful testing attempts, remove and replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated.

3.10 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 15056

PIPE SUPPORTS

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PART 1 – GENERAL

1.01 - SCOPE

A. Attention is directed to the DOCUMENT 00700. GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

B. Design, and provide a complete system of pipe supports with inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, sliding Teflon plates, and accessories as indicated and in compliance with Contract Documents. The term pipe support includes hangers, guides, restraints, anchors and saddles.

C. Provide all support systems and the design of all support systems for all piping as specified herein. The Contractor shall provide pipe support locations, configurations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein.

D. The Contractor shall be responsible for the proper design, fabrication, location, shop drawings and installation of all temporary and permanent pipe supports in accordance with the specified requirements.

E. Pipe support locations and types for piping 1/2-inch and larger shall be determined by the Contractor using the guidelines for support spacing specified herein and other criteria contained in this pipe support specification. Guidelines for pipe supports may need to be adjusted based upon field coordination, field routing, or other considerations outlined herein such as structural load limits. The Contractor may revise the pipe support locations and details through accepted shop drawing submittals stamped by a Registered Professional Engineer as specified herein. The Contractor is responsible for the proper design, installation and fabrication of all pipe supports in accordance with the specified requirements. For pipe supports 1/2-inch and larger pipe support shop drawings together with a marked up piping drawing showing support number, location and typical type shall be submitted by the Contractor for acceptance.

F. The Contractor shall be responsible for coordinating all pipe support designs for all trades to ensure compliance with all of the requirements of this specification, including but not limited to the total limitations specified herein.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and paymet for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Pipe support drawings specified herein and including data for accessory items for acceptance prior to fabrication. The Contractor shall submit pipe support coordination drawings including all piping and pipe supports for all trades.

    a. Detailed drawing of the device with dimensions.

    b. A table of applied forces and moments.

    c. A complete bill of materials.

    d. A unique identification and revision level.

    e. Stamp of a Registered Professional Engineer, registered in the state where this project is being constructed, experienced in pipe support design and pipe stress analysis as specified herein.

    f. Detailed connections to existing structure.

    g. Indicate all welds, both shop and field, by Standard Units of Measurement as specified in AWS D1.1.

2. Welding Procedure: Submit description required to illustrate each welding procedure to be performed in the specified work.

3. Welding Equipment: Submit descriptive data for welding equipment, including type, voltage and amperage.

4. Qualification for Welders: Provide certification that welders to be employed in work have satisfactorily passed AWS or ASME qualification tests. If recertification of welders is required, retesting is the Contractor's responsibility at no additional cost to the Owner.

5. Pipe support manufacturers' qualifications as specified herein.

    a. List of at least five (5) successful pipe support projects and current addresses and telephone numbers of persons in charge of representing the owner or the owner of those construction projects during the time of pipe support design, fabrication and installation.

    b. Qualification of manufacturers' Registered Professional Engineer, registered in the state where this project is being constructed, who stamps and seals shop drawings and designs.

6. Coordination drawings for pipe supports shall include as a minimum the following information.

    a. Coordination drawings shall include all pipe supports covered by specifications.

    b. These coordination drawings will be used by the Contractor to ensure that the pipe supports do not obstruct access, access for equipment operation or removal including all mechanical and electrical equipment, panels, valves, gauges, and instrumentation.

    c. The Contractor shall be responsible for including and coordinating the work of all subcontractors into the coordination drawings.

    d. Prepare reproducible coordination drawings, indicating equipment, piping, valves, expansion joints, ductwork, conduit, cable trays, junction boxes, lighting fixtures, sleeves, inserts, embedments, supports, hangers and appurtenances at not less than 1/4-inch scale. Drawings shall show beams, columns, ceiling heights, wall, floors, partitions and structural features as indicated on the contract drawings. Individual pipes and conduit 2-inches or less in diameter that will be field routed need not be shown on coordination drawings.

    e. Coordination drawings shall include large-scale details as well as cross and longitudinal sections required to fully delineate all conditions. Particular attention shall be given to the location, size, and clearance dimensions of equipment items, shafts, operators and necessary maintenance access.

f. Make all minor changes in duct, pipe or conduit routings that do not affect the intended function, but items may not be resized or exposed items relocated without the approval of the Owner. No changes shall be made in any wall locations, ceiling heights, door swings or locations, window or other openings or other features affecting the function or aesthetic effect of the building. If conflicts or interferences cannot be resolved, the Owner shall be notified. Any problems of coordination that require architectural or structural changes of design shall be submitted to the Owner for resolution.

g. After the reproducible drawings have been coordinated and all changes have been made, the drawings shall be signed by the Contractor and all subcontractors indicating that all work on that drawing has been coordinated with all associated vendors and subcontractors and all conflicts have been resolved.

h. Relocation of any duct, pipe, conduit or other material that has been installed without proper coordination among all trades shall be performed at no additional cost to the Owner.

7. Written notification of any deviations from the requirements of this specification.

8. Support documentation and justification as specified.

9. Certificates of Design signed by a Registered Professional Engineer for all pipe supports.

10. Manufacturer's product data and specifications for shop painting.

11. Material Certification:

a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

12. A copy of the contract mechanical process, and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

a. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

b. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

c. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

d. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 - PRODUCT HANDLING

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

1.06 - DESIGN CRITERIA

A. Design criteria as specified herein.

1.07 - QUALITY ASSURANCE

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Welder Qualifications:

1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

D. Pipe supports: All supports and parts shall conform to the latest requirements of the Code for Pressure Piping ASME/ANSI B31.1 and Manufactures Standardization Society (MSS) Standard Practice SP-58, SP-69, SP-89 and SP-90 except as supplemented or modified by the requirements of this specification.

E. Structural Concrete: Conform to the requirements of SECTION 03300, CAST-IN-PLACE CONCRETE. Concrete strength: 4,000 PSI unless noted otherwise.

F. Conform to the requirements of the latest edition of the AISC Manual of Steel Construction for miscellaneous and supplementary steel. Tube steels are ASTM A500 Grade B, structural shapes A36, plates A-572 or equal. Stainless steel structural members shall conform to ASTM requirement Type 316L.

G. Pipe Support Manufacturer Qualifications:

1. Must possess a written quality assurance program.

2. Have a minimum of 5 years experience in the design and fabrication of pipe supports.

3. Have completed the design and fabrication of at least 5 successful pipe support projects of equal size, complexity, and systems as this project within the past 10 years.

4. Retains the services of a Registered Professional Engineer, registered in the state where this project is being constructed, with a minimum of ten years experience in the design of piping systems and pipe supports.

5. Manufacturers' Standardization Society (MSS) Member.

6. Have a field service technician on staff with at least 5 years experience in resolving field installation, interference and interface problems associated with the design, installation and manufacture of pipe supporting components.

H. Hanger inspections shall be performed in accordance with MSS-SP-89 and ASME B31.1.

1.08 - WARRANTY – Not Used

1.09 - REFERENCES

A. The American Society of Mechanical Engineers (AMSE):

1. B31.1: Power Piping.

B. ASTM International (ASTM):

1. A36: Standard Specification for Carbon Structural Steel

2. A307: Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

3. A312: Seamless and Welded Austenic Stainless Steel Pipe

4. A500: Cold Formed Welded and Seamless Carbon Steel Structural Tubing.

5. A572: Specification for Steel Plate.

6. E165: Practice for Liquid Penetrant Inspection Method.

7. E709: Practice for Magnetic Particle Examination.

C. American Welding Society (AWS):

1. D1.1: Structural Welding

D. Canadian Standards Association (CSA):

1. 40.20: General Requirements for Rolled or Welded Structural Quality Steel

2. 40.21: Structural Quality Steel
3. Welding Procedure Specifications.

E. Fluid Sealing Association: Technical Handbook.

F. Manufacturers' Standardization Society (MSS):

1. SP-58: Pipe Hangers and Supports - Materials and Design.
2. SP-69: Pipe Hangers and Supports - Selection and Application.
3. SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices.
4. SP-90: Guidelines on Terminology for Pipe Hangers and Supports.

G. National Association of Expansion Joint Manufacturers: Standards of the Expansion Joint Manufacturers Association, Inc.

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - MATERIALS

A. Provide materials used in pipe supports, which are compatible with the pipes to which they are attached. Provide Type 316L stainless steel supports for all stainless steel piping. Copper plated pipe supports are not acceptable.

B. Allowable materials: As indicated in ANSI B31.1 Appendix A and MSS-SP-58 Table 2.

C. Provide Type 316L stainless steel for pipe supports, hangers, guides, restraints, and anchors that are exterior or interior submerged, in potentially wetted areas in wet wells, channels, tanks, and screening areas and in chemically corrosive atmospheres.

D. Provide only new material. Previously used and/or scrap material is not acceptable.

E. Provide tube steels that are ASTM A500 Grade B, Structural shapes A-36, plates A-572 or equal.

F. Provide sliding Teflon plates. The sliding surfaces shall be a nominal 3/8-inches glass filled Teflon bonded to stainless steel backup plate with a 10 gauge minimum thickness. The bearing pad upper and lower units shall be as follows: Conslide Type CSA elements as manufactured by Con-Serv. Inc., Balco TFE Slide Bearing Plates 10N-cs as manufactured by Balco Inc., or Dynalon Slide Bearings as manufactured by JVI, Inc. or acceptable equivalent product.

1. The blended TFE material used for this bearing shall be composed of virgin (unreprocessed) TFE resin tested per ASTM D1457 and reinforcing agents milled glass fibers. This structural material shall have the following representative mechanical and physical properties:
2. Tensile strength -2,000 psi.
3. Elongation –225 percent
4. Specific Gravity -2.17 to 2.22
5. The coefficient of friction shall average 0.06 under compressive load of 2,000 psi .
6. The compressive creep shall be a minimum of 2 percent at 2,000 psi and 70 degrees F.
7. The elements shall be flat, clean and prepared for installation in the structure. Slots and holes shall be fabricated in the bearing manufacturer's plant.

G. Concrete anchor bolts - Hilti Kwik-Bolt II Stud Anchors, Rawl Bolt, Phillips Wedge Anchors, or equal.

2.02 - DESIGN, LOCATION, AND TYPE OF PIPE SUPPORTS

A. Design and provide pipe supports for piping 1/2-inch and larger to include the following loads:

1. Gravity Force: This force includes the weight of pipe, pipe contents (hydro load), valves, in-line equipment, insulation and any other weight imposed on the piping and/or pipe support.

2. Thermal Expansion Force: This force is developed by the restraint of free end displacement of the piping due to thermal growth.

3. Hydrostatic/Dynamic Forces: These forces are developed due to the internal pressure (positive and negative) during operation of the piping system. These forces include the forces due to water hammer, pressure pulses due to rapid valve closure, fluid discharge resulting from pump startup, operation of positive displacement pumps, etc.

4. Wind Loadings: Wind loadings.

B. Provide supports, guides, anchors, flexible couplings and expansion joints in accordance with the coupling and joint manufacturers' specifications and requirements.

C. For all pump suction and discharge nozzles provide an anchor located between the pump nozzles and the nearest expansion joint or non-rigid coupling.

D. Where possible, provide pipe supports, which are the manufacturers' standard products.

1. Provide pipe supports with individual means of adjustment for alignment.

2. Provide pipe supports complete with appurtenances including locking and adjusting nuts.

3. Hanger rods shall be subjected to tension only.

4. Where lateral or axial pipe movement occurs, provide hangers for the necessary swing without exceeding 4 degrees. Provide base supports designed using pipe slides. The bearing surfaces: 0.06 coefficient of friction or less.

5. Provide concrete inserts capable of supporting the design loads.

6. Metal framing systems will be acceptable to support piping 2 inch and smaller.

7. Provide insulated piping supported using rigid load bearing insulation (baton board type) with 16 gauge shields to fit between the insulation and the support. Shields to encompass a minimum 1/3 of the pipe circumference and be 12 inch in length.

8. Provide load-bearing insulation capable of supporting the load, as a minimum on the bottom 60 degrees of the pipe support. Cope insulation and adjust to avoid interference of steel structures.

9. Provide supplementary steel as needed.

10. Do not support pipes from other pipe, conduits or metal stairs.

11. Chain, strap, T-bar, perforated bar and/or wire hangers are not acceptable.

12. Contact between piping and dissimilar metals such as hangers, building structural work or equipment subject to galvanic action is not acceptable.

13. All pipe supports located in fluid flow shall be supplied with double nutting.

E. Provide thrust anchors to resist thrust where required. Wall pipes may be used as thrust anchors if so designed. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes.

F. Provide expansion joints where indicated and where required based on Contractor's design of the pipe support system. Indicate expansion joints on submittal drawings.

G. For piping 2-inch and smaller provide manufacturer's standard supports and standard spacing guidelines

H. Pipe supports connected to structural framing and slabs are subject to the following limitations:

1. Less than 100 lb horizontal load per support.
2. For a maximum of one pipe support per footof slab width perpendicular to the span.
3. Piping not supported from floors by metal framing must meet the limitations as specified above.

I. All outside above ground supports shall be Type 316L stainless steel as specified herein.

J. Provide pipe supports that do not overload or over stress the piping, equipment, or structure that they are supporting or to which they are attached. Allowable pipe stress to be within ANSI B31.1 code allowable.

K. The Contractor shall provide the services of a field service technician (preferably from the pipe support manufacturer) to field coordinate the locations of supports and resolve interferences and conflicts encountered during installation.

2.03 - FABRICATION

A. Provide pipe supports formed in accordance with paragraph 5.1 of MSS-SP-58.

B. Providing welding in accordance with Structural Welding Code.

C. Provide dimensional tolerances as specified in MSS-SP-89.

D. Provide threading and tapping in accordance with MSS-SP-89.

2.04 - SHOP PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Install items in accordance with manufacturers' printed instructions and as indicated and specified herein.

B. Perform welding in accordance with Structural Welding Code:

1. Visually inspect welding while the operators are making the welds and again after the work is completed in accordance with AWS D1.1 Section 6.0. After the welding is completed, hand or power wire brush welds, and clean them before the Qualified Inspector makes the check inspection. The Qualified Inspector shall inspect welds with magnifiers under light for surface cracking, porosity, and slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size and insufficient throat and concavity. The Qualified Inspector shall inspect the preparation of grove welds for throat opening and for snug positioning for back-up bars.
2. Nondestructive evaluation of welds connecting structural steel members subjected to critical stresses: Perform in accordance with the weld quality and standards of acceptance in AWS D1.1.
3. Magnetic Particle Inspection: Perform in accordance with ASTM E709.
4. Liquid Penetrant Inspection: Perform in accordance with ASTM E165.
5. For weld areas containing defects exceeding the standards of acceptance in accordance with AWS D1.1, Section 3.7. Provide additional testing of the repaired area at no additional cost to the Owner.
6. Test Locations: As selected by the Owner.
7. Correct any deficiencies detected as directed by the Engineer at no additional cost to the Owner.

C. Proceed with the installation of the pipe supports only after required building structural work has been completed and concrete support structure has reached its 28-day compressive strength as specified in SECTION 03300, CAST-IN-PLACE CONCRETE.

D. Install pipe supports to comply with MSS-SP-89. Group parallel runs of horizontal piping to be supported together on trapeze type hangers.

E. Install pipe supports to provide indicated pipe slopes. Do not exceed maximum pipe deflection allowed by ANSI B31.1.

F. For exposed continuous pipe runs, install pipe supports of same type and style as installed for adjacent similar piping.

G. Install pipe supports to allow controlled movement of piping systems. Permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Piping to be free to move when it expands or contracts except where fixed anchors are indicated or required by the Contractor's pipe support systems. Where hanger rod swing length cannot be provided or where pipe movement based on expansion of 1 inch/100 feet, for each 100 degrees F change in temperature exceed 1/2-inch, provide sliding supports.

I. Prevent contact between dissimilar metals. Where concrete or metal support is used, place 1/8-inch thick Teflon, neoprene rubber, or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and pipe support.

J. Prevent electrolysis in support of copper tubing by use of pipe supports which are plastic coated. Electrician's tape is not an acceptable isolation method.

K. Apply an anti-seize compound to nuts and bolts on all pipe supports.

L. Locate reinforcing steel in concrete structure with x-ray prior to drilling for embedment plates and anchor bolts. Avoid contact or interference with reinforcing steel.

3.02 – PAINTING

A. After installation, paint Pipe Supports in accrodacne with SECTION 09941, FIELD PAINTING.

3.03 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.04 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein.

3.05 - MANUFACTURER'S TRAINING – Not Used

3.06 - LUBRICATION REQUIREMENTS – Not Used

3.07 - SPARE PARTS – Not Used

3.08 - INSTALLATION OF BUILDING ATTACHMENTS

A. Support piping from structural framing, unless otherwise indicated.

B. Concrete Inserts:

1. Use existing embedded concrete items whenever possible.

2. Use expansion anchors only when existing embedded attachment points are not available or unsuitable. Attach to hardened concrete or completed masonry.

3.09 - THRUST ANCHORS AND GUIDES

A. Thrust Anchors:

1. Center thrust anchors between expansion joints and between elbows and expansion joints for suspended piping. Anchors must hold pipe rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and to preclude separation of joints.

2. Restraining rod size and number shall be as indicated and adhere to manufacturers recommendations as a minimum.

B. Pipe guides: Provide adjacent to sliding expansion joints in accordance with recommendations of the National Association of Expansion Joint Manufacturers and the specific joint manufacturer.

3.10 - PIPE SUPPORTS

A. Where piping of various sizes is to be supported together, space supports for the largest pipe size and install intermediate supports for smaller diameter pipes.

B. Provide minimum of two pipe supports for each pipe piece.

C. Where pipe connects to equipment, support pipe independently from the equipment. Do not use equipment to support piping.

D. Provide pipe supports so that there is no interference with maintenance or removal of equipment.

E. Unless otherwise indicated or authorized by the Engineer, place piping running parallel to walls approximately 1-1/2 inch out from face of wall and at least 3 inches below ceiling.

F. Pedestal pipe supports: adjustable with stanchion, saddle, and anchoring flange. Provide grout between baseplate and floor.

G. Piping supports for vertical piping passing through floor sleeves: use hot dipped galvanized steel riser clamps.

H. Support piping to prevent strain on valves, fittings, and equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise indicated. Do not install pipe supports in equipment access areas or bridge crane runs.

I. Stacked horizontal runs of piping along walls may be supported by metal framing system attached to concrete insert channels.

J. Do not support piping from other piping.

K. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized whenever possible.

L. Whenever possible, pipe attachments for horizontal piping shall be pipe clamps.

M. All rigid rod hangers shall provide a means of vertical adjustment after erection.

N. Where the piping system is subjected to shock loads, such as disturbances due to pump discharge or thrust due to actuation of safety valves, hanger design shall include provisions for rigid restraints or shock absorbing devices.

O. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated suitable linkage shall be provided to permit rod swing.

P. Hanger spacing shall not exceed the spacing listed below:

1. In the case of concentrated loads the supports shall be placed as close as possible to the load to reduce the bending stress.

2. Where changes in direction of the piping system occur between supports, the total length between supports shall be kept to less than three-fourths of the full span. When practical, a support shall be placed immediately adjacent to any change in direction of the piping system.

Q. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to the riser piping shall be riser clamp shear lugs. Welded attachments shall be of material comparable to that of the piping, and designed in accordance with governing codes. If friction is relied upon to support riser piping proper justification and documentation shall be submitted to ensure that enough friction force is provided to resist the applied loading.

R. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.

S. All threads shall be UNC unless otherwise specified.

T. TFE slide bearing plates with steel backup plates shall be stitch weld attachments to the structure. A 1/8-inch fillet weld, 1/2-inch long every 3 inches on center each side of an element shall be used unless otherwise indicated or specified by the manufacturers' written recommendations. Bearing elements with slots or holes shall be stitch welded in place for location. The TFE surfaces of the bearings shall be maintained clean and free from grit, dirt or grease.

3.11 - INSULATED PIPING

A. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.

B. Where vapor barriers are indicated on water piping, install coated protective shields.

3.12 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 15066

STAINLESS STEEL PIPE AND FITTINGS

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PART 1 – GENERAL

1.01 - SCOPE

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

B. Provide and test stainless steel pipe, fittings and appurtenances as indicated and in compliance with Contract Documents.

C. Pipe and fittings 2-1/2 inch and larger are included in this specification, for pipe and fittings 2 inch and smaller provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Pipe manufacturer’s technical specification and product data.
2. Certified shop and erection drawings. Contractor shall submit electronic files of the piping layout including the following.
    a. Pipe layouts in full detail.
    b. Location of hangers and supports.
    c. Location and type of anchors.
    d. Location of couplings and expansion joints.
    e. 1/2-inch = 1 foot-0 inches scale details of all wall penetrations and fabricated fittings or special fittings.
    f. Schedules of pipe, fittings, expansion joints and other appurtenances.
3. Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed with appropriate standard.
4. Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.
5. Submit reports required for welding certifications per ASME B31.1 paragraph 127.6.

6. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.

7. Material Certification:

   a. Provide certification from the piping and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

   b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

8. A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

   a. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

   b. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

   c. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

   d. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 - PRODUCT HANDLING

A. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

B. During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

1.06 - DESIGN CRITERIA

A. The design conditions for the equipment specified in this section are indicated on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE and as specified.

B. Provide manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

C. Welder Qualifications:

   1. Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

D. Job Conditions:

   1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

1.08 - WARRANTY – NOT USED

1.09 - REFERENCES

A. American Society of Mechanical Engineers (AMSE):

1. B31.1: Power Piping.

B. ASTM International (ASTM):

1. A240: Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
2. A380: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.
3. A530: Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
4. A774: Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
5. A778: Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

C. Fluid Sealing Association: Technical Handbook.

D. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - STAINLESS STEEL PIPE

A. Manufacturers:

1. Douglas Brothers
2. Felker
3. J.F. Ahern
4. Dixie Southern

B. Material:

1. Type 316L sheet and plate per ASTM A240.
2. Maximum carbon content of 316L material limited to 0.03 percent.
3. Finish: 2D.

C. Fabrication:

1. Fabricate in accordance with ASTM A778 in NPS sizes shown with dimensional tolerances per ASTM A530.
2. Perform welding by qualified welders conforming to standard procedures. Weld piping with wall thickness up to 11 gauge, 0.125-inch, with the TIG (GTAW) process. Properly bevel heavier walls and use a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process.
3. Add filler wire of ELC grades to all welds to provide a cross section at the weld equal to or greater than the parent metal. Distribute smooth and evenly weld deposit and provide a crown of no more than 1/16-inch on the I.D. and 3/32-inch on the O.D. of the piping.
4. Concavity, undercut, cracks or crevices are not acceptable.
5. Butt Welds: Full penetration to the interior surface, with inert gas shielding provided to the interior and exterior of the joint.
6. Remove excessive weld deposits, slag, spatter, and projections by grinding.
7. Continuously weld angle face rings on both sides to the pipe or fitting.
8. Grind all welds on gasket surfaces smooth.
9. Contour pipe branches, taps and bosses to the radius of the main pipe run and bevel and weld with full penetration. No projections to the inside of the branch or main run are acceptable. Provide a smooth transition from ID of run to ID of branch.

10. Wire-brush inside and outside weld areas with brushes of stainless steel that are specifically designed to be used only on stainless steel.

11. After manufacture, passivate stainless steel pipe, fittings, and appurtenances by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid. Temperature and detention time to be sufficient for removal of oxidation and ferrous contamination without more than superficial etch of surface. Perform a complete neutralizing operation by immersion in a trisodium phosphate rinse followed by clean water wash. Perform in accordance with ASTM A380.

12. After fabrication, either passivate by immersion (see above paragraph) or scrub interior and exterior of welds with same solution or pickling paste and stainless steel wire brushes to remove weld discoloration and then neutralize and wash clean. Perform in accordance with ASTM A380.

13. Perform all welding in the shop. Field welding is not acceptable. If field welding is allowed for certain circumstances, the Contractor shall submit the welders qualifications and an acceptable method of cleaning the pipe and fittings for review prior to start of any field welding.

14. Fittings: Butt weld type manufactured in accordance with ASTM A774 of the same raw material and in the same thicknesses as the pipe. Socket weld fittings are not acceptable. Elbows up to 24-inch diameter: Provide smooth flow-die formed, long radius; with centerline to end of elbow equal to 1.5 times the nominal pipe size.

15. Fabricate tees and branch connections true and square with wall thickness same as pipe.

16. Reducers evenly tapered with tangent ends for butt weld connection. Reducers may be straight tapered cone construction.

17. Secure flanges to pipe ends and plug openings prior to shipment.

D. Design:

1. Stainless steel pipe: Nominal pipe size diameter pipe fabricated of stainless steel sheets having the following Schedule, U.S.S. gauges and plate thickness:

Nominal Pipe Size inches	Actual O.D. inches	Schedule/Gauge/Plate	Nominal Wall Thickness inches
2.5	2.875	SCH 5S or 10S	0.083
3	3.500	SCH 5S or 10S	0.083
4	4.500	SCH 5S or 10S	0.083
6	6.625	SCH 5S or 10S	0.109
8	8.625	SCH 5S or 10S	0.109
10	10.750	12 Ga. Sheet	0.109
12	12.750	12 Ga. Sheet	0.109
14	14.000	11 Ga. Sheet	0.125
16	16.000	11 Ga. Sheet	0.125
18	18.000	11 Ga. Sheet	0.125
20	20.000	10 Ga. Sheet	0.140
24	24.000	3/16 inch Plate	0.188

2. For buried piping use a minimum SCH 10S or as indicated in the Process Piping Schedule.

3. Joints: Flanged or, bolted split sleeve type couplings as indicated and specified. Split couplings requiring cut or roll grooving of the pipe not allowed unless specifically called for.

4. Flanged Joints: Van Stone back-up flange type, ANSI Class 150 lb. (PN10).

5. Provide stainless steel back-up flanges of the grade of pipe specified with the following thickness. Galvanized steel and ductile iron flanges are not acceptable.

Pipe Size, inches	Flange Thickness, inches
2.5, 3 and 4	0.375
6 and 8	0.500
10 to 18	0.750
20 and 24	0.750

6. Hardware: Type 316 stainless steel.
7. Fabricate flanged joint face rings fabricated of rolled stainless steel angles.
8. Use angle face rings with thickness equal to or greater than the wall of the pipe or fitting to which it is welded. Continuously weld on both sides to the pipe or fitting. Fabricate angle legs so as not to interfere with the flange bolt holes.
9. Isolate stainless steel flanges from all other ferrous metal connections at valves, flanges and equipment with flange insulating kit.
    a. Pipe Flange Insulating Kit:
        (1) Flange gasket: Type E, 1/8-inch thick NEMA Grade G-10 reinforced epoxy retainer with two seals of the following material:
            (a) Wastewater and Residuals: Nitrile.
            (b) Aeration Systems: EPDM.
        (2) Insulating sleeves: 1/32-inch thick NEMA Grade G-10, full length, one for each flange bolt.
        (3) Insulating washers: 1/8-inch thick NEMA Grade G-10, two for each flange bolt.
        (4) Mechanical washers: 1/8-inch thick Type 316 stainless steel, two for each flange bolt.
        (5) Manufacturers:
            (a) Trojan Insulating Gasket Advance Products and Systems.
            (b) Or equal.

2.02 - BOLTED SPLIT SLEEVE TYPE COUPLINGS

A. Provide stainless steel couplings in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

2.03 - EXPANSION JOINTS

A. Provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

2.04 - PIPE SUPPORTS

A. Provide in accordance with SECTION 15056, PIPE SUPPORTS.

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS – NOT USED

3.02 - INSTALLATION

A. Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.

B. Pitch piping toward low points. Provide for draining low points.

C. Before assembly, remove dirt and chips from inside pipe and fittings.

D. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped.

1. Except as otherwise specified, provide number and size of bolts conforming to same ANSI standards.

2. Provide Type 316 stainless steel hardware.

3. Provide ring gaskets of materials designed for the service specified and indicated, 1/16-inch thick gaskets.

4. Make up flanged joints tight with care being taken to prevent undue strain upon valves or other pieces of equipment.

5. Bolt threads must fully engage the nuts. At a minimum the bolt must be flush with the nut and no more than 1/2-inch excess thread protruding from the nut.

6. Provide insulating kits as specified herein.

3.03 - PAINTING – NOT USED

3.04 - CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.05 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein.

3.06 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided as specified herein

3.07 - LUBRICATION REQUIREMENTS – NOT USED

3.08 - SPARE PARTS – NOT USED

3.09 - FIELD TESTING

A. Clean off dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

B. Pressure and Leakage Tests:

1. Conduct combined pressure and leakage test in pipelines.

2. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.

3. Test when desired and comply with Engineer's orders and specifications.

4. Fill section of pipe with water and expel air.

5. Pressure and leakage test consists of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to test pressures indicated in the Process Pipe Schedule.

6. No visible leakage in joints.

7. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section failed to pass test.

8. If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.

9. Immediately upon completion of testing, drain and dry piping to remove all traces of water and condensation.

10. Modifications to test procedure only if permitted by Engineer.

3.09 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 15101

PROCESS VALVES AND APPURTENANCES

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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Process Valve and Appurtenances as specified and/or as shown on drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications

C. Provide and process valves and appurtenances as indicated and in compliance with Contract Documents.

1. Provide sizes and capacities as indicated or specified.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025 – MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Data, regarding valve characteristics and performance including Cv.

2. Shop drawing data for accessory items.

3. Manufacturer's literature as needed to supplement certified data.

4. Operating and maintenance instructions and parts lists.

5. Listing of reference installations as specified with contact names and telephone numbers.

6. Valve shop test results.

7. Qualifications of field service technician.

8. Shop and Field inspections reports.
9. List of recommended spare parts other than those specified.
10. Recommendations for short and long term storage.
11. Special tools.
12. Shop and field testing procedures and equipment to be used.
13. Number of service technician days provided and per diem field service rate.
14. Manufacturer’s product data and specifications for shop painting.
15. Provide a layout drawing, plan and section showing orientation of plug, gate, check, ball valves and actuators and nearest obstructions for each valve.
16. Manufacturer's product data and specifications for shop painting.
17. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.
18. The latest ISO 9001 series certification or quality system plan.
19. Material Certification:
    a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.
   1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
   2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specification and justification are resubmitted with the entire package.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer’s written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in Section 01610 and as specified.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

D. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

E. Provide enclosures for the area classifications specified and indicated.

F. Contractor responsible for verifying outside diameter of pipe to be tapped.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and specified herein.

H. Manufacturer of valve shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

I. If equipment proposed is heavier, taller, different laying length or requires more operating space than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.07 - REFERENCES

A. American Society of Mechanical Engineers (ASME)

1. B1.20.7: Hose Coupling Screw Threads.
2. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.
3. B16.4: Cast-Iron Threaded Fittings, Class 125 and 250.
4. B16.10: Face-to-Face and End-to-End Dimensions of Ferrous Valves.

B. ASTM International (ASTM)

1. A48: Standard Specification for Gray Iron Castings.
2. A126: Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
3. A536: Standard Specification for Ductile Iron Castings.

C. American Water Works Association (AWWA)

1. C500: Metal-Seated Gate Valves for Water Supply Service.
2. C504: Rubber-Seated Butterfly Valves.
3. C509: Standard Specifications for Resilient-Seated Gate Valves for Water and Sewage Systems.
4. D102: Coating Steel Water-Storage Tanks.

D. NSF International (NSF)

1. 61: Drinking water system components Health effects

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - MATERIALS

2.01 - ECCENTRIC PLUG VALVES

A. Manufacturers:

1. DeZurik.
2. Val-Matic.
3. Omni Valve

B. Type: Non-lubricated, eccentric.

C. Body Working Pressure

1. Cast Iron, ASTM A126 Class B or Ductile Iron, ASTM A536, Grade 64-45-12.

a. Valves 4-inch through 12-inch: 175 psi.

D. Ends

1. Grooved: ANSI/AWWA C606 for ductile iron valves.

2. Flanged: ANSI B16.1 Class 125 pound for cast iron valves.

3. Buried Valves: Mechanical Joint.

E. Valve Ports

1. Provide rectangular ported valves, circular ports are not acceptable.

2. All valves 100% port area.

F. Valve Seats

1. Coat plug with seat material specified. Bolted systems are not acceptable.

a. Seat Material:

(1) Neoprene or Buna-N synthetic rubber.

2. Provide valves with one piece coated plugs with mating seats of 90 percent, minimum, pure nickel 1/8-inch welded into the body of valves.

3. Provide valves with seats clamped to valve with mating seat of 90 percent, minimum, pure nickel welded to the valve body.

G. Upper and Lower Plug Journal Bearings

1. Removable, permanently lubricated stainless steel bushings for valves 20-inch and smaller.

2. Provide grit seals for upper and lower plug shafts for all valves.

H. Stem Seals

1. Adjustable multiple V-packing.

2. Replaceable and adjustable without valve disassembly.

3. Provide valves with two sets of packing rated for vacuum service for all pump suction isolation service and for services where a vacuum is specified and indicated.

I. Operators for Valves 4-inch and larger

1. Manually Operators

a. Gear operated with handwheels, levers are not acceptable.

b. Provide gear operators rated for bi-directional shutoff at the valve working pressure rating as specified herein.

c. Gear operators: Totally enclosed worm gear, traveling nut type is not acceptable. Provide permanently lubrication, watertight and dustproof, with adjustable open and closed stops and plug position indicator.

d. Provide all work gears designed and certified to withstand input loads up to 300-feet-pounds minimum at the stops without damage.

e. Buried or submerged valves: Provide watertight gear operator with handwheel operated floorstand where indicated. Gear operator to be totally enclosed and gasketed with Type 316 stainless steel hardware.

2. All buried valves to open clockwise.

J. Shop Testing

1. Provide all plug valves tested and certified bubble tight in both directions at the full rated working pressure as specified herein.

K. Shop Painting

1. Provide epoxy painting as specified herein.

2. Provide fusion bonded epoxy, 12 mils inside and out.

2.02 - RUBBER FLAPPER CHECK VALVES

A. Manufacturers

1. Val-Matic.

2. DeZurik APCO.

3. Crispin.

B. Materials

1. Body and Cover: Ductile Iron ASTM A536 Grade 65-42-12.

2. Rubber Flapper: Buna N 70 Durometer ASTM 2000-BG encapsulating an ASTM A36 steel plate.

3. Hinge Pin: AISI 1018.

C. Provide valves with a full pipe size flow area.

D. Provide valves 4-inch and larger capable of passing a 3-inch sphere.

E. Provide a threaded connection with bronze plug on cover and on the bottom of the valve.

F. Working Pressure

1. 2-inch through 24-inch: 250 psi.

2. 30-inch and 36-inch: 150 psi .

G. Ends: Flanged ANSI B16.1, Class 150.

H. Provide seating surface at a 45 degree angle such that the flapper travels a maximum of 35 degrees from full closed to full open position.

I. Provide valve with cover designed for removal of the valve internals without removing the valve from the pipeline.

J. Position Indicator

1. Provide a mechanical indicator to provide disc position for valves 4-inch (100 mm) and larger.

2. Provide the indication with continuous contact with the disc.

3. Provide a limit switch for remote indication of valve position. Provide limit switches in accordance with SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM - GENERAL.

K. Backflow Device

1. Provide a screw type rising stem backflow device located on the bottom of the check valves.

2. Provide a stainless steel T-handle device with bronzed bushings.

2.03 - DUCK BILL CHECK VALVES

A. Manufacturers

1. Proco
2. Tideflex
3. Flowrox
4. Wapro

B. Service

1. Process Drains:
    a. Material: EPDM.
        (1) Provide flanged or slip on type valve with Type 316 stainless steel clamps as indicated.
        (2) Provide inline type with flanged connection or insertable as indicated.

2.04 - EXTENSION STEMS

A. Provide where indicated and required for operation of all valves

B. Material:

1. Stems: Type 316L solid stainless steel bar or Schedule 40 Type 316L pipe
    a. Minimum Size: 1.25 inch (32 mm) diameter, Slenderness ration <200
2. Connectors, thrust relief assemblies, torque tube assemblies, universal joints and operating nuts: Type 316 or Type 316L stainless steel
3. Miter gears: Cast iron with 2 part epoxy coating

2.05 - STEM GUIDES

A. Manufacturer

1. Trumbull Industries.

B. Provide valve stem guides where indicated and as required by the valves manufacturer.

C. Stem Guide Spacing: 6 to 8 feet (1.8 to 2.5 metres), maximum slenderness ratio of 200.

D. Stem Guides for Stems 2-inch (50 mm) and Smaller:

1. Materials
    a. Stem Guide: Cast Type 316 stainless steel with 2 to 36 inch (50 to 900 mm) adjustment.
    b. Bushing: Bronze, NSF 61
    c. Hardware: Type 316 stainless steel.

E. Stem Guides for Stems 2-1/8-inch (54 mm) to 4 inch (100 mm):

1. Materials
    a. Stem Guide: Ductile Iron 65-45-12 with 2-3/4 to 17-1/4 inch (70 to 438 mm) adjustment.
    b. Bushing: Split type, Bronze, NSF 61
    c. Hardware: Type 316 stainless steel.

2.06 - FLOOR BOXES

A. Manufacturer

1. Trumbull Industries.

B. Provide position indicators installed on all multi-turn valves and quarter turn valves with gear boxes 3-inch and larger.

1. Type: Planetary gear design

C. Materials

1. Provide the sun gear, planet gear, ring gears, and scale plate constructed of Delrin.

2. Housings of carbon steel or aluminum are not acceptable.

3. Hardware and Fasteners: Type 316 stainless steel.

D. Position Indicator Design Features

1. Provide the position indication to show the position of the valve, from fully open to fully closed, identified at ground level.

2. Movement of the indicating arrow must be visible through a window covering a minimum of 300 degrees of the circumference of the indicator.

3. Size of the characters and numerals: minimum 3/16 inch.

4. Provide the top scale plate with markings representing the number of turns, contain the word “CLOSED”, and a directional arrow.

5. Provide permanently recessed, embossed or engraved markings in the scale plate. The use of adhesive labels is not acceptable.

6. Provide the “OPEN” line marked on a transparent polycarbonate window, field adjusted for the number of turns of each valve size.

7. Provide the position of the adjustable “OPEN” window secured to the top of the scale plate by the outside diameter of three Type 316 stainless button head cap screws.

8. Provide all adapters to secure the position indicator, for installation in either a valve box floor box or wall bracket as indicated and required.

9. Provide the position indicator and adapter with matching flat sides to prevent rotation of the indicator during operation.

E. Buried Valves

1. Provide the position indicator installed in a valve box within 6 inches of grade.

2.07 - SHOP PAINTING

A. Coat internal and external ferrous surfaces of valve with NSF Certified Epoxy in accordance with ANSI/NSF Std. 61, and in conformance to AWWA D102 Inside System No. 1 for all valves not specified to have a fusion bonded epoxy coating.

B. Process Valve Color: Red.

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

3.02 - INSTALLATION

A. Prior to installation, protect stored valves and appurtenances from damage due to exposure to sunlight, heat, dirt, debris, freezing and thawing, vandalism, etc.

B. Clean all debris, dirt, gravel, etc, from inside of piping before placing valves in place.

C. Erect and support valves in respective positions free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Clean out debris and foreign material from valve openings and seats, test operating mechanisms to check functioning, and check nuts and bolts for tightness. Repair, valves and other equipment which do not operate easily or are otherwise defective at no additional cost to the Owner.

D. Set plumb and support valves in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place. Install valves in control piping for access.

E. Provide bolted split sleeve coupling or flexible type grooved coupling on downstream side of buried valves to assist in valve removal.

F. Where indicated provide Type 316 stainless steel stem extension to operating floor elevation as shown and provide the bevel gear operator with a fabricated steel floorstand and handwheel.

3.03 - FIELD TOUCH-UP PAINTING

A. After installation and accepted testing, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 - CLEAN UP – NOT USED

3.05 - MANUFACTURER’S FIELD SERVICES

A. Manufacturer’s Field Services shall be provided as specified herein.

3.06 - MANUFACTURER’S TRAINING

A. Manufacturer’s training shall be provided as specified herein.

3.07 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.08 - SPARE PARTS

A. Comply with requirements specified in SECTION 01600, CONTROL OF MATERIALS.

3.09 - CHECK VALVES

A. Install swing check valves horizontally in pipelines unless otherwise indicated.

3.10 - PLUG VALVES

A. Install valves in horizontal piping with shaft horizontal such that in open position, plug is located in upper part of valve body. Orient valves so that in closed position, flow is against the face of the plug.

3.11 - FIELD TESTING

A. Pressure test valves with pipeline pressure testing.

B. Test functions of each valve.

C. Make all adjustments necessary to place valves in specified working order at time of above tests.

D. Remove all replace valves and appurtenances at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that valves will perform the service specified, indicated and as submitted and accepted.

3.12 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 15370

PROCESS PIPING AND APPURTENANCES

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Process Piping and Appurtenances as specified herein and/or as shown on the Contract Drawings.

B. Provide and test process piping and appurtenances as indicated and in compliance with Contract Documents.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit manufacturer's certificates of conformance.
2. Submit certified copies of test reports.
3. Piping layouts in full detail.
4. Location of pipe hangers and supports.
5. Large scale details of wall penetrations and fabricated fittings.
6. Schedules of all pipe, fittings, special castings, flexible connectors, adapters, couplings, expansion joints, and other appurtenances.
7. Reports as required for welding certifications per ASME B31.1 Paragraph 127.6.
8. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.

9. Grooved joint couplings and fittings: Provide product submittals with products specifically identified by the manufacturer's style or series designation.
10. Brochures and technical data on coatings and linings and proposed method for application and repair.
11. Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.
12. Shop drawing data for accessory items.
13. Manufacturer's literature as needed to supplement certified data.
14. Operating and maintenance instructions and parts lists.
15. Schematic control and power wiring diagrams.
16. Shop and Field inspections reports.
17. List of recommended spare parts other than those specified.
18. Recommendations for short and long term storage.
19. Special tools.
20. Shop and field testing procedures and equipment to be used.
21. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
22. The latest ISO 9001 series certification or quality system plan.
23. Material Certification:
    a. Provide certification from the piping and equipment manufacturers that the materials of construction specified are recommended and suitable for the service conditions specified and as indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified. And indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Authority.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.
24. A copy of the contract mechanical process, civil, structural, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".
25. Failure to include all drawings applicable to the equipment specified in this section will result in submittal return without review.
26. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.
27. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.
28. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specification and justification are resubmitted with the entire package.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Provide in accordance with SECTION 01610, DELIVERY, STORAGE AND HANDLING.

D. During loading, transportation and unloading, prevent damage to pipes and coatings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by Engineer. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to protect pipe, lining, and coating.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for equipment specified in this section are indicated on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Welder Qualifications:

1. Qualify and certify welding procedures, welders, and operators in accordance with ANSI B31.1, for shop and project site welding of piping work.

2. Qualification for welders: Welding shall be performed by welders holding current certification for the welding procedures in use.

3. Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds and clean them before the inspector makes the check inspection. Inspect welds for defects exceeding tolerances allowed by code under which the weld was made. Repair all defects exceeding tolerance.

B. Provide all grooved joint couplings, fittings, valves, and specialties to be the products of a single manufacturer. Grooving tools used must be of the same manufacturer as the grooved components.

1. Provide all castings used for coupling housings, fittings, and valve bodies date stamped for quality assurance and traceability.

C. Job Conditions:

1. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, and other equipment to be installed in piping system.

1.08 - REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. B16.1: AN Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800

2. B16.3: Malleable Iron Threaded Fittings Classes 150 and 300

3. B16.5: AN Standard for Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys

4. B16.9: Factory-Made Wrought Buttwelding Fittings

5. B31.1: Power Piping

B. ASTM International (ASTM):

1. A47: Standard Specification for Ferritic Malleable Iron Castings
2. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. A105: Standard Specification for Carbon Steel Forgings for Piping Applications
4. A139: Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
5. A181: Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
6. A193: Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
7. A194: Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
8. A197: Standard Specification for Cupola Malleable Iron
9. A216: Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
10. A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
11. A256: Standard Method of Compression Testing of Cast Iron
12. A269: Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
13. A278: Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F
14. A307: Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
15. A312: Seamless and Welded Austenic Stainless Steel Pipe
16. A351: Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
17. A449: Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
18. A536: Ductile Iron Castings
19. B62: Standard Specification for Composition Bronze or Ounce Metal Castings
20. C177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
21. C1136: Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
22. D256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
23. D570: Standard Test Method for Water Absorption of Plastics
24. D638: Standard Test Method for Tensile Properties of Plastics
25. D696: Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between-30 Degree C and 30 Degree C with a Vitreous Silica Dilatometer
26. D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
27. D792: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
28. D1330: Standard Specification for Rubber-Sheet Gaskets
29. D1457: Standard Specification for Polytetrafluoroethylene (PTFE) Molding and Extrusion Materials

30. D1599: Standard Test for Short-Time Rupture Strength of Plastic Pipe, Tubing and Fittings
31. D1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
32. D1785: Standard Specification for Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Plastic Pipe, Schedules 40, 80 and 120
33. D2000: Rubber Products in Automotive Applications
34. D2105: Standard Test for Longitudinal Tensile Properties of Reinforced Thermosetting Plastic Pipe and Tube
35. D2412: Standard Test for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
36. D2467: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
37. D2564: Standard Specification for Solvent Cements for Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Plastic Pipe and Fittings
38. D2855: Standard Practice for Making Solvent Cemented Joints with Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Pipe and Fittings
39. D2996: Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
40. D3035: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
41. D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
42. D5685: Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe Fittings
43. E84: Standard Test Method for Surface Burning Characteristics of Building Materials
44. F441: Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
45. F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
46. F1476: Standard Specification for the Performance of Gasketed Mechanical Couplings for Use In Piping Applications.

C. American Welding Society (AWS):
   1. B3.0: Welding Procedure and Performance Qualification

D. American Water Works Association (AWWA):
   1. C219: Bolted, Sleeve-Type Couplings for Plain-End Pipe
   2. C606: Grooved and Shouldered Joints

E. Expansion Joint Manufacturers Association Standards.

F. Fluid Sealing Association - Technical Handbook.

G. Manufacturer's Standardization Society (MSS):
   1. SP-67: Butterfly Valves
   2. SP-69: Pipe Hangers and Supports - Selection and Application

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - DUCTILE IRON PIPE AND FITTINGS

A. Provide in accordance with SECTION 02615, DUCTILE IRON PIPE AND FITTINGS.

2.02 - STAINLESS STEEL PIPE AND FITTINGS 2-1/2-INCH AND LARGER

A. Provide in accordance with SECTION 15066, STAINLESS STEEL PIPE AND FITTINGS.

2.03 - PVC PIPE AND FITTINGS

A. Schedule 80

B. Material: Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.

C. Provide pipe and fittings manufactured in compliance to ASTM D1785 meeting and/or exceeding the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

D. Provide pipe and fittings manufactured in the USA, using domestic materials, by an ISO 9002 certified manufacturer. Store all pipe shall be stored indoors after production at the manufacturing site until shipped from factory.

E. Provide standard lengths of pipe sizes 10-inch and larger beveled each end by the pipe manufacturer.

F. Provide pipe and fittings with the National Sanitation Foundation (NSF) seal of approval for potable water applications.

G. Joining:

1. Solvent cementing process.
2. Provide flanges at valves, pumps and equipment only or as indicated and specified.
3. Provide Type 316 stainless steel flange bolting and hardware for all piping system except sodium hypochorite use titanium.

2.04 - PRESSURE GAUGES

A. Gauges:

1. Non-liquid filled type.
2. Helical wound bourdon tube, Inconel X-750.
3. Welded parts: Type 316 stainless steel.
4. Bearings: Precision Sapphire Type.
5. 1/2-inch NPT bottom male thread connection.
6. Accuracy: 1/2 percent of scale range.
7. 4-1/2-inch diameter with ABS plastic case.
8. Provide external adjustment.
9. Pipe and Fittings: Schedule 5 Pressfit or Schedule 40 threaded or socket welded, Type 316L stainless steel.
10. Pump Discharge Gauges: Provide gauges with range to cover the normal operating range, above the pump shutoff head and the range of pressures that will result from flushing.

B. Pipe and fittings: Type 316L stainless steel, provide as specified herein.

C. Ball valves: General service stainless steel ball valves in accordance with Section.

D. Pressure Sensor Rings:

1. 1-inch and Larger: Provide sensor/isolators that fit inside the bolt circle of 150-lb (Class 150) or 300-lb (Class 300) ANSI flanges as required.

2. 3/4-inch and Smaller: Provide sensor/isolators full flange or threaded as specified and indicated. For chemical system provide full flange, threaded connections are not acceptable.
3. Face to face length of the sensor: Conform to Specification MSS-SP67.
4. Type: Flow through design with flexible sleeve around full circumference. The center section shall have a cavity behind the sleeve filled with silicone fluid to transfer pressure to the gauge.
5. Rigidly support all pressure instruments by a post at least 7/8 inch diameter welded to the isolator. On sensor rings with more than one instrument, provide all connections 1/2-inch NPT as a minimum, 1/4-inch NPT fittings are not acceptable.
6. Provide sensor/isolator rings that do not have any fill plugs or valves that can be inadvertently removed with the resultant loss of fill fluid. Pressure sensor/isolators using valves are not acceptable.
7. Provide liquid filled sensor/isolators permanently vacuum sealed at the factory with a modular seal consisting of a membrane and needle fitting to allow removal and replacement of pressure instruments without compromising the vacuum fill. Sensor/isolators using valves are not acceptable.
8. Provide the needle fitting with both 1/4-inch NPT(F) threads and 1/2-inch NPT(M) threads.
9. Provide the pressure sensor/isolator capable of operating under pressure with all pressure instruments removed with no loss of fill fluid and without the need for isolating valves.
10. Attach pressure instruments to the isolator with a hand tightened lock ring.
11. It shall be possible to remove or attach pressure instruments to the isolator without requiring the use of any tools.
12. Permanently fill the pressure sensor with high viscosity silicone instrument oil to damp out surges or pressure spikes without the requirement for a separate snubber.
13. Pressure rating: 200 psi minimum for all lines tested at 150 psi or less and 600 psi minimum per lines tested above 150 psi.
14. Provide gauges as specified herein. Provide all other types of instruments indicated and specified in accordance with Section13300.
15. Materials:
    a. Pressure sensor/isolator rings: Provide materials suitable for the service conditions specified and indicated, as a minimum provide the following

Service	Body & Plates	Sleeve
Water	Type 316L Stainless Steel	Natural Rubber
Wastewater	Type 316L Stainless Steel	Natural Rubber

2.05 - PRESSURE AND FLOW INSTRUMENTATION

A. Provide in accordance with SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM - GENERAL.

2.06 - COUPLINGS-SLEEVE TYPE

A. Manufacturers:
   1. Romac
   2. Smith Blair
   3. Viking Johnson
   4. Dresser

B. Provide couplings meeting AWWA C219

C. Couplings 12-inch and smaller:

1. End rings and center rings: ASTM A536 ductile iron, fusion bonded epoxy coated
2. Gaskets: Buna-N, NSF 61 approved
3. Hardware: Type 316 stainless steel

D. Couplings 14-inch and larger:

1. End rings and center rings: ASTM A36 steel, fusion bonded epoxy coated
2. Gaskets: Buna-N, NSF 61 approved
3. Hardware: Type 316 stainless steel

E. Bridles and tierods: Minimum 3/4-inch diameter, except where tierods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges.

1. Provide as indicated

2.07 - WALL AND FLOOR SLEEVES

A. Materials:

1. Floor Sleeves:
   a. Schedule 40 Galvanized steel ASTM A53 GRB
2. Wall Sleeves Between a Dry Area and a Wet Area (Tank, Channel etc)
   a. Schedule 40 Type 316L stainless steel
3. Wall Sleeves Between Dry Area or Between Dry Area and Ground
   a. Schedule 40 Galvanized steel ASTM A53 GRB

B. Water Stops: Provide water stops welded on both sides. Provide water stops 1/4-inch thick and 2-inch high and centered on the wall thickness.

C. Provide modular, mechanical type seals, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

D. Provide the elastomeric elements sized and selected per manufacturer's recommendations and have the following properties as designated by ASTM. Coloration shall be throughout elastomer for positive field inspection. Each link shall have a permanent identification of the size and manufacturer's name molded into it.

E. Temperature Range: -40 to +250 degrees F.

1. Material: EPDM, ATSM D2000 M3 BA510
2. Color: Black

F. Modular seal pressure plates: Molded of glass reinforced Nylon Polymer with the following properties:

1. Izod Impact – Notched: 2.05ft-lb/in. per ASTM D256
2. Flexural Strength @ Yield: 30,750 psi per ASTM D790
3. Flexural Modulus: 1,124,000 psi ASTM D790
4. Elongation Break: 11.07 percent per ASTM D638
5. Specific Gravity:1.38 per ASTM D792

G. Hardware: Type 316 stainless steel.

2.08 - TRANSITION COUPLINGS

A. Provide coupling in accordance with AWWA C219 as specified herein

B. Sizes: 2-inch through 24-inch .

C. Materials:

1. End rings and center rings: Ductile iron ASTM A536.
2. Gaskets: Virgin Styrene Butadiene Rubber(SBR) suitable for potable water and wastewater service, ASTM D2000 MBA 710.
3. Provide 5/8-inch , Type 316 Stainless steel bolts and nuts

D. Working Pressure: 250 psi .

E. Lining and Coating: Fusion bonded epoxy in accordance with AWWA C213.

2.09 - DISMANTLING JOINTS

A. Materials:

1. Flanged Spool: AWWA Class D steel ring flange compatible with ANSI class 125 and 150 bolt circles. Provide pipe of ASTM A36 plate 1 percent cold expanded to size.
2. End Ring and Body: ASTM A36 steel
3. Gaskets: ASTM 2000 Virgin NBR suitable for wastewater service
4. Bolts and Nuts: Type 316 stainless steel
5. Tie Rods: Type 316 stainless steel

B. Assembly Tolerance: 3 inches

C. Coating: Fusion bonded epoxy, NSF 61 certified

D. Pressure Rating: 150 psi working pressure

E. Manufacturers

1. Romac
2. Viking Johnson

2.10 - SHOP PAINTING

A. Provide in accordance with SECTION 09940, SHOP PAINTING.

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

3.02 - INSTALLATION OF PIPE

A. Install pipelines parallel to building walls wherever possible. Install piping to lines and grades indicated and support. Where temporary supports are used, provide temporary supports as specified in SECTION 15056, PIPE SUPPORTS to prevent shifting or distortion of pipe. Provide for expansion.

B. Slope piping toward low points and provide for draining at low points.

C. Before assembly, remove debris from inside pipes and fittings.

D. Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth burrs. Make up flanged joints tight, and prevent strain upon valves or other pieces of equipment.

1. Bolt threads must fully engage the nuts. At a minimum the bolt must be flush with the nut and no more than 1/2-inch excess thread protruding from the nut.

E. Install grooved joints in accordance with the manufacturer's written recommendations.

1. Grooved ends: Clean and free from indentations, projections, or roll marks.

2. Gaskets: Molded and produced by the coupling manufacturer of an elastomer suitable for the service pecified and indicated.

3. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed.

F. Install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping system as indicated, and at changes in direction or other places to prevent joints from pulling apart under pressures indicated in the Process Pipe Schedule.

G. Examine pieces for damage. Do not install pieces that are damaged according to Engineer. If any damaged piece should be discovered after having been installed, remove and replace with a sound piece at no additional cost to the Authority.

H. Handle pipe with equipment such as nylon slings and padded skids, designed to prevent damage to the coating. Repair abrasions and injuries to the coating prior to the application of insulation or prior to the application of final field coating.

I. Support piping laid in trenches in trench on bed of selected backfill material which maintains desired line and grade.

J. Use dielectric bushings or unions when ferrous pipes join nonferrous pipes carrying liquid either underground or elsewhere.

K. Welding in accordance with AN Standard B31 and AWS B3.0.

3.03 - PAINTING

A. Provide in accordance with SECTION 09941, FIELD PAINTING.

3.04 - CLEAN UP

A. Prior to Start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.05 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein.

3.06 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided as specified herein.

3.07 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.08 - SPARE PARTS – Not Used

3.09 - WALL SLEEVE SEALS:

A. Expand rubber against pipe and sleeve by tightening bolts when assembled around pipe and inserted in wall.

3.10 - TEMPORARY PLUGS

A. Close open ends of pipe with temporary plugs or caps when pipe installation is not in progress. Use watertight plugs for exterior, buried piping and if water or debris is in trench when work is resumed, do not remove until adequate provision has been made to prevent any water or debris entering pipe even if it necessitates dewatering trench.

3.11 - PHYSICAL CHECKOUT, FIELD AND FUNCTIONAL TESTING

A. Clean dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

B. Water for testing provided by the Contractor.

C. Pressure and Leakage Tests:

1. Provide temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.

2. Test pipelines in sections of acceptable length.

3. Fill section of pipe with water and expel air.

4. Pressure and leakage test consists of first raising pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi numerically equal to test pressures indicated in the Process Pipe Schedule.

5. No visible leakage in joint is acceptable.

6. If unable to achieve and maintain specified pressure for one hour with no additional pumping, section has failed to pass test.

7. If section fails pressure and/or leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, and conduct additional tests and repairs until section passes test at no additional cost and without any time extensions.

D. Make piping connections to equipment with pipe in a free supported state and without application of vertical or horizontal forces to align piping with the equipment flanges.

E. Do not cover joints in underground piping with backfill material until piping has successfully passed pressure test.

F. Test pressures as indicated in Process Pipe Schedule.

G. Repair faulty joints even to extent of disassembling and remaking joint, remove defective pipe and fittings and replace in manner satisfactory to the Owner.

3.12 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 15855

FIBERGLASS REINFORCED PLASTIC DUCT, DAMPERS AND APPURTENANCES

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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Fiberglass Reinforced Plastic Duct Dampers and Appurtenances as specified and/or as shown on drawings.

B. Provide duct and dampers for odor abatement systems with all appurtenances to make it operable, as indicated and in compliance with Contract Documents.

C. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all the sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 – DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accoirdance with the provisions of the DOCUMENT 00700, GENEREAL CONDITIONS, and SECTION 01300, SUBMITTALS.

1. Submittals required under this section include, but are not limited to the following.

a. When the Contractor proposes tanks which requires an arrangement differing from that indicated on the drawings or specified, prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing all necessary changes and embodying all special features of the equipment he proposes to furnish. Make changes, if accepted at no additional cost to Owner.

b. Certified shop and working drawings. Drawings for the duct and dampers shall also include a complete description of the laminate construction as specified within this section and be accompanied by a detailed postcure procedure that will be utilized.

c. Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

d. Files shall include Tag Names, Parts List (identifying each component), Dimensions, and connection sizes.

e. Files shall be drawn to scale.

f. Drawings shall be in conformance with all other requirements as specified in this specification.

2. A letter from the resin supplier stating that the material used for this project will comply with the specification and meet all corrosion requirements.

3. Design calculations performed by the manufacturer and stamped by a Professional Engineer for record purposes.

4. Samples, representative of the ductwork, construction method and material used to be supplied on this project.

5. Schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references.

6. Manufacturer's literature and specifications. Show catalog dates.

7. Operating and maintenance instructions and parts list.

   a. In operating instructions incorporate a functional description of entire system including system schematics.

   b. In maintenance instructions, clearly define requirements for particular system and show special calibration and test procedures.

8. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.

9. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.

10. Four copies of manufacturer's recommended regeneration instructions, procedures and safety precautions. Provide detailed instructions for particular system as required.

11. List of 5 operating installations to demonstrate compliance with the requirements of Paragraph 1.07.H.

    a. Provide current (verified) contact information for each installation.

12. Paint manufacturer's product data and specifications indicated conformance to shop painting requirements specified including statement of compliance for compatibility.

13. Manufacturer's literature as needed to supplement certified data.

14. Two (2) sample cutouts demonstrating 100 mils (liner, and filament wound structural laminate. Samples to be a minimum of 8-inch diameter cut out, and a 12-inch diameter piece of duct at least 12 inches (300 mm) long complying with RTP-1 visual level I.

15. Copies of burial calculations for at least 3 sizes of duct between 12-inch and 48-inch .

16. Submit details of:

    a. Resin Type

    b. Types and amounts of filler

    c. Corrosion liner description

    d. Reinforcement types for hand lay-up or chopped laminates

e. For filament-wound laminates:

(1) Helix angle

(2) Glass content range

(3) Strand yield

(4) Strand by inch in the winding band

(5) Ply thickness

(6) Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate.

f. For all Fabricated parts:

(1) Construction type

(2) Laminate thickness

(3) Ply sequences

(4) Glass content range

g. For all secondary overlays (both interior and exterior):

(1) Laminate thickness

(2) Ply sequences and widths

(3) Construction details for all other special configurations and fabricated parts.

17. Shop test results.
18. Motor shop test results.
19. Qualifications of field service technician.
20. Schematic control and power wiring diagrams.
21. Shop and Field inspections reports.
22. List of recommended spare parts other than those specified.
23. Recommendations for short and long term storage.
24. Special tools.
25. Shop and field testing procedures and equipment to be used.
26. Number of service technician days provided and per diem field service rate.
27. Manufacturer’s product data, specifications, and color charts for shop painting.
28. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
29. The most recent ISO 9001 series certification.
30. Material Certification:

a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of three (3) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

31. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".

    a. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

32. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

    b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in rejection of the entire submittal with no further review and consideration.

1.05 - PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

1.06 - DESIGN CRITERIA

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Do work required by and in accordance with applicable State and local codes; arrange for permits, inspections and tests required by these codes; and provide complete systems ready for use. Provide tanks and accessories that conform to applicable safety standards including those for safety of personnel.

B. Provide components to manufacturer's standard for service intended unless otherwise required.

C. Provide components and accessories of manufacturers' latest and proven design.

D. The drawings and specifications direct attention to certain required features of the tanks, but do not purport to cover details entering into its design, construction and installation; nevertheless, provide tanks so that systems will be complete and ready for operation.

E. Provide field services as required for installation, with factory-trained technician to assist in determining location.

F. Coordinate the work schedule of other parts of the chemical systems manufacturer's service personnel during construction, testing, start-up, and acceptance, to coordinate with the tank manufacturer.

G. Upon completion of the installation, provide services of above serviceman for field testing.

H. Turn on no form of energy to any part of system prior to receipt by Engineer of certified statement of approval of installation from Contractor containing his supplier's authorization to energize system unless done by the supplier's servicemen may do so for purposes of checkout.

1.08 - REFERENCES

A. Air Movement and Control Association (AMCA):

1. 500D: Laboratory Methods of Testing Dampers for Rating.

B. American Society of Mechanical Engineers (ASME):

1. B-16.5: Pipe Flanges and Flanged Fillings NPS 1/2 Through NPS 24 Metric/Inch Standard.
2. RTP-1: Reinforced Thermoset Plastic Corrosion Resistant Equipment.

C. American Society for Testing and Materials (ASTM):

1. C582: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
2. D2310: Standard Classification for machine-Made “Fiberglass” Pipe.
3. D2412: Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
4. D2996: Standard Specification for Filament Wound “Fiberglass” (Glass Reinforced Thermosetting-Resin) Pipe.
5. D3567: Practice for Determining Dimensions of Fiberglass (Glass-Fiber Reinforced-Thermosetting-Resin) Pipe and Fittings.
6. D3982: Standard Specification for Contact Molded Fiberglass Duct and Hoods.
7. E84: Standard Test Method for Surface Burning Characteristics of Building Materials.

D. National Bureau of Standards (NBS):

1. PS 15: Custom Contact Molded Reinforced Chemical Resistant Process Equipment.

E. NSF International (NSF):

1. 61: Drinking Water System Components - Health Effects

F. Occupational Safety and Health Association (OSHA):

1. 29 CFR Part 1910.27: Fixed Ladder
2. 29 CFR Part 1926.104: Safety Belts, Life Lines and Lanyards
3. 29 CFR Part 1926.500: Fall Protection
4. 29 CFR Part 1926.501: Fall Protection
5. 29 CFR Part 1926.502: Fall Protection

G. Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA):

1. 1884: Fiberous Glass Duct Construction Standards.

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - FRP DUCT

A. Materials and Fabrication:

1. Type: Filament wound rated at design pressures as specified and indicated.
2. Minimum wall thickness, in accordance with SMACNA Table 5-7 and as specified:
    a. 2-inch through 14-inch: 0.145-inch.
    b. 16-inch through 22-inch: 0.180-inch.
    c. 24-inch through 30-inch: 0.220-inch.
    d. Wall thickness of the duct furnished shall not at any point be less than specified minimum wall thickness when measured in accordance with ASTM D3567.
    e. Rectangular ductwork thickness: As specified in SMACNA and as specified and indicated. In no case shall the rectangular duct thickness be less than substituting the long side of the rectangular duct for the round equivalent thickness.
3. Grade: Type 1, Grade 2 RTRP, Class E per ASTM D2310 and D2996.
4. Provide all ducts designed for not less than 20 inches water column pressure, and 15 inches water column vacuum.
5. The design, applicable construction, and inspections shall be in accordance with SMACNA, and visual inspection criteria in accordance with ASME RTP-1. Table 6, Visual Level II.
6. Provide a minimum structural safety factor of 4 in the design of all ducting.
7. Maximum deflection of rectangular ducts under deadload and operating conditions: Not to exceed 1 percent of the width of the longest side.
8. Resin: Hetron FR992, Derakane (Ashland Inc.) 510 or equal, selected to meet the exposures and temperatures of the air to be exhausted.
9. Minimum barcol hardness: 36.
10. Fillers other than antimony trioxide added for flame retardancy are not acceptable and should not exceed 5 percent by weight.
11. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer. No thixotropic agent is to be used in the corrosion liner or on surfaces to be in contact with the corrosive environment.
12. Flame spread rating: 25 or less per ASTM E84.
13. Catalyst: DHD9 or Hi-Point 90 per resin manufacturer.
14. Corrosion liner:
    a. Inner surface: One ply of 10 mils thick minimum C-glass surfacing veil saturated with vinylester resin.
    b. Provide the surface veil overlapped a minimum of 1 inch with two (2) layers of 1-1/2 oz./sq. ft. chopped strand mat following the surface veil layers.
    c. Corrosion liner is to gel completely before proceeding with structural laminates. In no case shall the interruption exceed 12 hours.
    d. Total liner thickness: 100 mils minimum.

e. No thixotropic agent or fire retardant additive is to be used in the liner resin.

f. Corrosion liner: Not less than 20 percent or more than 30 percent glass by weight.

g. Provide liner passing ASME RTP-1 Table 6, level II visual inspection. Total glass content 25 percent to 30 percent.

15. Structural layer: Filament wound of Hetron FR992, or Derakane 510 premium grade, vinylester resin and Type E 250 strand yield continuous glass roving.

a. Band width: 2.25 inches using (7) strands per inch.

b. Filament winding cycle thickness: 0.06 inches maximum.

c. Glass content 55 percent to 65 percent.

d. Winding angle: 65 degrees ± 2 degrees for increased vacuum service.

16. Provide the exterior of all laminates containing sufficient resin to insure a relatively smooth surface free from exposed glass fibers or sharp projections.

17. Provide an ultraviolet stabilizer added to the final coat of resin that also incorporates paraffinated wax curing elements.

18. Provide ductwork located outdoors with an exterior colored surface coat.

a. Color: White or as selected by Owner.

19. Provide ductwork located indoors with two (2) coats of PPG Speedhide 42-7 Intumescent paint to provide a class 1 flame and smoke rating.

20. ASTM E84 Steiner Tunnel test results shall be attached as part of the submittal packet.

21. Standard lengths: Provide in accordance with the manufacturers published product data sheets and accepted shop drawings.

22. Duct stiffness: Minimum rated stiffness in accordance with ASTM D2412 for the pipe laying conditions.

23. Markings on duct and spool pieces shall be in accordance with shop drawings.

2.02 - FITTINGS AND JOINTS

A. Fittings:

1. Hand-layup construction fabricated from the same resin and have the same strength as the FRP ductwork.

2. Internal diameter of all fittings: Equal to the adjacent duct.

3. Tolerance on angles of all fittings: +/- 1 degree for 24 inch diameter and smaller and +/- 1/2 degree for 30 inch diameter and larger.

B. Elbows:

1. Radius: 1.5 times the diameter.

2. 24-inch and smaller: Smooth radius.

3. 30-inch and larger: Mitered.

4. Bends 30 degrees and less: 1 miter, 2 piece

5. Bends 31 degrees to 60 degrees: 2 miter, 3 piece

6. Bends 61 degrees to 90 degrees: 4 miter, 5 piece

C. Turning Vanes:

1. Provide turning vanes and splitters at all single mitered bends 46 degrees and greater and similar fittings that are not one-piece smooth radius fittings per SMACNA standards.

2. Turning Vanes: Filament wound and reinforced with unidirectional glass, metallic vanes are not acceptable.

D. Flange Joints:

1. Provide flanged connections at flexible connectors, expansion joints, vessels, grease filters, fans, and other locations as indicated.

2. Flanges:

a. Hand lay-up construction with dimensions in accordance with NBS PS 15-69 and the Duct Dimension Schedule.

b. Flanges 24-inch and smaller: One piece integral, SMACNA Thermoset Duct construction manual and supplied undrilled for field drilling and alignment.

3. Flanges shall be drilled in accordance with NBS PS 15-69 -Table 2. acks of flange face shall be flat so that washer seats fully on bolt face and flange backing.

4. Flange Faces: Perpendicular to the axis of the duct within 1/2 degree.

5. Flange Faces: Flat to within +/- 1/32 inch for sizes 18-inch and smaller and flat within +/- 1/16 inch for sizes 20-inch and larger.

6. Gaskets: EPDM, full face, minimum 1/8-inch thick.

7. Hardware: Type 316 stainless steel.

E. Duct Joints:

1. Butt and wrap joint type connections.

2. Fittings: Butt and wrap joint type connections.

3. Apply adhesive material for field joining in rolls and resin containers no larger than five gallons.

4. Provide all joints per SMACNA standard, and per manufacturer’s laminate schedule and procedures.

2.03 - EXPANSION JOINTS

A. Expansion Joints:

1. Provide expansion joints where indicated and where required for flexibility and to accommodate the duct support system.

2. Provide flanged joints where connecting ductwork to vessels, grease filters, fans, equipment and other locations as indicated.

3. Provide slip-type joints where flanges joints are not specified or indicated.

4. Type: W-design configuration with integral flanges suitable for service with FRP duct under the conditions specified and indicated.

5. Material: EPDM

6. Backing Rings: 3/8-inch thick, 2 inches wide, Type 316 stainless steel.

7. Extension: 3 inches .

8. Compression: 2.5 inches .

9. Lateral Offset: 2.5 inches .

10. Thickness: 1/4-inch minimum.

11. Bolts, Nuts and Washers: Type 316 stainless steel.

B. Manufacturers:

1. RM-Holz (Holz Rubber Company, Inc.)
2. Metraflex, Inc.
3. Garlock (EnPro Industries)
4. Mercer Rubber Company

2.04 - DUCT DRAINS

A. Provide 1 inch minimum CPVC pipe and CPVC ball valve trapped duct drains on all low points in all main, branch and riser ducts to allow removal of condensate.

1. Provide piping in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and valves in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

B. For ducts located outdoors insulate the drains, trap and piping with 1-inch (25 mm) of insulation in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

2.05 - DAMPERS

A. Provide factory fabricated dampers conforming to AMCA 500D requirements and as specified.

B. Provide FRP dampers manufactured from the same materials and resin as specified for duct.

C. Materials and Construction:

1. Blades: Two (2) piece, molded including blade stiffeners. Provide damper blade offset 5 degrees in the closed position to form a normal stop.
2. Axle: Pultruded FRP made of the same resin as specified for the duct and continuous strand roving.
3. Control Shaft: Provide axle extending 6 inches (150 mm) beyond frame, full length vinylester with Type 316 stainless steel pins embedded transverse of axle.
4. Bearings: Molded PTFE with 10 percent carbon and graphite fill.
5. O-Rings: Viton.
6. Metallic parts in contact with the air stream are not acceptable.

D. Provide the following type of dampers for the service specified:

1. Balancing:
   a. Opposed multi-blade type.
2. Isolation:
   a. Butterfly type constructed of one gauge heavier than respective duct.
   b. Provide dampers equipped with full circumference extruded double tadpole blade seals.
   c. Butterfly damper leakage: Not to exceed 2.9 cfm/sq. ft. against 26 inches W.C.
3. Volume damper:
   a. Butterfly type, locking quadrant of same material as duct.

E. Provide manual dampers with lever type, locking quadrant operator Identified with OPEN and CLOSE positions.

F. Where indicated, provide electric motor operators as specified herein.

G. Dampers shall be of self-supporting construction and shall not deflect or deform while free standing.

H. Dampers shall have flanged ends for connection to ductwork and equipment.

I. Manual Operators:

1. Dampers 16-inch and larger: Provided gear operators with an epoxy coating.

2. Dampers 14-inch and smaller: Provide hand quadrant actuators fabricated of Type 316 stainless steel with a 5-stage locking quadrant indicator.

J. Balancing Dampers:

1. Manual: Provide a fully adjustable slot with an extra hole drilled in the handle for contractor to "drill and pin-in place" once system is balanced so handle cannot vibrate loose.

2. Electric: Provide as specified.

K. Chain wheel operators: Provide galvanized steel chainwheels with galvanized steel chain and chain guides for all dampers with operator or gear operators higher than 6.5 feet above operating floor level.

1. Provide chain that reaches to within 3 feet of the operating floor level.

2. For dampers with gear operator mount with chainwheel in the vertical position.

3. Provide in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

L. Electric Motor Actuators:

1. Provide in accordance with SECTION 15109, ELECTRIC MOTOR ACTUATORS AND APPURTENANCES.

2. For fan inlet service provide modulating actuators.

2.06 - AIR INLETS

A. Material compatible with ductwork system specified.

B. Provide Type 316L stainless steel wire mesh bird screen for all fresh air intakes.

C. Each air exhaust from each of the tanks shall have a volume damper as indicated and specified.

2.07 - DUCT SYSTEM SUPPORTS

A. Duct Support:

1. Provide supports for all ducts designed and furnished by the duct system supplier in accordance with SECTION 15056, PIPE SUPPORTS and as specified herein.

2. Provide hanger spacing as indicated in ASTM D3982.

3. Provide ductwork supported from structure by straps or rods. Provide Type 316L stainless steel angle iron brackets to support ducts where structure is not available.

4. For exterior duct, design and provide free standing duct supports to meet specified duct spacing requirements and specified loads.

5. Provide anchors, inserts or clamps to secure hangers to structures. Provide Type 316 stainless steel anchors, screws and bolts. Provide in accordance with manufacturers recommendations and Factory Mutual limitations and restrictions.

B. Provide all duct supports shall be designed to withstand seismic loads as indicated and specified.

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS – Not Used

3.02 - INSTALLATION

A. General:

1. Install ducts, dampers and appurtenances in accordance with manufacturer's recommendations.

2. Prior to installation, inspect each duct length and all fittings, flush clean of any debris or dust, and straightened, if not true. All duct and fittings shall be equally cleaned before assembly.

3. Provide all materials and equipment required.

3.03 - PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

D. After installation and accepted testing by the Engineer Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 - CLEAN UP

A. Prior to start-up and field testing all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleand from all equipment and concrete surfaces.

3.05 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein.

3.06 - MANUFACTURER'S TRAINING – Not Used

3.07 - LUBRICATIONS REQUIREMENTS- Not Used

3.08 - SPARE PARTS

A. Provide in accordance with SECTION 01600, CONTROL OF MATERIALS and as specified herein.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

C. Provide the following spare parts, all identical and interchangeable with similar parts installed in Work:

1. Two spare gaskets of all types, materials and sizes.

2. One (1) set of all special tools.

3.09 - DUCTWORK

A. Assemble per SMACNA, Standards as specified hereinbefore.

B. Do not exceed 6-feet spacing of hangers on horizontal ducts; 4-feet on vertical ducts.

C. Support ductwork from structure by 16-gauge straps. Use hanger material compatible with ducts; use angle brackets to support vertical ducts.

D. Use anchors, inserts or clamps to secure hangers to structures; use stainless steel anchors if drilled-in type are installed.

E. Install duct connections to masonry openings airtight. Pack the space between the sleeve and framed prepared opening and the duct and the duct insulation with mineral wool or other FM approved fire resistant material.

F. Flanged connections to equipment, 3-inch minimum length.

G. FRP ductwork:

1. Joints, finished joints in accordance with NBS PS 15-69 Standards.

3.10 - SYSTEM TESTING

A. Test at 1.5 times the system design pressure specified and indicated.

B. Determine leakage by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. All fixtures, devices, or other accessories connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

3.11 - SYSTEM BALANCING

A. Adjust manual and automatic control devices to balance air flows so they perform as indicated and specified.

B. Balance air systems so each outlet is within 10-percent and each fan is within 5-percent of values indicated.

C. Submit report to the Owner outlining balancing procedures used; report to include:

1. Type of measuring devices used.
2. Air quantities at each outlet, damper and fan.
3. Fan speeds.
4. Fan suction and discharge pressures.
5. Air quantities through fan, by test and by summation of air quantities at outlets.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Remove all replace equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

3.12 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 15857

ODOR CONTROL SYSTEMS – CARBON

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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes furnishing all labor, materials, tools and equipment necessary to provide Odor Control systems as specified and/or as shown on drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Provide carbon odor control systems as indicated and in compliance with Contract Documents.

D. Scope includes

1. Furnish, install and test an odor abatement system cable of handling and removing 99 percent of 25 PPM hydrogen sulfide and sewage vapors, complete, with all appurtenances to make it operable, as indicated and as specified.

2. Obtain all state, local or federal permits.

1.02 – MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the previously provided costs for the addition of the Odor Control System and therefore, shall be utilized to cover the cost of the discrepancy between the Shop Drawing and this section.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. When the Contractor proposes tanks which requires an arrangement differing from that indicated on the drawings or specified, prepare and submit for review detailed structural, mechanical, and electrical drawings and equipment lists, utilities consumption schedule and operating instructions, showing all necessary changes and embodying all special features of the equipment he proposes to furnish. Make changes, if accepted at no additional cost to Owner.

2. Certified shop and working drawings. Drawings for the vessels and fans shall also include a complete description of the laminate construction as specified within this section and be accompanied by a detailed postcure procedure that will be utilized.

   a. Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is Proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

   b. Files shall include Tag Names, Parts List (identifying each component), Dimensions, and connection sizes.

   c. Files shall be drawn to scale.

   d. Drawings shall be in conformance with all other requirements as specified in this specification.

3. The Contractor shall submit Certificates of Analysis from the activated carbon supplier indicating the proposed carbon meets the specifications. Test Reports on the representative samples of GAC shall contain the following information.

   a. Hydrogen sulfide (H_2S) capacity, (g/mL)

   b. Mesh size confirmation

   c. Moisture, (percent as packed)

4. Provide a written statement certifying that the sample of the carbon material is representative of the carbon media that will be shipped and installed under this contract.

5. Schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references.

6. Manufacturer’s literature and specifications. Show catalog dates.

7. Operating and maintenance instructions and parts list.

   a. In operating instructions incorporate a functional description of entire system including system schematics.

   b. In maintenance instructions, clearly define requirements for particular system and show special calibration and test procedures.

8. Clearly mark all drawings and data to show only items applicable to work. Show all data, nozzle schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details on all drawings.

9. Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittals sheets and shop drawings.

10. Four copies of manufacturer’s recommended regeneration instructions, procedures and safety precautions. Provide detailed instructions for particular system as required.

11. List of 5 operating installations of similar units. Provide current (verified) contact information for each installation.
12. Submit details of:
    a. Resin Type
    b. Types and amounts of filler
    c. Corrosion liner description
    d. Reinforcement types for hand lay-up or chopped laminates
13. Shop test results.
14. Motor shop test results.
15. Qualifications of field service technician.
16. Schematic control and power wiring diagrams.
17. Shop and Field inspections reports.
18. List of recommended spare parts other than those specified.
19. Recommendations for short and long term storage.
20. Special tools.
21. Shop and field testing procedures and equipment to be used.
22. Number of service technician days provided and per diem field service rate.
23. Manufacturer's product data, specifications, and color charts for shop painting.
24. Provide a listing of the materials recommended for service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and as indicated.
25. Material Certification:
    a. Provide certification from the manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of three (3) years. Provide proposed materials at no additional cost to the Owner.
    b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.
26. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".
    a. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.
27. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.
    a. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

b. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in rejection of the entire submittal with no further review and consideration.

1.05 – PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed according to the manufacturer's written recommendations.

B. The materials and equipment shall be stored on a flat, clean, dry surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.

C. Comply with the requirements specified in SECTION 01610, DELIVERY, STORAGE AND HANDLING.

1.06 – DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents.

B. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

C. The design conditions and other pertinent requirements for the equipment specified in this section are indicated on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Systems shall be the product of one manufacturer.

C. Systems shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Do work required by and in accordance with applicable State and local codes; arrange for permits, inspections and tests required by these codes; and provide complete systems ready for use. Provide tanks and accessories that conform to applicable safety standards including those for safety of personnel.

E. Provide components to manufacturer's standard for service specified and indicated unless otherwise required.

F. Provide components and accessories of manufacturers' latest and proven design.

G. Coordinate the work schedule of other parts of the chemical systems manufacturer's service personnel during construction, testing, start-up, and acceptance, to coordinate with the tank manufacturer.

H. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

I. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

2. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection - 1 person-day.

3. Functional Completion Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified – 1 person-day.

4. Field Performance Testing: Field performance test equipment specified – 1/2 person-day.

5. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions – 1/2 person-day.

6. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

7. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

J. Manufacturer of systems shall have a minimum of five (5) operating installations with an equal or greater flow rate of the size specified and in the same service as specified operating for not less than five (5) years.

K. If equipment proposed is heavier, larger, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.08 – REFERENCES

A. Air Movement and Control Association (AMCA):

1. 210 Test Code

2. 300 Test Code

3. 500D: Laboratory method for Testing Dampers for Rating.

B. American Society for Testing and Materials International (ASTM):

1. A36: Standard Specification for Carbon Structural Steel.

2. C582: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment

3. D2867: Standard Test Method for Moisture in Activated Carbon.

4. D3299: Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

5. D4097: Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

6. D4167: Standard Specification for Fiber-Reinforced Plastic Fans and Blowers

7. D5158: Standard Method for Determination of Particle Size of Powered Activated Carbon by Air Jet Sieving

8. D6646: Standard Test Method for Determination of the Accelerated Hydrogen Sulfide Breakthrough Capacity of Granular and Pelletized Activated Carbon

9. E84: Standard Test method for Surface Burning Characteristics of Building Materials.

C. Fiberglass Reinforced Plastics Institute, Inc. (FRPI):

1. Laminate Certification Manual.

D. National Bureau of Standards (NBS):

1. PS 15: Custom Contact Molded Reinforced Chemical Resistant Process Equipment.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.09 - SPECIAL TOOLS

A. Provide one 40-inch (1 meter) long grain sampler for obtaining carbon samples from adsorber vessel. Sampler to consist of two polished brass telescoping slotted tubes.

PART 2 - PRODUCTS

2.01 – MANUFACTURERS

A. The owner has standardized the Odor Control System as manufactured by Purafil Inc.

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 – ACTIVATED CARBON

A. Provide activated carbon to fill each reactor vessel.

B. The activated carbon shall be virgin, un-impregnated granular activated carbon, derived from bituminous, sub-bituminous or lignite coal.

C. The activated carbon shall be suitable for vapor phase adsorption of Hydrogen Sulfide and other odor causing compounds such as mercaptans typically found in vapors emitted by the wastewater treatment process.

D. Activated carbon shall conform to the following minimum requirements:

H2S breakthrough capacity (Per ASTM D6646)	g H2S removed/cc	0.2 minimum
Moisture (per ASTM D2867)	wt. percent	8 maximum
Mesh size (per ASTM D5158)		
Greater than 4 Mesh	percent	10 maximum
Less than 8 Mesh	percent	5 maximum

E. Submit a certificate certifying that the carbon meets the specified requirements.

2.03 – SEISMIC DESIGN REQUIREMENTS

A. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

B. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

C. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

D. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all compounds have been sized for the seismic forces specified and indicated.

2.04 - ADSORBER VESSEL

A. Provide carbon bed adsorber of polyethylene or HDPE.

B. Provide equipment suitable for continuous exposure to saturated hydrogen sulfide gas. Provide a certification from the resin manufacturer listing the nomenclature, composition, and characteristics of the resin supplied with the submittal data.

C. Equip adsorber with anchor pads, bolts, washers, and lifting lugs necessary for field erection. Anchor bolts and washers 316 stainless steel, 1/2-inch minimum bolt.

D. Provide three samples probes at 9-inch intervals below the top of each carbon, extending into the carbon bed 1 foot minimum. Probe sized for adequate extraction of air samples from the carbon bed and be nonblinding. Extend probes outside the vessels wall and blocked off with a ball valve and cap.

E. Carbon bed support system as recommended by the manufacturer.

2.05 - STATIC GROUNDING OF CARBON BED

A. Include provisions to adequately ground the carbon bed. Details should be submitted to demonstrate that the carbon bed will be adequately grounded. Provide stainless steel 2-hole ground pads at each vessel and associated grounding materials and hardware for connection to the system grounding grid.

2.06 - PVC DUCTWORK

A. Provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

2.07 - MOTORS

A. Provide in accordance with SECTION 01171, ELECTRIC MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of fans under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and speed: As indicated in the Fan Schedule.

D. Provide flex-coupled motors with base supports.

E. In addition to the requirements for bearings specified under Electric Motors in SECTION 01171, ELECTRIC MOTORS, provide motors with ball or roller bearings. Provide vertical motors with at least one bearing designed for thrust with bearings. Provide bearing with a minimum B-10 life of 100,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet 0.9 motors from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Service Factor: 1.15.

I. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

J. Rating: 460V, 3-phase, 60 Hertz.

K. Insulation: Class F with Class B temperature rise, 40 degrees C ambient.

L. Site Altitude: 3,300 feet above sea level.

2.08 - GASKETING AND SEALING

A. Flanged nozzles: Viton or hypalon full face gaskets of 50 to 60 Shore “A” Durometer hardness.

B. Fabricated gaskets: Machine-made or die-stamped with inside and outside edges parallel or concentric, as applicable. Make bolt holes oversized to prevent crimping of gasket when installed.

2.09 - CARBON ADSORBER ACCESSORIES

A. Overflow, and drain connections furnished with Schedule 80 CPVC pipe, fittings and ball valves. Provide clear PVC pipe for overflow.

B. Piping: Provide in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES.

C. Valves: Provide in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

D. Provide a Magnehelic differential pressure gauge installed on the housing to indicate differential pressure across each carbon bed. Tank mount with enclosure, calibrated in inches of water and column.

E. Blank flanges, material same as vessel, with bolts for air inlet connection.

F. Lifting and hold down lugs.

2.10 - CENTRIFUGAL FANS

A. Single-width, single-inlet, multiblade design, backward-inclined blades. Drive motor, fan and casing mounted on vessel lid.

1. Construct fan of aluminum with epoxy coating. Encase Type 316 stainless steel shaft in FRP sleeve.

2. Flanged inlet and outlet connections.

3. Provide a casing drain with ball valve and cap

4. Shaft Seal: Viton

5. Fan Shaft shall be ground and polished Type 316 stainless steel. Bearings shall be located in an enclosed drive compartment and shall be heavy-duty, self-aligning, with extended lube tubes for continuous service, with a minimum of 50,000 hrs. L10 life. A neoprene shaft seal shall be located where the shaft enters the inner bearing housing with a neoprene shaft slinger between the seal and wheel.

B. Fan Assembly:

1. Dynamically balanced and completely assembled at the factory prior to shipping. All fans shall meet balance requirements of the Acoustical Society of American Standards. Fan construction shall conform to ASTM Standard D4167 for fiber reinforced plastic fans and blowers. Fan performance shall be tested in an AMCA Registered Test Laboratory in accordance with AMCA 2010 Test Code for air performance and AMCA 300 Test Code for sound. Fans shall be licensed to bear the AMCA Certified Air Performance Rating Seal.

C. Accessories:

1. Provide electrical grounding of fan housing to motor frame.

2. Provide Type 316 stainless steel hardware.

D. Provide motors in conformance with Section 01171, ELECTRIC MOTORS and as specified and indicated.

2.11 - ENCLOSURE

A. Provide the enclosure of materials compatible with the environment in which it is operating and enclosing the entire fan assembly.

B. Fabricate the exterior of the enclosure of fiberglass or Type 316 stainless steel.

C. Provide an enclosure of unitized welded, bolted or screwed panel construction.

D. Access Covers:

1. Provide hinged access covers on all sides and top of the enclosure with lockable latches, locks and keys, 2 sets.

2. Checking, changing and adding lubricant to be capable of being performed without unmounting or removing enclosure and without the use of tools to open the enclosure.

E. Cooling and Insulation

1. Fabricate the enclosure to that the air is controlled and directed over the motor. Interior surface of the enclosure: 2-inch urethane foam with a protective film that is washable and free of perforations and/or materials that would accumulate oil and dust.

2. Provide air circulation fan and thermostat.

F. Provide the enclosure as an integral part of the blower assembly and if size permits ship the blower assembly with the enclosure mounted so that factory quality, as tested, shall be consistent with all units.

2.12 - SHOP PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

2.13 - INTERCONNECTING DUCTWORK

A. Provide the ductwork assembly and design compatible with the fan and vessel.

2.14 – CONTROL PANEL – Not Used.

2.15 - EQUIPMENT SCHEDULE

A. Carbon Adsorber

1. System Air Flow Capacity: 50 to 175 cfm (m^3/min)
2. Carbon Volume: 9.5 pounds
3. Number of Vessels: 1 per pump station
4. Number of Beds/Vessel: 2
5. Vessel Diameter: 24 inches
6. Vessel Overall Height: 54 inches
7. Vessel Pressure Drop at Design Flow Rate: 4 inches WC

B. Fans

1. Quantity: 1 per unit
2. Fan Rating: As indicated on Fan Schedule
3. Motor HP: As indicated on the Fan Schedule.
4. Motor Enclosure: Class 1 Div 2
5. Motor Speed: 1800 rpm
6. Drive Type: Direct

PART 3 - EXECUTION

3.01 - VERIFICATION OF CONDITIONS

A. Before the start of the work of this Section, verify that the project is ready for this work.

B. Verify that field measurements are as shown on approved shop drawings and/or manufacturer's instructions.

C. Verify that the equipment or material is in conformance with the approved shop drawings and specifications and resolve any deviations.

D. Notify subcontractors involved or affected by this work and coordinate the work with them.

3.02 - INSTALLATION

A. General

1. Install equipment and appurtenances in accordance with manufacturer’s recommendations.
2. Provide all materials and equipment required.

3.03 - PAINTING

A. After installation and approved testing by the Engineer. Contractor shall apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.04 – CLEAN UP

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.05 – MANUFACTURER’S FIELD SERVICES

A. Manufacturer’s Field Services shall be provided as specified herein.

3.06 – MANUFACTURER’S TRAINING

A. Manufacturer’s training shall be provided as specified herein.

3.07 – LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.08 - SPARE PARTS

A. Provide in accordance with SECTION 01600, CONTROL OF MATERIALS and as specified herein.

B. Furnish and deliver to Owner at site of Work the following spare parts, all identical and interchangeable with similar parts installed in Work:

1. One of each type pressure gauge, with diaphragm seals or plain, as necessary.

2. Two spare gaskets of all types, materials and sizes.

3. Complete set of replacement belts.

3.09 - ADSORBER

A. Install adsorber and all components in accordance with manufacturer's recommendations.

B. Install adsorber on a concrete pad as indicated on the drawings.

3.10 - FIELD AND FUNCTIONAL TESTING

A. After installation, perform all of the following full operational tests in presence of the Owner. Furnish all labor, materials and equipment required for such tests.

1. Adsorber Vessel:

a. Factory test with water to the height of the overflow or the straight side height of the vessel, greater amount. Submit test data.

b. The water level must be unchanged after 24 hours with no visible signs of leakage or wall deflection exceeding 1/4 percent of span.

2. Start-up:

a. Provide the services of a factory-trained service technician, certified by the manufacturer to service the type of equipment herein specified, to assist in start-up operation.

b. Tests to be performed consist of start-up and operation of entire system at design capacity, and verification of operation of drives and other components, without, overheating, leakage, cracking of parts, structural damage, jamming, binding, or other defects.

c. During tests, make observations of fan head, capacity, and motor input. Promptly correct or replace all equipment not conforming to the requirements of this section revealed by or noted during tests at no additional cost to the Owner.

3. In case of failure to demonstrate ability to function as indicated and specified, modify, rebuild or replace equipment or parts thereof at no additional cost to Owner, until equipment is in accordance with specifications. After three (3) unsuccessful test attempts, replace non-conforming equipment at no additional cost to the Owner. Repeat tests until specified requirements have been met, at no additional cost to the Owner.

3.11 - SYSTEM TESTING

A. Following the Owner approval of start-up results, provide services of an independent State qualified air testing laboratory to measure and report on efficiency and performance of the odor control system. Submit testing procedures of testing laboratory to the Owner at least 15 days prior to tests. Have manufacturer's service technician present during system testing.

3.12 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 16050

ELECTRICAL WORK – GENERAL

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide General Electric Work as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Description:

1. Provide operational systems for both normal and standby electric power systems, normal and emergency lighting systems, grounding systems, lightning protection systems, radio system and other specified systems, including the installation and wiring of miscellaneous equipment and devices. Perform all Work and testing as indicated and specified to provide operationally ready electrical systems.

2. Provide conduit, wiring and connections for power, motors, motor controllers, control devices, lighting, control panels, instrumentation and alarms and for equipment furnished by others as indicated on the Contract Drawings.

3. Provide temporary circuits, overcurrent devices, conduit and wiring, and other temporary electrical equipment required to complete the Work of Division 16.

4. Engage the services of an Independent Electrical Testing Firm to perform the field inspections, tests and adjustments specified in Section 16998.

5. Provide the services of a specialty firm to provide short circuit, coordination and Arc Flash analysis for the electrical distribution as specified herein.

6. Install all raceways and equipment to meet the seismic requirements of Section 01900. Raceways supports and equipment anchoring shall be provided as specified in Section 16110.

7. All electrically powered equipment and devices provided under other Sections are connected to electrical systems as part of the Electrical Work, as indicated. Provide all conduits, wiring and wiring terminations as indicated.

8. Provide all supervision, labor, materials, tools, test instruments or other equipment or services and expenses to test, adjust, set, calibrate, functionally and operationally check all Work and components of the various electrical systems and circuitry throughout the installation.

D. Provide set up, and maintain all derricks, hoisting machinery, staging, and planking and perform all hoisting required to complete the Electrical Work.

E. General Contractor to provide earth and rock excavation, backfill, concrete masonry, concrete reinforcement, and construction joints required for Electrical work.

F. Obtain all necessary permits required to complete the work of DIVISION 16 – ELECTRICAL WORK.

G. Related Work:
1. Division 1: General Requirements

2. Division 16: Electrical

3. The Diesel Generator System shall be supplied under SECTION 11398, DIESEL ENGINE-GENERATOR SET AND APPURTENANCES. Provide all conduit, wiring and terminations for system operation as indicated.

4. Provide conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators and control panels. Install vendor furnished cables specified under Specification SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM - GENERAL.

5. Provide conduits, wiring and terminations for power feeders for HVAC equipment provided under DIVISION 15, MECHANICAL and as shown on the electrical drawings.

6. Provide and install control stations shown on the electrical drawings local to equipment supplied under other divisions.

7. Provide and install safety disconnect switches shown on the electrical drawings local to equipment supplied under other divisions.

8. Motors shall be provided by the Contractor under SECTION 01171, ELECTRIC MOTORS. All associated conduit, wire and terminations of motors shall be provided under DIVISION 16, ELECTRICAL.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Shop Drawings and Data: Include manufacturer's drawings, bills of material, panel and equipment layouts, catalog data, schematics diagrams, interconnection diagrams, wiring diagrams and other documentary or descriptive information for each assembly submitted in one package.
    1. Bills of material: Include a numbered list of all components, with manufacturer's name, catalog number, rating, and other identification. Place item number or identification on all other drawings where item appears.
    2. Submit equipment installation instructions in separate submittals from other shop drawings.
    3. Mark shop drawings and data submitted showing only items applicable to specific contract.
    4. Make submission of drawings for those components where dimensions of equipment, location of conduit entrances, are required to facilitate construction in accordance with the construction schedule.
    5. Include one-line diagrams, schematic diagrams, wiring diagrams, control sequence diagrams, relay diagrams, and metering. Submit only completed drawings showing all local and remote devices associated with each item. Submit one complete package of shop drawings. Partial submittals will be returned without action.
    6. Submittal shall use project specific tags as indicated on Contract drawings. Generic tags shall not be accepted.
    7. Submit time-current characteristic curves for all circuit breakers and fuses.
    8. Submit instruction manuals for installation, operation, and maintenance of equipment, and parts list. Mark standard publications forming a part of this contract. Cross out, blank out, or otherwise delete non-applicable items. Submittals which do not clearly indicate items and features provided will be rejected.
    9. Install permanent nameplates on all devices or pieces of equipment for which use or identification is not readily apparent, such as starters, relays, contactors, pushbuttons, indicating lights, and switches. Make sure position of nameplates are readable after equipment installation.
    10. Provide services of the manufacturer's representative as specified in the applicable specification sections.
2. Submit inspection and testing forms for all electrical distribution equipment to be inspected and tested under this section.
3. Submit data sheets for the insulation resistance testing of conductors and equipment prior to performing operating testing. List all cables and equipment to be tested.
4. Provide space on data sheet forms to enter the results of testing, instruments used with serial numbers, and name of personnel performing testing. This data to be filled out during testing.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's

written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide operational systems for both normal and standby electric power systems, normal and emergency lighting systems, security systems, CCTV systems, grounding systems, electrical heat tracing, lightning protection systems, fire alarm systems, radio system and other specified systems, including the installation and wiring of miscellaneous equipment and devices. Perform all Work and testing as indicated and specified to provide operationally ready electrical systems.

1. Provide conduit, wiring and connections for power, motors, motor controllers, control devices, lighting, control panels, instrumentation and alarms and for equipment furnished by others as indicated on the Contract Drawings.

2. Provide temporary circuits, overcurrent devices, conduit and wiring, and other temporary electrical equipment required to complete the Work of DIVISION 16, ELECTRICAL. All other temporary electrical Work including site temporary power service shall be provided under SECTION 01500, TEMPORARY FACILITIES.

3. Disconnect and remove existing electrical systems indicated for demolition under this Contract.

4. Engage the services of an Independent Electrical Testing Firm to perform the field inspections, tests and adjustments specified in SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

5. Provide the services of a specialty firm to provide short circuit, coordination and Arc Flash analysis for the electrical distribution system in accordance with SECTION 16359, ELECTRIAL SYSTEM STUDIES.

6. Provide lightning protection, fire alarm, radio system and telephone systems as specified herein.

7. Install all raceways and equipment to meet the seismic requirements of SECTION 01900, SEISMIC REQUIREMENTS. Raceways supports and equipment anchoring shall be provided as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

8. All electrically powered equipment and devices provided under other Sections are connected to electrical systems as part of the Electrical Work, as indicated. Provide all conduits, wiring and wiring terminations as indicated.

9. Provide all supervision, labor, materials, tools, test instruments or other equipment or services and expenses to test, adjust, set, calibrate, functionally and operationally check all Work and components of the various electrical systems and circuitry throughout the installation.

D. Provide set up, and maintain all derricks, hoisting machinery, staging, and planking and perform all hoisting required to complete the Electrical Work.

E. General Contractor to provide earth and rock excavation, backfill, concrete masonry, concrete reinforcement, and construction joints required for Electrical work.

F. Obtain all necessary permits required to complete the work of DIVISION 16 – ELECTRICAL WORK.

1.07 - QUALITY ASSURANCE

A. Provide Quality Assurance in accordance with SECTION 01400, QUALITY ASSURANCE.

B. Install electrical Work in conformance with latest rules and requirements of National Fire Protection Associated Standard No. 70 (National Electrical Code) and the Massachusetts Electrical Code.

1.08 - REFERENCES

A. National Electrical Safety Code (NESC)

B. Occupational Safety and Health Administration (OSHA)

1. OSHA Part 1910; Subpart S, 1910.308

2. OSHA Part 1926; Subpart V, 1926.950 through 1926.960

C. National Fire Protection Association (NFPA)

1. ANSI/NFPA 70B: Electrical Equipment Maintenance
2. NFPA 70E: Electrical Safety Requirements for Employer Workplaces
3. ANSI/NFPA 70: National Electrical Code
4. ANSI/NFPA 780: Lightning Protection Code
5. ANSI/NFPA 101: Life Safety Code

D. National Electrical Manufacturers Association (NEMA)

E. American National Standards Institute (ANSI)

1. ANSI C2: National Electrical Safety Code
2. ANSI Z244-1: American National Standard for Personnel Protection

F. Insulated Cable Consultants Association (ICEA)

G. Instrument Society of America (ISA)

H. Underwriters Laboratories (UL)

I. Factory Mutual (FM)

J. International Electrical Testing Association (NETA) – Acceptance Testing Specification for Electric Power Distribution Equipment and Systems (STD)

K. Institute of Electrical and Electronics Engineers (IEEE)

L. Massachusetts Electrical Code

M. All inspections and tests shall utilize the following references:

1. Project Design Specifications
2. Project Design Drawings
3. Project Short Circuit and Coordination Study
4. Manufacturer’s shop drawings submittals and instruction manuals applicable to each particular apparatus.

N. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.09 - INTERFERENCE AND ERRONEOUS LOCATIONS

A. Verify in field, all data and final locations of Work installed under other Sections required for placing of electrical Work.

B. Do not run conduit in floor slabs or walls of buildings unless indicated.

1.10 - SEISMIC REQUIREMENTS

A. Conform to the requirements indicated on structural drawings and as specified in SECTION 01900, SEISMIC REQUIREMENTS and as specified herein.

1.11 - APPROVAL AND MARKING EQUIPMENT

A. All devices and materials shall be listed and/or labeled by Underwriters' Laboratories, Inc., wherever standards have been established by that agency. Where Underwriters' Laboratories listing is not available for equipment, submit certified test reports of recognized, independent testing laboratory, approved by the local inspecting authority, indicating that equipment is in conformance with local code requirements or any other applicable requirements.

B. Mark equipment, devices and material with name or trademark of manufacturer and rating in volts and amperes and other information on a nameplate.

1.12 - FAULT CURRENT AND ARCH FLASH HAZARD LEVEL LABELLING

A. Provide electrical system studies as specified herein.

B. Provide label describing fault current availability at the meter socket. Affix label to meter socket.

C. Provide label describing the arc flash hazard at the required equipment. Label shall display the following information:

1. Available incident energy and the corresponding working distance
2. Minimum arc rating of clothing
3. Required level of personal protective equipment (PPE)
4. Highest hazard/risk category for the equipment
5. Nominal system voltage
6. Arc flash boundary
7. Shock hazard

D. Perform a calculation to determine the arc flash hazard level at the panelboards.

E. Acquire the utility fault current availability from the utility.

F. Use arc flash tables in NFPA 70E.

G. The electrical system protection trip settings resulting from the study shall be provided to the electrical testing firm specified under SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS to adjust and set the electrical system parameters in the field.

H. The Arc Flash Labels shall be generated by the specialty firm and installed in the field by the Contractor under Division 16.

1.13 - ELECTRIC SERVICE

A. Electrical power system for the facility shall operate at 480 volt, 3-phase, 3-wire, 60-Hertz.

B. Provide electrical low voltage distribution system that operates on 120/208 volt, 3-phase, 4 wire, 60-Hertz obtained from the power system by step down transformer(s).

C. Contact the following organization for coordinating the incoming power requirements for the project:

EVERSOURCE
Kathleen White
484 Willow Street
Yarmouth, MA 02673
Kathleen.white@eversource.com
(508) 790-9021

D. The organization identified above will furnish and install:

1. Pad-mounted transformer, including metering equipment.
2. Primary cable.
3. Connection and terminations of all primary cables at the service transformer.

E. The following shall be provided under other divisions:

1. Poured and pre-cast concrete, construction joints, and form work for duct lines, manholes, and handholes.
2. Rebar, inserts, embedments, windows, ladders, pulling iron and related material.
3. Concrete pad for transformer in accordance with Eversource standards.
4. Excavation and backfill.

5. Manhole and handhole frames and covers.
6. Manhole and handhole waterproofing.
7. Core drilling of existing concrete.

F. The following shall be furnished and installed under this division:

1. Secondary cables of sufficient length for termination at the transformer.
2. Connection and terminations of all secondary cables at the service transformer.
3. Grounding at pad.
4. Hardware in manholes and handholes including cable supports, ground rods, ground cables, and associated equipment.

1.14 - EQUIPMENT SPECIFIED ELSEWHERE

A. Certain items of control equipment and other equipment are indicated on electrical drawings for connection, but are specified and provided in other sections pertaining to plumbing, heating, ventilating and air conditioning, mechanical process, diesel generator system, and instrumentation, etc.

1.15 - HAZARDOUS AREAS

A. Equipment, materials and installation in areas designated as hazardous shall comply with NEC Articles 500, 501, 502 and 503.

B. Equipment and materials installed in hazardous areas shall be UL listed for the hazardous area classification.

1.16 - CODE, INSPECTION AND FEES

A. Equipment, materials and installations shall comply with the requirements of the local authority having jurisdiction.

B. Obtain all permits and arrange for all inspections.

1.17 - TESTS AND SETTINGS

A. Test systems and equipment furnished under Division 16 and replace all defective Work and equipment at no additional cost. Refer to the individual equipment sections and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS for additional specific testing requirements. Employ the services of an Independent Testing Company, other than the manufacturer of the electrical distribution system, to perform the tests specified.

B. Field testing and commissioning shall be performed in accordance with the latest revisions of NETA Standard ATS "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

C. A typed test report for each component tested shall be submitted. The firm doing the testing shall include, in the report, their opinion whether or not the equipment being tested complies with the specification. Any discrepancies shall be noted in the concluding summary of the report. Test report forms shall be in compliance with NETA standards. Five complete copies shall be provided. Reports shall be signed by the person in charge of the field testing, an officer of the firm performing the tests and an officer of the Electrical Subcontractor.

D. In addition to the specific testing requirements listed in the individual sections, the following tests and settings shall be performed:

1. Mechanical inspection, testing and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits and equipment for operation.
2. Check the full load current draw of each motor. Check ampere rating of thermal overloads for motors and submit a typed record of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.
3. Check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.

4. Check settings of the motor circuit protectors. Adjust settings to allow the motor to be started when under load conditions.
5. Check motor nameplates for correct phase and voltage.
6. Check rotation of motors prior to testing the driven load.
7. Check interlocking, control and instrument wiring for each system and/or part of a system to prove that the system will function as indicted by control schematic and wiring diagrams.
8. Inspect each piece of equipment in areas designated as HAZARDOUS to make sure that installed equipment has rating as specified in Paragraph 1.14.
9. Verify all terminations at transformers, equipment, panels and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to “A”, “B” and “C” phases.

1.18 - INTERPRETATION OF DRAWINGS

A. Coordinate the conduit installation with other trades and the actual supplied equipment. Coordinate equipment conduits top and/or bottom entries as required for the equipment installation and as specified and indicated on the Contract Drawings.

B. Install each 3-phase circuit in a separate conduit unless otherwise indicated.

C. Install all conduits and wiring system as indicated on and matching the Contract drawings. Conduits shall not be combined unless otherwise indicated on Contract drawings.

D. Conduit shown exposed shall be installed exposed; conduit shown concealed should be installed concealed.

E. All fittings and boxes shall be provided for a complete raceway installation.

F. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installations.

G. Except where dimensions are shown, the locations of equipment, fixtures, and outlets indicated are approximate only. Obtain information relevant to the placing of electrical Work and in case of any interference with other Work.

H. Circuit layouts are not intended to show the number of fittings, pull boxes, or other installation details. Furnish all labor and materials to install and place in operation all power, lighting and other electrical systems indicated.

I. Raceways and conductors for the fire alarm and telephone systems are not indicated. Interconnection descriptions are indicated in their Riser Diagrams as indicated. Provide raceways and conductors, as required by the system manufacturer, for a complete and operating system. Raceways shall be installed concealed in all finished spaces and installed exposed in process spaces.

J. Raceways and conductors for lighting, switches, receptacles, and other miscellaneous low voltage power and signal systems as specified are not indicated. Raceways and conductors shall be provided for lighting, switches and receptacles for a complete and operating system.

1.20 - PHASE BALANCING

A. The drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly balanced loads across all phases.

B. Field balancing of circuits shall not alter the conductor color coding requirements as specified in SECTION 16120, ELECTRIC WIRES AND CABLES.

1.21 - SIZE OF EQUIPMENT

A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

B. The equipment shall be kept upright at all times during storage and handling.

C. Equipment shall not be physically larger than what is shown on the Contract Drawings.

1.22 - EQUIPMENT IDENTIFICATION

A. Identify equipment furnished under Division 16 with the name of the equipment it serves. Switchboard, motor control centers, control panels, panelboards, junction or terminal boxes shall have nameplate designations as indicated. Equipment nomenclature and identification system shall be as specified herein.

B. Nameplates shall be engraved, laminated plastic, 1/16-in. thick by 3/4-in by 2-1/2-in. with 3/16-in. high white letters on a black background.

C. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using a waterproof epoxy adhesive. Two-sided foam adhesive tape shall not be used. Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface.

1.23 - SEQUENCING AND SCHEDULING DEMOLITION WORK

A. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of power. Obtain Owner's consent before removing any circuit from continuous service.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 - REMOVAL AND RELOCATION OF MATERIAL AND EQUIPMENT

A. Carefully dismantle and salvage electrical equipment, switches, fixtures, conduits, cables, wiring, boxes, as necessary to carry out proposed changes. Rehabilitate and relocate items of equipment as required and as indicated or specified.

B. Remove from site and dispose of material and equipment removed.

3.02 - DEMOLITION

A. Survey the existing electrical systems and equipment identified for removal with representatives from the other trades and civil site work prior to performing any demolition work. Identify all conduit and equipment to be removed with tags or paint.

B. Where equipment is to be removed all associated ancillary components (e.g. supports, handholes, poles, fixtures, etc.) and associated wiring and conduit shall also be removed.

C. Equipment, building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition. Disconnect and remove all electrical power, communications, controls, alarm and signal system.

D. Existing underground electrical systems feeding equipment, building or structures scheduled for complete demolition shall be made safe, disconnected and removed.

E. Equipment scheduled to be turned over to the Owner shall be carefully disconnected, removed and delivered to the Owner where indicated. Provide labor, hoisting and transportation of the equipment. All other miscellaneous electrical materials, devices, etc., associated with the equipment being turned over shall be demolished and removed from the site.

F. Remove electrical work associated with equipment scheduled for demolition except those portions to remain or be reused.

G. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to point of concealment including abandoned circuit above accessible ceiling finishes. Removed unused wiring back to source (or nearest point of usage).

H. Disconnect and remove abandoned electrical equipment unless otherwise indicated or specified.

I. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers and other accessories.

J. Repair adjacent construction and finishes damaged during demolition and extension work.

K. Where electrical systems pass through the demolition areas to serve other portions of the premises, they shall remain or be suitably relocated and the system restored to normal operation.

L. Trace out existing wiring that is to be relocated or removed and perform the relocation or removed work as required for a complete operating and safe system.

M. Remove exposed conduits, wireways, outlet boxes, pull boxes and hangers made obsolete by the alterations, unless specifically designated to remain. Patch surfaces and provide blank covers for abandoned outlets which are removed.

3.03 - PROTECTION OF ELECTRICAL EQUIPMENT

A. Store equipment in compliance with manufacturer's recommendations and as specified herein.

B. Protect electrical equipment from the weather, especially from water dripping or splashing upon it, at all times during shipment, storage, and construction.

C. Do not store equipment outdoors.

D. Where equipment is installed or stored in moist areas, or unheated buildings, provide acceptable means to prevent moisture damage. Provide uniformly distributed source of heat in electrical equipment to prevent condensation and damage to electrical insulation systems.

3.04 - DEFECTIVE OR DAMAGED EQUIPMENT

A. Damaged equipment shall not be used. Equipment damaged in shipment, storage, installation or through other means shall be replaced without additional cost.

B. All equipment showing signs of damage shall be rejected regardless of dielectric test results.

C. All electrical equipment is considered "in storage" regardless of location until first energized. Manufacturer's recommendations for storage precautions, conditions and care shall be followed.

D. Equipment that found to be damaged or failed the field inspection and acceptance tests specified under SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS shall be replaced at no additional cost.

3.05 - STARTING EQUIPMENT DATA LIST

A. Obtain data from the equipment supplier shop drawing submittals or equipment nameplates and prepare a complete tabulation of all motors over 1/3 hp, electric heaters over 1 kW, air conditioning units and starting equipment, to be furnished on the project.

1. Include in tabulation form the following information:

a. Name and identification of equipment.

b. Manufacturer.

c. Horsepower or kilowatt rating.

d. Voltage.

e. Phase.

f. Speed.

g. Full load current.

h. Locked rotor current or code letter.

i. Type of enclosure (open drip-proof, totally enclosed, fan cooled, etc.).

j. NEMA size of starter or contactor.

k. Overload heater size.

l. Type of starter (full-voltage, reduced-voltage, autotransformer, etc.).

m. Breaker trip setting or fuse size.

n. Voltage of starter operating coil.

o. If starter is at a motor control center, list motor control center number.

2. Final acceptance of the electrical system is contingent upon submittal of the complete motor and equipment tabulation.

3. Arrange tabulation in groups by building location.

4. Furnish six copies of the tabulation to the Engineer when a submission is made.

3.06 - EQUIPMENT ENCLOSURE

A. The equipment enclosure classifications of the plant areas are indicated within the Area Classification Schedule shown on the electrical drawing 00 E-601. Provide all equipment, devices, installations and material meeting the requirements of this schedule.

B. Pump Station electrical enclosure layout to be submitted after all of the components within it have been approved.

3.07 - AS BUILT DRAWINGS

A. At the completion of the Project, provide two sets of contract drawings that are marked to show the as-installed equipment, devices, conduits, underground duct lines locations, layouts, wiring and any revisions to the Contract Drawings occurred during construction. As built drawings markup shall be complete and provide a detailed and accurate representation of as installed field conditions of all equipment provided under this Contract.

3.09 - INSTALLATION

A. Provide conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions.

1. All dimensions shall be field verified at the job site and coordinated with the Work of all other trades.

2. Provide electrical installation working drawings containing the following:

1. Concealed and buried conduit layouts, shown on floor plans. The layouts shall include locations of process equipment, motor control centers, transformers, panelboards, control panels and equipment, motors, switches, motor starters, junction or pull boxes, instruments and other electrical devices connected to concealed or buried conduits.

2. Coordinate all Work with other divisions.

3.10 - SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions. Locate all slots for electrical Work and form before concrete is poured.

B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other Subcontractors and locate the concealed conduit before the slab is poured.

C. Seal all openings, sleeves, penetration and slots as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

3.11 - CUTTING AND PATCHING

A. Arrange installation of all Work such that cutting and patching is not required.

B. Do not cut joints, beams, girders, columns or any other structural members.

3.12 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 16110

ELECTRICAL RACEWAY SYSTEMS

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electrical Raceway Systems as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer’s product data for all raceway systems, accessories, supports and miscellaneous hardware in accordance with the requirements of SECTION 16050, ELECTRICAL WORK – GENERAL.
2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are re-submitted with the entire package.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

C. Provide raceway systems, with matching accessories, fittings and boxes, as indicated and specified.

D. All raceway runs are indicated diagrammatically to outline general routing of raceway. Unless specifically identified for installation in concrete walls or slabs, raceways shall be run exposed with raceway supporting systems. Avoid interfering with pipes, ducts, structural members, or other equipment.

E. Raceways and conductors between lighting, switches, receptacles and other miscellaneous low voltage and signal systems as specified and indicated are not shown on the Plan View Drawings. Raceways and conductors shall be provided for complete and operating systems. Conduit and wiring descriptions are indicated on the Riser Diagrams for the Fire Alarm, Telephone and Instrumentation Systems. Raceways shall be installed exposed unless otherwise indicated. Avoid conflicts with HVAC ducts, cranes, hoists, monorails, equipment hatches, doors, windows, structural beams and process equipment.

F. Provide raceway systems in accordance with the following:

1. In NEMA 1, NEMA 4 or NEMA 12 areas, use galvanized rigid steel raceway systems, fittings and accessories.

2. In chemical areas and those areas designated NEMA 4X, use PVC coated rigid steel raceway systems, fittings and accessories.

3. In classified hazardous areas designated as Class I, Division I and Class 1, Division 2, use PVC coated rigid steel raceway systems, fittings and accessories with tapered threads and sealing fittings as required by the Massachusetts Electrical Code for hazardous applications.

G. All raceway systems shall be installed in accordance with the criteria described in this section.

1. Use Type 316 stainless steel support systems for exterior application, hazardous areas, NEMA 4 and in NEMA 4X areas.

2. NEMA 1 and NEMA 12 areas shall use hot dipped galvanized steel support systems.

H. Aluminum conduit and boxes shall not be used.

I. Provide fire stops for all electrical penetrations through fire rated walls and floors.

1.07 - REFERENCES

A. National Fire Protection Association (NFPA):

1. National Electrical Code (NEC)

B. Massachusetts Electrical Code

C. Underwriter's Laboratories, Inc. (UL):

1. U.L.-1: Electrical Flexible Metal Conduit
2. U.L.-6: Rigid Metal Electrical Conduit
3. U.L.-360: Electrical Liquid-Tight Flexible Steel
4. U.L.-651: Schedule 40 and 80 PVC Conduit
5. U.L.-886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations, Class 1, Groups A, B, C, and D and Class 11, Groups E, F, and G

D. National Electrical Manufacturers Association (NEMA):

1. RN-1: Polyvinylchloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
2. TC-2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)

1.08 - SEISMIC REQUIREMENTS

A. All raceways shall be supported to Massachusetts Electrical Code requirements and conform to the requirements as indicated on the structural drawings and as defined in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

PART 2 - PRODUCTS

2.01 - ACCEPTABLE MANUFACTURERS

A. Rigid Metal Conduit and polyvinylchloride-coated rigid steel conduit:

1. Triangle/PWC, Inc.
2. Perma-Cote Industries.
3. Republic Steel Corporation.
4. Robroy Industries.
5. Or equal.

B. Polyvinylchloride (PVC) Conduit:

1. Triangle/PWC, Inc.
2. Robroy Industries.
3. Carlon Electrical Sciences, Inc.
4. Or equal.

C. Flexible Conduit:

1. American Flexible Conduit Company.
2. Anamet, Inc.
3. Electri-Flex Company.
4. International Metal Hose Company.
5. Eaton Crouse-Hinds.
6. Or equal.

D. Boxes and Fittings:

1. O.Z./Gedney Company.
2. Crouse-Hinds Electrical Construction Materials.
3. Appleton Electric Company.
4. Or equal.

E. Fiberglass-Reinforced Polyester Boxes:

1. Crouse-Hinds Electrical Construction Materials.
2. Fibox.
3. Hoffman Engineering Company.
4. Vynckier Enclosure Systems.
5. Or equal.

F. Support Systems:

1. Michigan Hanger Co., (O-Strut).
2. Thomas & Betts (Superstrut).
3. Unistrut Corp.
4. Or equal.

G. Fire Stop Material and Barriers:

1. Nelson Fire Stop Products.
2. Dow Corning Corporation.
3. 3 M Company.
4. Or equal.

2.02 - MATERIALS AND COMPONENTS

A. Rigid Metal Conduit:

1. Provide galvanized rigid metal conduit, each with a coupling on one end and thread protector on other end.
2. Hot-dip galvanize rigid steel conduit over entire length, along interior and exterior surfaces, including threads. Conduit shall conform to U.L.-6.

B. Flexible-Metal Conduit:

1. Provide flexible-metal conduit for use in NEMA-1 and NEMA-12 dry areas and match fittings, size, and material to rigid conduit to which it is connected. Flexible-metal conduit shall conform to U.L.-1.
2. Provide liquid-tight PVC coated flexible-metal conduit for use in NEMA-4 damp areas consisting of flexible-metal conduit, with liquid-tight, sunlight-resistant jacket extruded over the conduit. All fittings and accessories shall be PVC coated. Provide stainless steel, braided flexible conduit in NEMA 4X, corrosive areas. On larger than 1-1/4-in., furnish separate external ground wire. Liquid-Tight flexible-metal conduit shall conform to U.L.-360.
3. Provide stainless steel braided flexible conduit in all hazardous areas.

C. Polyvinylchloride (PVC) Conduit:

1. Provide PVC conduit, Schedule 40 conforming to NEMA Standard TC-2 and UL-651. PVC Schedule 40 conduit shall not to be used unless embedded in concrete and unless otherwise indicated on the drawings.

D. Polyvinylchloride-Coated Rigid Steel Conduit:

1. Provide polyvinylchloride-coated (PVC-Coated), rigid steel conduit conforming to NEMA Standard RN-1 consisting of hot-dipped galvanized rigid steel conduit, with a polyvinylchloride jacket bonded to the outside of all conduit surfaces with a nominal thickness of 40 mils meeting the requirements of NEMA RN-1, 3.1. The adhesive strength of the bonding to equal or exceed tensile strength of the coating. Provide couplings and fittings for this conduit conforming to the requirements of NEMA RN-1, 3.5.
2. A two-part urethane coating shall be applied to the interior of all conduit and fittings at a two mil thickness. The interior coating shall be flexible to allow field bending without cracking or flaking.

E. Boxes:

1. In NEMA 1 and NEMA 12 areas, provide standard, sheet-metal, outlet and junction boxes constructed of code-gauge, galvanized sheet steel. Size each box by the Massachusetts Electric Code.

2. Provide boxes containing fixture studs for hanging fixtures. Use concrete-tight boxes for installation in concrete. Do not use shallow boxes unless building construction is such that it is impossible to use standard-depth boxes.

3. Provide outlet boxes and fittings for hazardous locations conforming to U.L.-886 for class, group, and division indicated. Outlet boxes and fittings for hazardous areas shall also meet requirements of NEMA 4 areas.

4. Provide boxes and covers for polyvinylchloride-coated steel conduit made of 316L stainless steel or, in classified areas and outside, galvanized cast iron, with a polyvinylchloride factory-applied coating over the galvanizing. Provide coating thickness of 40- mil. Boxes shall have hubs with extruded sleeves extending beyond the hub in the same manner as specified for conduit couplings. Provide cover screws of Type 316 stainless steel.

5. Provide cast boxes with covers or device plates that can be used for the area classification. Use cover screws of Type 316 stainless steel or high brass for iron boxes.

6. Provide boxes for use with polyvinylchloride conduit made of polyvinylchloride for use as junction boxes and provide high impact strength fiberglass-reinforced polyester boxes for use as device boxes, pull boxes, and terminal boxes. Size each box as required by the Massachusetts Electrical Code.

7. Where designated in the drawings, provide pull boxes above or below motor control center installations 20 inches by 20 inches by 12 inches deep. Boxes of dimensions 10 inches by 10 inches by 6 inches deep and larger shall be hung from ceilings constructed of angle or channel frames. Provide neoprene gaskets for sealing. Sectionalize covers longer than 36-in. to facilitate handling and gasket sectionalized covers where covers meet, using angle iron or channel cross members at the joint. Sheet metal shall be No. 12-gauge galvanized sheet steel. Fabricate interior angles and supports of galvanized steel. Provide each box with a grounding lug for connection to the nearest ground bus. Current capacity of ground lug shall be that required by the Massachusetts Electrical Code for the largest feeder entering the equipment.

8. Provide terminal blocks in all terminal boxes, panels, and instrumentation cabinets/panels requiring terminations as indicated or by wiring diagrams for equipment actually purchased. All terminals shall be rated 600V, 20 amp. All terminals shall be screw type with provisions for white markers.

9. In NEMA 4 and NEMA 4X areas, provide 316L stainless steel outlet and junction boxes. Size each box as required by the Massachusetts Electric Code.

F. Fittings:

1. Provide cast-iron fittings of malleable iron or a mixture of gray iron and cast steel.

2. Provide expansion fittings where conduits cross expansion joints. Equip these fittings with grounding straps, clamps, and copper bonding jumpers.

3. For PVC conduit, provide PVC fittings that can be solvent welded to match conduit.

4. Provide PVC-coated coupling and fittings for PVC-coated conduit with an integral, bonded, overlapping pressure-sealing sleeve of the same thickness as conduit coating. Provide extended sleeves one pipe diameter or 2-in. (whichever is less) beyond the end of the coupling so sleeve of coupling makes a watertight fit with the plastic jacket on the conduit when coupled together. Sealing sleeves at threaded connections shall seal out vapors and liquids.

5. Provide PVC coated fittings and accessories with PVC-coated rigid galvanized steel conduit.

G. Supports:

1. Provide raceway component supports which are meant to function with the raceway, and will support the raceway as indicated and meet the NEC and manufacturer’s requirements.

2. Provide Type 316 stainless steel hangers, threaded rods, channels, straps, clips, and clamps for raceways provided in hazardous areas, NEMA-4 and NEMA-4X areas. Provide stainless steel bolts, nuts and washers.
3. Provide hot dipped galvanized steel support system for raceways installed exposed in NEMA-1 and NEMA-12 areas.
4. Provide support for flexible conduit with components which do not compress and do not deform conduit.

2.03 - FIRESTOP PRODUCTS

A. Only firestop systems listed and tested to the UL 1479 Standard complete with prototype test data showing their individual applications shall be used.

B. Fire resistance ratings of installed firestop systems shall not be less than the fire resistance rating of the surrounding fire separation or firewall.

C. All listed system designs selected for use shall have a smoke seal incorporated within the rated firestop systems.

D. All firestop materials that will come directly in contact with plastic pipe or plastic coated wire shall have undergone Firestop Material compatibility testing by the Firestop Systems manufacturer and/or the pipe or wire manufacturer.

E. All firestop materials and smoke seals shall have elastomeric characteristics to allow for building settling and seismic movement.

F. All firestop materials and smoke seals shall be free of asbestos.

G. Site firestop systems must be installed in accordance with the UL 1479 Standard listed system design limitations.

H. All listed system designs used must provide a Flame (F), Temperature (T) and Hose (H) stream rating in accordance with those outlined in the most recent BOCA codes, include any additional requirements of the Work in this Section.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Provide all material, equipment, and labor to install the electrical raceway systems as indicated and as specified herein.

B. Perform all Work in accordance with the Massachusetts Electric Code.

C. Use no conduit less than 3/4-in. in diameter.

D. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer’s printed instructions.

3.02 - METHODS OF RESTRAINING RACEWAYS

A. Utilize threaded rod with rod stiffeners and transverse channel braces at 45 degrees angle, at 15-ft. on center, maximum, and on one side of rod support.

B. Utilize longitudinal bracing with channel braces at 30 feet on center, maximum.

C. Strap raceways directly to transverse channel braces, using pipe strap with both ends of strap bolted into the channel brace.

D. Do not rigidly brace raceways to different parts of a building that may respond differently during an earthquake. Seismic restraints shall not limit expansion and contraction of the raceway support system.

E. Provide flexible connections for conduits 2-in. outside diameter or greater than when terminating to fixed equipment to prevent loss of raceway integrity in the event of an earthquake.

3.03 - INSTALLATION OF FITTINGS

A. Install expansion fittings and bonding jumpers wherever conduits cross structural expansion joints. Keep the fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

B. Do not install fittings to replace elbows and pull boxes. Use oversize fittings whenever large cable is installed, in order to maintain bending radius.

C. Terminate ends of all floor conduits installed for future use with couplings and readily removable plugs set flush with finished floor surface. Cap spare wall conduits at wall where they enter building.

D. Equip ends of all conduits with conduit fittings. Fit conduits terminating at motor control center or power distribution equipment, or in box above or below, with grounding type bushings, or solidly ground by locknuts or other fittings. Connect each grounding bushing to ground bus by a bare or green-covered copper wire. Do not use ground wire smaller than 12 awg. Install ground wire larger than 12 gauge when indicated. Where conduits terminate in unprotected areas or where bonding is required over expansion joint, flexible conduit or equivalent; use ground wires No. 6 Awg. copper or larger. Copper bonding jumpers are required over expansion joints.

E. Terminate conduits entering gasketed sheet-metal boxes or gasketed sheet-metal equipment enclosures with gasketed hubs.

F. Terminate conduits entering nongasketed sheet-metal boxes or enclosures with double locknuts and insulated bushings, or equivalent.

G. Make joints tight. Use raceway fittings compatible with raceway use and location.

3.04 - INSTALLATION OF RACEWAYS

A. Install exposed raceways parallel or at right angles to walls and ceiling beams. Make all changes in directions with bends, elbows, and pull boxes. Space parallel runs evenly throughout. Attach in place with hangers and fasteners. Ground raceways by connection to grounded enclosures, bonding, or other means, to obtain permanent low resistance path to ground throughout installation. Raceway sections in single run and in parallel runs shall be of same type and finish.

1. Run parallel or banked raceways together, on common supports.

2. Install raceways level and square. Provide minimum 7 ft. headroom.

B. Support raceways concealed above suspended ceilings from slab above ceiling in same manner as exposed raceways. Do not support raceways from ceiling supports.

C. Provide cast-in-place inserts in concrete to support all runs, unless otherwise permitted. Use stainless steel sleeve type concrete anchors for installing boxes, and conduit supports. Provide Type 316 stainless steel nuts, bolts, and washers, for use with concrete anchors. Wedge inserts shall not be used.

D. Support conduits by hangers or pipe straps spaced according to Massachusetts Electrical Code, but in no case more than 10 feet on centers.

E. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with PVC coated rigid steel conduit. Flexible metal conduit may be used 6 inches above the floor.

F. Provide sleeves passing through exterior walls and slabs which are wall entrance seals of watertight construction. Furnish watertight seal between slab and sleeve, and between sleeve and conduit or cable. Use wall-entrance seals of malleable iron with watertight sealing gland which may be tightened any time after installation.

G. Do not use dissimilar metals in conjunction with each other. Use insulation between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. Maintain electrical continuity of system. Use bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers as insulation.

H. Install fittings to match raceway being used.

I. Install expansion fittings wherever conduits cross structural expansion joints. Keep fittings in line with conduit, and install with regard to temperature so that full working range of expansion is available.

J. Where conduits pass through firewalls, grout hole around the conduit to the full depth of the material penetrated using U.L. listed fire stop material.

K. Provide separate metallic raceways for all low voltage instrumentation raceways 50 volts and below shielded wiring, data highway wiring, and fire alarm wiring and install 12-inches from control and power raceways.

L. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box; use two locknuts, one inside and one outside the box.

M. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

N. Install pull wires in all empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having 200-lb. tensile strength. Leave 12 inches of slack at each end of the pull wire.

O. Keep raceways 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.

P. Complete raceway installation before beginning conductor installation.

Q. Use temporary closures to prevent foreign matter from entering raceway.

R. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

S. Conduit in transition (from below to above grade, through walls and through concrete) shall be PVC coated rigid galvanized steel (PVC-RGS). The transition shall be made below grade at the final sweep before the transition for exposed conduit. PVC-RGS conduit shall extend one (1) foot minimum above transition finished floor.

3.05 – BENDS

A. Make all bends to prevent distortion of circular cross section. Field bent conduit shall have an inside radius of nine diameters.

B. The maximum number of bends in any single conduit run shall be in accordance with the Massachusetts Electrical Code requirements.

3.06 - CUTTING, THREADING AND CONNECTING

A. Make all field cuts in conduits squarely, file cut ends, ream to remove rough edges and thread in accordance with Massachusetts Electric Code. No running thread shall be permitted. Make all connections mechanically strong and tight, with connectors. Where conduit surface coating is damaged or removed in the cutting, threading or reaming process, restore the surface to its original condition.

3.07 - CONDUIT CLEANING

A. Clean conduits before and after installation, ream ends free of burrs, and free inside surfaces from all imperfections.

B. After installation of each new conduit run, snake the run with band to which is attached a tube cleaner with cylindrical mandrel of a diameter 85 percent of nominal diameter of conduit. Remove and replace all conduit through which mandrel will not pass.

C. Use a sponge with steel brush to clean steel conduit and use a sponge with nylon brush to clean PVC conduits.

D. After cleaning, protect ends of all conduit with standard caps to prevent entrance of water, concrete, debris, or other foreign substance.

3.08 - CONDUIT DRAINAGE

A. Pitch conduit to drain to outlet boxes, or install so as to avoid trapping moisture. Where dips are unavoidable in exposed conduits, install fitting to match conduit system with drain hole at low point.

3.09 - INSTALLATION OF BOXES

A. Unless otherwise indicated, install NEMA 1 or NEMA 12 sheet metal boxes only in dry, accessible locations. Install NEMA 4 and 4X rated boxes in exterior concrete or masonry walls, in floor slabs, in basements, all other below grade locations and elsewhere as indicated. Unless otherwise indicated, cast metal boxes shall be used where vapor-tight fixtures are required, for all surface mounting of wall switches and receptacles and for all outdoor use.

B. Install boxes in conformance with all the requirements of Massachusetts Electric Code. Install boxes designed for type of construction involved. Support boxes in same manner as conduit. Size boxes to provide bending radius for wire or cable of eight times diameter or in accordance with Massachusetts Electric Code, whichever is larger.

C. Center all outlets in panels, or spaces and adjust to structural finish. Where specific locations are not indicated, locate outlets with respect to equipment served.

D. Place all outlet boxes, junction boxes and pull boxes, in accessible locations when they are installed above or behind plastered ceilings, furred spaces, or suspended ceilings. Install access panels. Mark all access panels for all boxes so panels can be readily located in future. Mark, using metal tabs or plastic buttons which cannot mark ceilings or walls, that can be used for type of construction being used.

E. Assemble cast-metal boxes with threaded conduit hubs in such manner that conduit connections and gasketed covers are watertight. Close all unused threaded openings with pipe plugs and compound.

F. Provide cast boxes with covers and device plates that can be used for the area classification. Install screws of Type 316 stainless steel or high brass for iron boxes.

3.10 - FLEXIBLE CONNECTIONS TO MOTORS AND EQUIPMENT

A. At all motors and electrically operated equipment to which conduit connections are made, install with a connection between end of conduit and terminal box of motor or other equipment.

B. Install the conduits in locations permitting direct connection to motors.

C. Make connections between rigid raceway and motor or equipment subject to vibration and adjustment using flexible conduit. Make each connection with one quarter bend so that no vibration can be transmitted beyond flexible connection.

D. Use maximum of 6 feet of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet or damp locations. Install liquid-tight flexible metal conduit in areas subject to wetting due to fire protection sprinklers or broken or ruptured water line. Locate conduit to reduce the possibility of damage to the exterior flexible conduit jacket. Use fittings that screw into flexible conduit and provide gaskets. Install separate ground conductor across flexible connections.

3.11 - HAZARDOUS AREAS

A. Install all conduits, fittings, equipment and devices within areas to comply with requirements of Massachusetts Electrical Code including Hazardous Locations, Class, Division, and Group as indicated on the Contract Drawings.

B. In such hazardous locations, seal conduits terminating at boxes enclosing circuit-opening equipment at entrance to enclosure with compound-filled, commercial, sealing fittings to prevent passage of explosive or combustible gases through conduits.

C. Seal all conduits leading from or entering such hazardous locations at points of exit or entrance with two-part epoxy sealant.

D. Install conduit connections with five threads tightly engaged, and made up with thread compound.

E. Where drain/seal fittings are required, they shall be of malleable iron construction with an internal drainage path which provides a visual means to see that the compound chamber is filled. The installation shall enable the drain/breather fitting and filler plug to be installed right after the compound is poured.

F. Provide stainless steel braided flexible conduit rated for hazardous area locations when making connection between rigid raceway and motor or equipment subject to vibration and adjustment.

3.12 - FIRESTOP INSTALLATION

A. Firestop and smoke seal gaps and holes in all fire separation and firewall construction through which conduit, wire, cable, pass as a result of Electrical Work using a Listed System Design.

B. In combustible construction, firestop and smoke seal all through electrical penetrations of the faces as above and firestop and smoke seal all penetrations that enter or exit (transverse) the edges of one fire separation into another

fire separation. (i.e. where the header or sill plate is penetrated in the interior of a wall separation into the hollow ceiling or floor cavity of the adjacent separation.)

C. Apply firestop systems at unpenetrated electrical openings and sleeves installed for future use through fire separations and firewalls.

D. All Electrical items that pass through, transverse or terminate within fire separations or firewalls must be firestopped. Firestopping forms part of the Work of this Section.

E. All recessed electrical boxes or panels in fire separations shall be noncombustile (steel) and must be separated by one stud or joist cavity. Back to back installations and/or combustible (plastic) boxes and panels are not allowed unless the gypsum board trade has constructed a fire rated enclosure equal to that of the fire separation rating around each box or panel.

F. All holes or voids created in fire separations or firewalls for single penetrating wires, cables and conduit the annular spare shall not exceed 1" (25mm) for penetrating items up to 2" (50 mm) in outside diameter. For penetrating items over 2" (50 mm) in outside diameter the annular space must not exceed 1½" (37 mm).

G. All holes or voids created in fire separations or firewalls for multiple penetrating electrical items must have a fill ratio 50% of the overall void or hole size.

H. In all firestop systems that require mineral wood or ceramic fiber backer or filler materials, these materials must be dry and free of other contaminants before, during and after installation of sealant firestop materials. Alkaline water contamination of the backer or filler materials may cause corrosion of metallic penetrating items.

I. Apply firestop systems and smoke seals in strict accordance with manufacturer's instructions and Listed Systems Designs to provide temperature and flame rated seals, to prevent the passage of fire and smoke.

3.13 - PROTECTION

A. Provide protection and install in accordance with manufacturer printed instructions such that coatings, finishes, and enclosures are without damage or deterioration at completion of Project.

B. Repair damage to PVC with matching touch-up coating recommended by the manufacturer.

3.14 - CHECKOUT AND TESTING

A. Provide in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

B. Check overhead conduit system installation by using the following check list:

1. Conduits are supported on independent supports (i.e., not on process piping, pipe ways, or piping hangers).
2. Exposed conduits are run, parallel or perpendicular to structural members.
3. Conduits are routed far away from fire hazards and heat sources.
4. Conduits are supported at the specified intervals.
5. Pull boxes and fittings are installed so that covers are removable. Verify that covers are installed and tightly bolted with gaskets provided where needed.
6. Circular cross sectional area is same at conduit bends. Single bends do not exceed 90 degrees.
7. Conduits are terminated in threaded hubs or bushings to prevent damage to wire.
8. Conduits joints are tight.
9. Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture and gases into equipment and/or where indicated.
10. Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture and gases.
11. Flexible conduit is installed at motors and other equipment as specified. Verify that cabling and conduit runs are identified at each end.

3.15 - CONDUIT SEALS

A. Furnish and install sealant to maintain fire ratings of walls and floors in annular space between conduit and building finish.

B. Apply sealant after cable installation and all testing.

C. Furnish and install moisture/fire proof sealant in conduit interior and cable interstitial space where conduits enter/leave electric rooms, in all control panels, terminal boxes, motor control centers, and switchboard.

3.16 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 16120

ELECTRIC WIRES AND CABLES

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electric Wires and Cables as specified herein and/or as shown on the Contract Drawings.

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data for all cables, terminations, terminal blocks, lugs, connectors, fire proofing tape, identification tags, etc. in accordance with the requirements of SECTION 16050, ELECTRICAL WORK - GENERAL.

2. Submit the following data for fire stop material:

a. Manufacturer’s Listed Systems Designs.

b. Manufacturer’s Product Data Sheets.

c. Manufacturer’s Materials Safety Data Sheets.

d. Manufacturer’s printed instructions for installation on each proposed product. Identify where each material will be used at the Project site.

e. Manufacturer’s prefabricated devices providing descriptions for identification at the Project site.

3. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are re-submitted with the entire package.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project

site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Firestop Materials and Smoke Seal materials shall have a flame spread rating of 25 or less, National Fire Protection Association (NFPA Class “A”).

1.08 - DESCRIPTION

A. Provide wires, cables, termination and identification materials for complete electrical systems, as indicated and specified.

B. Perform tests on installed wire and cables in accordance with SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

C. Provide fire stops for all electrical penetrations routed through fire rated walls and floors.

1.09 - REFERENCES

A. American Society for Testing and Materials (ASTM):

1. B3: Soft or Annealed Copper Wire.
2. B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
3. B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Massachusetts Electrical Code.

C. National Fire Protection Association (NFPA):

1. NFPA-70: National Electrical Code (NEC).

D. Underwriters Laboratories, Inc. (UL):

1. U.L. 44: Wires and Cables Rubber Insulated.
2. U.L. 83: Wires Thermoplastic-Insulated.
3. U.L. 854: Cables, Service Entrance.
4. U.L. 1479: Fire Tests of through Penetration Firestops.

E. National Electrical Manufacturer’s Association (NEMA):

1. WC 5: Thermoplastic Insulated Wire & Cable.
2. WC 8: Ethylene-Propylene-Rubber-Insulated Wire & Cable.

F. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - ACCEPTABLE MANUFACTURERS

A. 600V Cable:

1. Pirelli Cable Corporation.
2. Okonite.
3. The Rockbestos Company.
4. Or equal.

B. Metering and Instrumentation Wire, 600V:

1. The Rockbestos Company.
2. Okonite.
3. Pirelli Cable Corporation.
4. Or equal.

C. Cable Fireproofing Tape:

1. MAC Products, Inc.
2. 3M Company.
3. Thomas & Betts Company.
4. Or equal.

D. Fire Stop Material and Barriers:

1. Nelson Fire Stop Products.
2. Dow Corning Corporation.
3. 3 M Company.
4. Or equal.

2.02 - MATERIALS AND COMPONENTS

A. Material and stranding of conductors to conform to ASTM B3, ASTM B33, and to ASTM B8.

B. Wires and Cables for Maximum 600-Volt power: Furnish copper conductors. For No. 8 and smaller, provide THWN/THHN type cable. Provide No. 6 and larger as XHHW/2. Provide No. 12 and No. 10 AWG as solid conductor. Provide No. 8 AWG and larger as stranded conductor. Provide wires and cable conforming to UL 83.

C. Wires and Cables for Maximum 600-Volt control, indicating, metering, or alarm circuits: Furnish copper conductors, type THWN/THHN stranded, rated 75C with thermoplastic insulation and nylon jacket. Provide wires and cable conforming to UL 83. Cables used in fire alarm circuits shall be listed per the requirements of Article 760 of NEC.

D. Shielded Cable for Instrumentation Wiring: Provide 19-strand tinned copper conductors, size No. 16 AWG. Insulate conductors individually with color coded polyethylene or polyvinylchloride. Twist pairs twisted with varying lay (if more than one pair) and cover with cable tape and copper or aluminum coated mylar shielding tape and tinned copper drain wire. Jacket shall be polyvinylchloride. Cables shall be rated 600 volts and 90 degrees C.

E. Category 6 (CAT6) Cable: Category 6 cable shall consist of 4 twisted pairs of different lay and ground wires, enclosed by an overall conductive mylar backed aluminum foil shield. This shall be enclosed by an overall thermoplastic jacket. The cable shall meet the applicable requirements of ANSI/TIA/IEA-568-B.

F. MODBUS RTU Cable: Provide No. 22 AWG, twisted shielded pair, tinned copper with overall braid and foil shield. Jacket shall be polyvinylchloride. Cable shall be designed for EIA RS-485 communications.

PART 3 - EXECUTION

3.01 - GENERAL

A. Provide all material, equipment, and labor to install the electric wire and cables as indicated and as specified.

B. Perform work in accordance with the Massachusetts Electrical Code.

C. Provide power cable identification as follows:

System Voltage	Neutral	Phase A	Phase B	Phase C
208/120V	White Black	Red	Blue	
240/120V	White Gray Stripe	Black Blue Stripe	Red Blue Stripe	None
480/277V	Gray	Brown	Orange	Yellow

D. Use green to identify insulated ground conductors.

NOTE: Colored insulation, tapes or sleeves may be used to provide color coding but they must be installed on all conductors at all pull and junction boxes. Insulated ground conductors must have green insulation.

E. Provide control, indicating, metering or alarm cable identification as follows:

1. AC Control Red
2. DC Control Blue

3.02 - INSTALLATION OF WIRING

A. Install wiring in accordance with applicable provisions of Massachusetts Electrical Code, and as indicated.

B. Provide wire and cable sizes as indicated. However, in no case use smaller cable sizes than required by the Massachusetts Electrical Code.

C. Unless otherwise indicated, use no conductor smaller than No. 12 AWG for power, No. 14 AWG for control, and No. 16 AWG for shielded applications.

D. Install conductors for branch lighting circuits so that voltage drop requirements of Massachusetts Electrical Code are met.

E. Install conductors continuous from outlet to outlet and make no splices except within outlet or junction boxes.

F. There shall be no splices between connection points.

G. Draw all conductors contained within a single conduit at the same time.

H. Apply wire pulling compound to conductors being drawn through conduits.

I. Use no cable bend with radius of less than eight times its diameter.

J. Support cables in riser conduits at intervals as required by Massachusetts Electrical Code.

K. Pull cables in underground conduit system without splices. Use lubricants recommended by the cable manufacturer. Do not exceed maximum pulling tension specified by the manufacturer. Use a gauge to measure pulling tension to insure that the recommended limit is not exceeded.

L. Wrap cables in manholes on an individual cable basis with fireproof tape 2 inches wide. Extend fireproofing 1-inch into any duct. Install tape in accordance with manufacturer’s instructions.

3.03 - CONDUCTOR IDENTIFICATION

A. Label each wire at both termination points. Label each wire at each end using numbering system consisting of equipment tags, terminal numbers and circuit number where wire is coming from. Carry individual conductor or circuit identification throughout. Random numbering labels similar to what is used for “Quick Pulls” type wiring shall not be acceptable.

B. Identify each wire in junction boxes, cabinets, and terminal boxes. Where no termination is made use a plastic-coated, wire marker and where termination is made use a, plastic, pre-printed sleeve wire marker.

C. In cases where terminal boards are provided for the control, indicating, and metering wires, identify all wires including motor leads and other power wires too large for connection to terminal boards, by sleeve wire markers as specified above.

D. In manholes and handholes, identify each power wire by laminated plastic tag with “to” and “from” destinations identified. Tags shall be located to be visible. Control wires to be bundled and marked with “to” and “from” destinations identified.

3.04 - CONNECTORS, TERMINAL LUGS AND BOARDS

A. For wiring of circuits consisting of No. 10 or No. 12 AWG solid wires, such as for lighting branch circuits, utilize self-insulated pressure type connectors for all splices or joints.

B. Terminate all wires and conductors means of ring and tongue, nylon self-insulated, tin-plated copper pressure terminals.

C. Fabricated terminal boards, installed where indicated, of type 600 volts, 30 amperes, screw terminals, with white marking strips for wire identification, of the 4-, 6-, 8-, or 12-pole type.

D. Mark terminal strips with ink or indelible pencil. Mark each wire consistently throughout entire system, using notation of wires given on manufacturer's wiring diagrams.

E. Wire connections for which terminals are not supplied, for example, at solenoids or motor terminal junction boxes:

1. 10 AWG and smaller: Use self insulated pressure-type connectors.

2. 8 AWG and larger: Use insulated, mechanical type with set screw or follower bearing directly on the wire. Split bolt connectors are not acceptable.

3.05 - INSTALLATION OF FIBER OPTIC CABLE

A. Install fiber optic cable as indicated on the Contract drawings. Provide all material, equipment, and labor to install the fiber optic cables.

B. Install fiber optic cable in accordance with fiber optic cable manufacturer requirements.

C. Fiber optic cable is supplied under DIVISION 13, SPECIAL CONSTRUCTION in specification SECTION 13345, DATA NETWORK in accordance with Table of Responsibility for Electrical, General and System Integrator on Contract Drawing 00 E-602.

D. Install cable directly from shipping reels. Ensure that cable is not:

1. Dented, nicked, or kinked.

2. Subjected to pull stress greater, or bend radius less, than manufacturer’s specification.

3. Subjected to treatment which may damage fiber strands during installation.

E. Conduit: Install fiber optic cable directly in conduit.

F. Identification: Identify each cable on both ends, all pull points it goes through and in all hand holes/ man holes.

G. Sequencing: Provide cables in accordance with sequencing requirements.

H. Handholes:

1. Provide supports for cables at maximum 300-millimeter centers along sides of manholes.
2. Provide a minimum 4-foot coil of spare fiber in each manhole throughout the cable length.
3. Install fiber optic cables in underground ducts. Rod and swab out ducts prior to installing cables.
4. Install fiber optic cables in the conduit systems provided inside buildings and structures.

3.06 - FIELD CABLE TESTS

A. Perform cable testing in accordance with SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

3.07 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 16160

PANELBOARDS

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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Panelboards as specified herein and/or as shown on the Contract Drawings.

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data in accordance with requirements of SECTION 16050, ELECTRICAL WORK - GENERAL.
2. Submit time current characteristic curves, short circuit rating and data for each circuit breaker type and rating.
3. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check marked to indicate specification compliance.
    a. Failure to include copy of the marked-up specification section will result in return of the entire submittal without further review and consideration until the mark-up specification are re-submitted with the entire package.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Review the manufacturer's recommended installation with the manufacturer prior to installation.

1.08 - REFERENCES

A. National Electrical Manufacturers Association (NEMA):

1. PB1- Panelboards
2. AB1- Molded Case Circuit Breakers

B. Federal Specifications (FS):

1. W-P-115A - Panel, Power Distribution.
2. W-C-375B - Automatic Circuit Breakers.
3. QQ-S-365B - Silver Plating, Electro deposited, General Requirements for

C. Massachusetts Electrical Code

D. Underwriter's Laboratories, Inc.:

1. U.L. 67 – Panelboards
2. U.L. 489 – Molded Case Circuit Breakers

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.09 - SEISMIC REQUIREMENTS

A. Conform to the requirements indicated on the structural drawing and as defined in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

PART 2 - PRODUCTS

2.01 - ACCEPTABLE PANELBOARD MANUFACTURERS

A. Eaton

B. Square D

C. GE

2.02 - PANELBOARDS

A. Provide factory assembled deadfront type panelboards.

B. Provide panelboards with branch circuit breakers and a main circuit breaker or main lugs only as indicated.

C. Furnish panelboards with full capacity separate ground bus, separate insulated neutral bus and furnish panelboards connected to a 3-phase, 4-wire service or single phase, 3-wire service as indicated. All buses to be tinned copper.

D. Provide panelboards with the voltage, frequency and current ratings as indicated conforming to NEMA Standard PB1, Federal Specification W-P-115A. U.L. 67, and the N.E.C.

E. Furnish the panelboard main and 100% neutral buses, with 98 percent conductivity rectangular copper bars provided with bolted type lugs.

F. Drill buses to fit either "A", "B" or "C" Phase connectors, and make sure that connectors are inter-changeable and installed in a distributed phase sequence.

G. Silver plate copper buses connections and terminals, to a thickness of 0.005-in., conforming to the requirements of Federal Spec. QQ-S-365B.

H. Prevent terminal lugs from turning per NEMA standard PBI and verify they can be used for the conductor material and size.

I. Provide main bus-bracing for each panel board for 10,000 amperes symmetrical short circuit at 240 volts or less and 65,000 amperes symmetrical short circuit at 480 volts unless otherwise indicated.

J. Provide typed panelboard directory cards with the following information:

1. Panelboard name designation.
2. Panelboard voltage rating.
3. Panelboard ampere rating.
4. Panelboard short circuit rating.
5. Panelboard pole/circuit numbers and branch circuit description as wired in the field.
6. Indicate 2 pole and 3 pole branch circuit breakers.
7. Label spare circuit breakers “spare”.

2.03 - CIRCUIT BREAKERS

A. Furnish bolt-on type branch and main circuit breakers. Furnish frame sizes, trip settings and number of poles as indicated. Clearly and visibly mark circuit breakers with ampere trip rating. Furnish breakers meeting the requirements of F.S. W-C-375B and NEMA AB1. Provide circuit breakers marked with ampere trip rating that can be read at a distance of two feet from the panel. Provide breakers meeting the requirements of Fed. Spec. W-C-375B and NEMA AB1.

B. Furnish all breakers with quick-make, quick-break, toggle mechanisms and thermal-magnetic, inverse time-limit overload and instantaneous short circuit protection on all poles, unless otherwise indicated. Automatic tripping indicated by the breaker handle assuming a clearly distinctive position from the manual ON and OFF position. Furnish breaker handle that is trip-free on overloads.

C. Provide circuit breakers rated 200A and larger shall have solid state adjustable trip units having long-time, short-time and instantaneous protective relaying.

D. Do not use single pole breakers with handle ties or bails in lieu of multipole breakers.

E. Furnish handle lock device on breakers to prevent the manual opening of the selected breakers.

F. Furnish padlocking device on all breakers to prevent the opening of circuit breakers.

G. Voltage and interrupting rating of all breakers in a panelboard shall not be less than voltage and short circuit rating of the panelboard main buses, as indicated. Series rated circuit breakers shall not be used. Furnish breakers to operate satisfactorily at the frequency indicated.

H. Furnish ground fault interrupter circuit breakers for circuits as indicated. The circuit breaker shall be UL listed, Class A, Group I device (5 milliamp sensitivity, 25 millisecond trip time or 30 ma for heat trace circuits).

I. Furnish single pole breakers with full module size. Do not install two pole breakers in a single module.

J. Furnish time-current characteristic curves and catalog information and data for each size of breaker furnished.

K. Provide transient surge protective devices in accordance with SECTION 16400, SURGE PROTECTION DEVICES, as specified herein and as indicated.

2.04 - CABINETS

A. Provide cabinets without knockouts. Drill cabinets only for the exact conduit entrances and mounting bolts. NEMA rating of panels to match areas as denoted on the drawings.

B. Finish cabinet fronts, trims and surface-mounted boxes in ANSI No. 61 or 49, light-gray enamel over a rust-inhibitive primer. Front covers shall be hinged to cabinets and shall be double door (door in door) construction. Provide cabinets for surface or flush mounting as indicated.

C. Unless otherwise specified, construct panelboard cabinets of code-gauge galvanized, sheet steel and equip with gutters for the risers and outgoing circuits.

D. Provide all panelboard locks keyed alike.

E. Provide cabinets drilled only for the exact conduit entrances and mounting bolts.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Mount panelboards such that the height of the top operating handle does not exceed 6 ft. 6-in. from the floor.

B. Hang each door of the cabinet on semi- or fully-concealed hinges with a combination catch and lock.

C. On cabinets 48 in. high and over, install a 3 point catch assembly latching at top, bottom and middle.

3.02 - CHECKOUT AND TESTING

A. Provide checkout, field, and functional testing in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL and SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 16260

LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Low Voltage Variable Frequency Dive Units as specified herein and/or as shown on the Contract Drawings.

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

B. The allowance specified in SECTION 01020, ALLOWANCES has been adjusted to be greater than the previously provided costs for the addition of the five Variable Frequency Drive Units and therefore, shall be utilized to cover the cost of the discrepancy between the Shop Drawing and this section.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are resubmitted with the entire package.

2. Shop Drawings: Provide a complete list of equipment components, and materials, including manufacturer's descriptive and technical literature, and catalog cuts. Provide complete wiring, system interconnection and schematic diagrams for the equipment and controls furnished including external interlocked and controlled components, equipment layout, time versus current curves for protective devices and any other details required to demonstrate that the system and the required external controls have been coordinated and will function as specified and indicated.

a. Provide data to verify that drives can be used for motor lead lengths up to 100 feet without output filters. Include information from the VFD manufacturer or output filter manufacturer stating that the motor terminal voltage limitations as defined by NEMA Standard MG-1 are met. For VFDs located more than a cable length of 100 feet from the motor load provide output filter at VFD.

b. Provide enclosure drawings and details showing all dimensions and construction details. Provide enclosure elevation drawings showing internal and external components with and without doors.

3. Submit a written statement signed by the VFD manufacturer that the VFD manufacturer has received the required information from the pump and motor manufacturers for the driven equipment. Submit statement from each driven equipment manufacturer indicating that the VFD drive submitted is compatible with driven equipment and is rated for the specified application. Statement shall certify that that the VFDs, motors and associated process equipment have been review and coordinated with the equipment selections.

4. Submit VFD wiring schematics showing all termination and required field wiring.
    a. Wiring schematics shall include project specific equipment tags in accordance with Electrical drawings including pump, fan, and motor tags.
    b. Wiring schematics shall use project specific device tags and loop numbers for all hardwired interlocks from devices including but not limited to temperature switches, pressure switches, emergency stop push buttons, etc.
    c. Submit Bill of Materials for each VFD including manufacturer, model number, and quantities of drive components.
5. Submit catalog cutsheets for drive components that clearly indicate all options being provided.
6. Harmonic Analyses Report:
    a. Submit harmonic analysis report including project specific load data for (2) scenarios as Specified in Section 2.02 – Harmonic Analysis.
    b. Submit a statement indicating that the harmonics limits specified are met.
    c. Harmonic loads to be used for analysis are as indicated in Attachment A of Specification 16260.
7. Provide installation and anchoring details to meet earthquake requirements as specified and indicated on the structural drawings.
8. Submit manufacturer’s printed installation instructions.
9. Spare Parts Data: Submit a list of spare parts.
10. Operating and Maintenance Instruction Manuals:
    a. Furnish:
        (1) Operating instruction manuals outlining step-by-step procedures required for system startup and operation.
        (2) Manufacturer's name, model number, service manual parts list.
        (3) Brief description of equipment and basic operating features.
        (4) Maintenance instruction manuals outlining maintenance procedures.
        (5) Troubleshooting guide listing possible reasons for breakdown(s) and repair(s).
        (6) Point-to-point connection wiring diagram for the system.
11. Performance Test Reports: Upon completion of installed system, submit in booklet form all shop and field tests performed to prove compliance with specified performance criteria.
12. Provide any specialty software and all required tools required for programming of the provided VFD units.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Provide quality assurance in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL, SECTION 01400, QUALITY ASSURANCE and as specified herein.

B. Provide services of Service Technician, specifically trained on type of equipment specified.

1. Start-up and testing:

   2 person-days

2. Vendor Training

   2 person-days

3. Person-day is defined as one 8-hour day, excluding travel time.

1.08 - DESCRIPTION

A. Provide complete IGBT (Insulated Gate Bipolar Transistors) type variable frequency drive (VFD) units and appurtenances including drive reactors, passive harmonic filters, transformer, DC chokes, harmonic filters, output filters, enclosures, control circuits and auxiliary items in a single line-up. Provide all drive components specified housed within one enclosure.

B. VFD manufacturer shall be the same manufacturer of the motor control center specified in SECTION 16920, 600-VOLT MOTOR CONTROL CENTERS.

C. Floor mounted VFD units shall not have overall measurements larger than what is shown on the Contract Drawings.

D. Coordinate the VFD units with the driven equipment manufacturers.

E. VFD units shall be manufacturer's standard technology and in production for no less than 5 years.

F. Provide control system operation, input and control signals, status signals and devices as specified herein and as indicated on the Contract Drawings.

G. Provide UL listed and labeled drives.

H. Coordinate VFD input harmonic filter with results of final harmonics study outlined in Paragraph 2.02.

I. VFD units rated 50 HP and larger shall be 18 pulse type.

J. VFD units smaller than 50 HP shall be 6 pulse type. Provide 6-pulse VFDs with either integral 5% impedance line reactor or integral passive harmonic filter in accordance with Contract single line diagrams.

K. Provide standalone VFDs and VFD’s integral to Motor Control Centers specified under specification SECTION 16920 – 600V MOTOR CONTROL CENTERS as indicated on the Contract single line diagrams.

L. For VFDs located more than a cable length of 100 feet from the motor load provide output filter at VFD.

M. Provide equipment rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

1.09 - REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE)

B. Massachusetts Electric Code

C. National Electrical Manufacturers Association (NEMA): MG 1

D. National Fire Protection Association (NFPA):

A. NFPA-70 National Electric Code.

B. Underwriter's Laboratories Inc. (UL):

1. UL-508 Electrical Industrial Control Equipment

1.10 - SEISMIC REQUIREMENTS

A. Conform to the requirements specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS and as specified herein.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

A. The Owner has standardized on Variable Frequency Drive Units as manufactured by Rockwell Automation Group.

1. Rockwell Automation

a. SBR.BLW-4-VFD – Powerflex 753

b. SBR.TP-4-VFD – Powerflex 753 (See SECTION 16920 – Low-Voltage Motor Control Centers)

c. PS4.P-1-VFD, PS4.P-2-VFD – Powerflex 753

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - HARMONIC ANALYSIS

A. The VFD manufacturer shall perform a detailed harmonic analysis as described under this section based on loads included in Attachment A to this Section.

B. The VFD manufacturer shall submit a statement that the harmonics limits specified are met.

C. The VFD system shall be provided such that there is less than 5% voltage total harmonic distortion at the point of common coupling (PCC). Current distortion at the terminals will be in accordance with Table 2.02A.

TABLE 2.02A

MAXIMUM HARMONIC CURRENT

DISTORTION IN PERCENT ISC/IL ODD HARMONIC

Ratio	5 to 9	11 to 15	17 to 21	23 to 33	35 +	TDD
Less than 20	4.0	2.0	1.15	0.6	0.3	5.0
20 to 50	7.0	3.5	2.5	1.0	0.5	8.0
50 to 100	10.0	4.5	4.0	1.5	0.7	12.0
100 to 1000	12.0	5.5	5.0	2.0	1.0	15.0
1000 +	15.0	7.0	6.0	2.5	1.4	20.0

Notes:

1. Even harmonics are limited to 25% of odd harmonics.
2. DC offset distortions not allowed.
3. Ratio = Isc/IL where
4. With phase shift transformers or converters with pulse number (q) higher than six (6) are used, the limits for the characteristic harmonic orders are increased by a factor equal to the square root of q divided by 6

provided that the amplitudes of the non-characteristic harmonic orders are less than 25% of the limits specified in the table.

Isc = Maximum short circuit current at PCC.

IL = Maximum demand load current at PCC (fundamental frequency component)

TDD: Total Demand Distortion

D. The harmonic analysis performed shall be based on the following:

1. Point of common coupling (PCC) shall be main distribution panel DP.04-1, 480 VAC bus.
2. Harmonic analysis shall be performed for two cases.
    a. When the system is fed by the electrical utility.
    b. When the system is fed by the onsite standby generator GEN.04-1.

E. The analysis shall include an explanation of all assumptions, sources of data, methodologies and formulas used in the study and a summary of the study results.

F. Based on the harmonic study results, supply the VFD units with any additional filtering equipment required to meet the harmonic requirements specified herein.

2.03 - PROVISIONS

A. Service conditions shall be as follows:

1. Ambient Temperature Range: 0 deg. C to 40 deg. C.
2. Operational Humidity: Up to 90 percent non-condensing.
3. Environment: As indicated on enclosure schedule.
4. Altitude: Below 3,300 ft. above sea level.
5. Input Power:
    a. Nominal voltage - 460 volts (plus 10 percent or minus 10 percent), 3-phase, 3 wire
    b. Nominal Frequency - 60 Hertz (plus or minus 2 Hz.)

B. Drive Systems:

1. General:
    a. Furnish solid state variable frequency, microprocessor type with Pulse Width Modulated (PWM) output wave form converter. The VFD shall employ a full wave rectifier, a DC bus choke, DC bus capacitors and Insulated Gate Bipolar Transistors (IGBT) as the output switching device to convert nominal 480 volts, 3 phase, 60 Hertz, 3 wire input power into adjustable-frequency 3 wire system at 0 to 480 volts, 3 phase, 0 to 60 Hertz output power.
    b. Motor control circuits shall be wired in accordance with the requirements specified herein and as indicated.
    c. The Contractor shall be responsible for the successful compatibility and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining all loads, torque, speed and performance requirements from the pump and motor manufacturers and integrating these into a variable frequency drive system that fulfills the requirements of this Specification.
    d. Provide constant torque drives or variable torque drives based on the type of the driven equipment load. Constant torque drives “CT” are indicated on Contract single line diagrams.

e. Provide VFD control so that there is accurate zero to full load torque control at low frequencies, including zero speed, with torque repeatability accuracy of 2% or better and torque response time less than 20 ms.

f. Provide on drive thermal magnetic type, 480 volts circuit breaker to be used as main disconnecting device and fixed diode input rectifier for a constant power factor.

g. For units 50HP and larger, provide VFD with three phase, PWM rectifier section, 18-pulse, or higher full wave diode bridge. Provide phase shifting transformer within enclosure at input bridge to provide appropriate phase shift.

(1) The transformer shall provide for the cancellation of the positive and negative sequence harmonic currents at the primary connection.

(2) The transformer shall reduce voltage and current distortion on the primary side and voltage distortion on the secondary side.

(3) The VFD shall be optimized for harmonic rich and high neutral current environment.

(4) Harmonic cancellation shall be by electromagnetic means only, capacitors or electronics shall not be used.

(5) Provide a primary to secondary phase shift by use of multiple secondaries.

h. RMS harmonic output of the drive not to provide more than 5 percent increase in motor heating over similar operation of the motor with zero harmonics in the current.

i. The unit shall withstand drive output terminal line-to-line and line-to-ground short circuits without component failure during start-up and during operation. Drive to safely shutdown until short is cleared.

j. Provide enclosures rated in accordance with the Area Classification Schedule on Contract drawing 00 E-601.

k. Provide NEMA-1 drives with gasketed type cabinets.

l. Provide drive output such that the motors have a base rating voltage less than or equal to 600 volts and that the peak instantaneous voltage shall be limited to 1600 volts or less, with a voltage rise time greater than or equal to 0.1 micro-seconds per NEMA Standard MG-1, Part 31.40.4.2.

m. The drive unit shall be of modular design to provide for ease and speed of maintenance.

n. Control circuits shall be isolated from power circuits. Unit to accept a 4-20 mA DC speed control signal from an isolated, ungrounded transmitter with unit in remote mode and from local door-mounted manual speed potentiometer or micro-processor type keypad with unit in local mode. The input 4-20 mA signal to be optically isolated from the drive run control circuit. Furnish door-mounted switch on the enclosure for local/remote mode. Manual speed potentiometer or keypad controls to have adjustable minimum speed setting of 10 to 80% of full speed and maximum speed setting of 50 to 100% of full speed. The total speed setting to follow a linear time ramp, adjustable from 1-300 seconds for acceleration and deceleration control. Provide output 4-20mA signal for VFD speed statues.

o. Harmonic filters shall be provided with contactors and controlled by the VFD to remove them from the line when the drive is not operating. Contactors shall be provided with spare contacts for remote alarm and to energize status lamp at VFD enclosure.

p. VFD shall be capable of full rated output when powered by incoming voltage with Total Harmonic Distortion (THD) in excess of 10%.

q. Furnish series choke and capacitors on DC bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.

r. Size enclosure to dissipate heat generated by VFD within limits of specified service conditions. Provide integral fans or cooling systems. VFD enclosures to have keypad controls located on exterior of enclosure. Provide visual alarm indicator on cabinet door.

s. Provide oversized cable lugs for incoming and outgoing cables. Cable lugs size shall be per cables as indicated.

2. Performance characteristics:

a. Continuous current rating (amps): Minimum of 110 percent of motor rated full load amps, continuous.

b. Acceleration time to top speed, 1-60 seconds, adjustable.

c. Deceleration time from top speed, 1-60 seconds, adjustable.

d. Frequency stability: +/- 0.5% (at 25 degrees C, +/- 10 degrees C) after reaching operating temperature.

e. Output voltage: Proportional to frequency with low speed boost.

f. Combined drive/and filtering efficiency, defined as VFD output KW divided by VFD input KW, shall meet the following requirements at the specified operating points:

(1) 96 percent minimum at 60 Hz VFD output and 100 percent load.

(2) 92 percent minimum at 50 Hz VFD output and 60 percent load.

g. VFD fundamental power factor shall be 0.95 or higher at all speeds and loads.

h. The VFD shall be capable of sustaining continued operation with a 30% dip in nominal line voltage.

i. Losses to be utilized in drive system efficiency calculation shall include the input isolation transformer, harmonic filter and power factor correction if applicable. Auxiliary controls such as internal VFD control boards and cooling fans shall be included in all loss calculations.

3. Drive Protection:

a. General - Fault detection and trip circuits shall protect VFD and connected motor against line voltage transients, single-phase, power line over-voltage and under-voltage, ground fault, output over-voltage and over-current, and VFD over-temperature. The VFD shall employ three (3) current limit circuits to provide trip free operation. The slow current regulation limit circuit shall be adjustable to 125% of the VFD's variable torque current rating. The rapid current regulation limit shall be adjustable to 170% of the VFD's variable torque current rating. The current switch off limit shall be fixed at 225% of the VFD's full load current rating.

b. Internal Protection: Provide circuitry as follows:

(1) Current limiting, fast acting, semiconductor input fuses for protection of internal power semiconductors.

(2) Instantaneous output over-current trip max. - 200 percent.

(3) DC bus and control circuit transformer fusing.

(4) Grounded control chassis.

(5) Under and over voltage trip, 3 phases.

(6) Motor overload protection, with solid state relays.

(7) Motor and VFD ground fault protection.

(8) Main circuit breaker, with door interlocked handle. Provide means to allow entry into panel by authorized personnel. Circuit breaker to be rated 65,000 AIC.

(9) Fault reset push button.

(10) Line to ground faults.

(11) Input metal oxide varistor and input line reactor for transient protection.

(12) VFD over-temperature.

c. Troubleshooting: Provide diagnostic aids to indicate cause of fault; used to assist in troubleshooting circuit problems. Isolated Form C contacts for remote indication of alarms to include the following:

(1) Over/under voltage indication.

(2) Over-current trip indication.

(3) DC bus charged indication.

(4) Fault detection indication.

(5) Recycle start indication (to indicate that the unit tried to pick up load for three previous tries and failed).

d. Provide power loss ride through capability which will allow the logic to maintain control due to load inertia without faulting. The number of restarts on power loss condition shall be programmable.

4. Auxiliary Systems - Provide variable frequency drive unit with appropriate power circuitry and auxiliary contacts, etc. for energizing and controlling the variable frequency drive as indicated.

C. Control Features:

1. Provide VFD control circuit as indicated on Contract Electrical Drawings.

2. Accept a grounded, isolated, 4-20 mA input remote speed control signal from an external device.

3. Provide a 4-20 mA output signal proportioned to VFD output frequency for remote speed indication.

4. Jog permissive input. When activated along with remote run contact, VFD will run at a pre-set speed.

D. Devices:

1. Provide operating, monitoring or alarm indicating devices, door mounted, as indicated on the Contract Drawings and as follows:

a. Separate adjustable speed potentiometer switch to adjust VFD frequency when operated in manual mode.

b. Speed indicating meter in Hz and rpm to indicate frequency and motor speed of the motor.

c. Control relays as indicated.

d. Provide LED cluster type alarm and status lights. Lights shall be Red for “OFF” position, Green for “ON” position and Amber for “Alarms”.

2.04 - SHOP TESTING

A. For VFD units 50 HP and larger, provide a factory performance test for each variable frequency drive unit. The test to consist of simulating the expected load to be driven. The drive to operate the actual motor load through the expected speed ranges. Test length to be two hours. Provide proto-type factory test results of similar VFD units for units up to 50 HP.

B. Provide a factory burn-in test and a control and alarm test on each drive unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.

C. Provide prototype factory test data for a similar size and type VFD unit for short circuit testing. Data to verify that each drive can be started into a line-to-line fault and line-to-ground fault on the drive terminals. Each drive can be operating at full load and be subjected to a line-to-line fault and line-to-ground fault on the drive terminals. All phases (A, B & C) to be included in test data.

D. Provide certified documentation of all tests performed.

E. Provide above stated tests in addition to routine factory tests.

PART 3 – EXECUTION

3.01 - INSPECTION

A. Examine VFD location for preparation in accordance with manufacturers written instructions. Check conduits and raceway location for connection to units.

B. Visually inspect delivered unit(s) and accessories for conformance with specification and drawings.

C. Verify availability of appropriate pacing signal and program motor protection relay settings.

3.02 - INSTALLATION

A. The VFDs shall be installed as indicated and in accordance with the manufacturer’s installation instructions.

B. Factory-trained service technician, other than sales representatives, shall supervise field installation, inspect, make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust control and instrument equipment until this equipment has been field tested.

C. The VFD units speed input and speed feedback shall be programmed in Hz.

3.03 - SPARE UNITS

A. Contractor to furnish and deliver to Owner PS4.P-3-VFD and associated appurtenances.

3.04 - FIELD TESTING

A. Perform testing checkout, and start-up for variable frequency drive equipment under technical direction of manufacturer's service technician.

B. Coordinate all testing with electrical testing performed under SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

C. Field Tests:

1. Test each drive over the total speed range that it will be required to operate through for the load being driven for two hours. Determine for each drive, motor, and load combination the following at minimum speed, maximum speed, and at 1/3 and 2/3 points between the minimum and maximum speeds:

    a. Input power (kW), voltage, current and RMS power factor on the line side of the drive isolation device.

    b. Output to the driven load in kilowatts.

    c. For each drive, measure the harmonic voltage distortion and harmonic current distortion for each harmonic at the main distribution bus for maximum and minimum load conditions.

    d. Measure the total harmonic voltage distortion and total harmonic current distortion at each PCC, while all drive loads are running. The test results shall confirm the harmonic study results and should prove that harmonic distortion limits specified in Paragraph 2.02 have been met. If testing results are not within the specified limits, provide additional filtering equipment to meet the harmonic distortion limits specified.

2. Test each drive by using the actual control signal for remote and local operation.

3. Test each driver alarm functions.

4. Perform all tests in the presence of the Owner’s representative.

5. Perform the above test in addition to the manufacturer's normal field tests and driven equipment testing as specified in Division 11.

6. Submit final test report with summary comparing field test data with harmonic analysis design calculated values for each drive.

3.05 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF TEXT

See Attachments

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ATTACHMENT A

Pump Station No. 4
Equipment List

Equipment	Total Quantity	Quantity Operating	HP/AMPS/kVA/kW
Non VFD Loads			
P.S. NO. 4 ODOR CONTROL FAN	1	1	1 HP*
PS. NO. 4 EXHAUST FAN	1	1	1 HP*
LP.04-1/XFMR T.04-1	1	1	7.5 KVA
VFD Loads			
RAW WASTEWATER PUMPS 1/2/3	3	2	40 HP**

* Motor is powered by full voltage motor starter.

** Motor is powered with 6-pulse variable frequency drive with passive harmonic filter.

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SECTION 16320

GENERAL PURPOSE DRY-TYPE TRANSFORMERS

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2.01 - ACCEPTABLE MANUFACTURERS 3
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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide General Purpose Dry-Type Transformers as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data of the transformer, enclosure, core and coil, insulation system and all specified accessories.
2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
    a. Failure to include a copy of the mark-up specification sections will result in rejection of the entire submittal with no further review and construction.
3. Provide manufacturer’s printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - DESCRIPTION

A. Provide copper-wound, dry-type transformers as indicated and specified.

B. Provide transformer windings and enclosures rated for the installation location per the Area Classification Schedule on Contract drawing 00 E-601 and in accordance with the requirements herein.

1.08 - REFERENCES

A. Underwriters' Laboratories, Inc. (UL):

1. UL 506 - Transformers, Specialty.

B. National Electrical Manufacturers Association (NEMA):

1. ST 20 - Dry-Type Transformers for General Applications (ANSI C89.2).
2. TP-1 – Guide for Determining Energy Efficiency for Distribution Transformers.

C. American Society for Testing and Materials (ASTM):

1. D 635 - Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.

D. Massachusetts Electrical Code.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.09 - SEISMIC REQUIREMENTS

A. Conform to the requirements as indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

1.10 - REQUIREMENTS OF REGULATORY AGENCIES

A. Furnish transformers in accordance with NEMA ST 20 and UL 506.

B. Furnish transformers with UL listing mark.

PART 2 - PRODUCTS

2.01 - ACCEPTABLE MANUFACTURERS

A. Eaton Corporation

B. Siemens

C. Schneider Electric

D. Or equal.

2.02 - TRANSFORMERS

A. Provide copper-wound, dry type transformers.

B. In NEMA 1 and NEMA 12 designated areas, furnish general purpose, ventilated, dry-type transformers in indoor-style enclosure. On single-phase transformers and three-phase transformers above 9 KVA, provide two windings per phase.

C. Auto transformers shall not be used in place of general purpose dry-type transformers.

D. Furnish two 2-1/2 percent full capacity taps above and below nominal in high voltage winding for transformers rated above 15 kVA. Provide two five percent taps below rated voltage for transformers rated 15 kVA and below.

E. Furnish transformers, single-phase or three-phase, as indicated. Furnish transformers with kVA ratings as indicated.

F. Furnish three-phase transformers, Delta-Wye, Delta-Delta or Wye-Wye connected as indicated and conforming with latest NEMA standards. Scott Tee connected transformers above 9 kVA shall not be used.

G. Furnish transformers with primary and secondary voltages and frequency, wye connected, as indicated for secondary windings, with neutral brought out for cable termination.

H. Furnish transformers that have continuous operation at rated kVA with normal life expectancy as defined in NEMA ST 20.

I. For transformers rated 30 kVA or less, furnish 180 deg. C insulation. Performance shall be obtained without exceeding 115 deg. C average temperature rise by resistance or 145 deg. C hot spot temperature rise in 40 deg. C maximum ambient and 30 deg. C average ambient. Maximum coil hot spot temperature shall not exceed 185 deg. C.

J. Transformers rated greater than 30 kVA shall be provided with 220 deg. C insulation materials with proven reliability and low-loss 80 deg. C full load operating temperature rise rating.

K. Furnish transformers made of flame retardant materials that will not support combustion as defined in ASTM D 635.

L. Furnish core mounting frames and enclosures of welded and bolted construction with mechanical rigidity and strength to withstand shipping, erection and short circuit stresses.

M. Transformers located in sprinkled areas shall be provided with NEMA 2 rated enclosure to protect transformer from water falling at an angle of 75 degrees from the vertical.

N. Furnish transformers that meet UL thermal overload test of 200 percent of rated current for one half hour.

O. Furnish transformers not to exceed the 65 deg. C rise established by UL as safe limit for maximum surface enclosure temperature.

P. Furnish transformers with sound level not exceeding:

Trans. kVA	Average Sound Level in dB NEMA ST 20
0 - 09	40
10 - 50	45
51 - 150	50

Q. Install transformers with sound levels greater than 50 dB on resilient vibration isolating mounts to prevent amplification of sound. Transformers rated 15 kVA and larger to be provided with rubber washer anti-vibration pads and molded neoprene assemblies to isolate noise from the transformer to the mounting surface.

R. Provide a grounded copper electrostatic shield between the primary and secondary windings. The design of the shield shall be to shunt noise and transients to the ground path.

S. Furnish transformers sized and configured for 100 percent neutrals for the secondary full load current.

T. Furnish transformers with copper windings.

U. Furnish transformers that meet efficiency guidelines of NEMA Standards in accordance with the Department of Energy (DOE) requirements.

2.03 - SHOP TESTING

A. Furnish results of audible-sound-levels tests in accordance with NEMA ST 20 of similar size transformer.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Install and guard transformers as specified by latest Massachusetts and ANSI standards, and in accordance with manufacturer's printed instructions.

B. Install transformers so that there is space around transformer to dispose of transformer full load losses by ventilation without ambient temperature reaching 40 deg. C. maximum as specified in Paragraph 2.02.

C. Unless otherwise indicated, wall mount with supports, transformers rated 15 kVA and below. Floor mount transformers rated above 15 kVA.

D. Provide lifting lugs and jacking plates on transformer enclosure.

E. Provide concrete pad for all floor mounted transformers.

3.02 - CHECKOUT AND TESTING

A. Provide in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 16400

SURGE PROTECTION DEVICES

PART 1 - GENERAL 1
1.01 - SCOPE 1
1.02 - MEASUREMENT AND PAYMENT 1
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2.01 - ACCEPTABLE MANUFACTURERS 3
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2.03 - SYSTEM APPLICATION 6
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PART 3 - EXECUTION 7
3.01 - INSPECTION 7
3.02 - INSTALLATION 7
3.03 - CHECKOUT AND TESTING 7
3.04 - CONTRACT CLOSEOUT 7

PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Surge Protection Devices (SPDs) as specified herein and/or as shown on the Contract Drawings.

B. Provide Surge Protection Devices (SPD) integral to the electrical distribution system equipment as indicated. The distribution system includes switchboard, motor control centers, 480V distribution panels and 120/208V panelboards.

C. The components shall provide protection for electrical and electronic devices against the damaging effects of surges, transients and electrical line noise.

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.

5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.

6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.

7. "Exposed" shall mean not concealed as defined above.

8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.

9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and construction.

2. Shop drawings, manufacturer's product data, and component ratings in accordance with this section and the requirements of Section 16050.

3. Provide verification that the SPD complies with the required ANSI/UL 1449 listing by UL.

4. Submit SPD type, model number, system voltage, phases, modes of protection, voltage protection rating (VPR) and nominal discharge current (In).

5. Provide outline drawings and internal wiring diagrams.

6. Submit factory test data.

7. Operating and Maintenance Instruction Manuals:

a. Operating instruction manuals outlining step-by-step procedures for system startup and operation and in accordance with SECTION 01300, SUBMITTALS.

b. Manufacturer’s name, model number, service manual parts list.

c. Brief description of equipment and basic operating features.

d. Maintenance instruction manuals outlining maintenance procedures.

e. Troubleshooting guide listing possible breakdown and repairs.

f. Simplified connection wiring diagrams for each circuit.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. SPD units and all components shall be designed manufactured and tested in accordance with the latest applicable UL Standard (ANSI/UL 1449 3rd Edition).

B. SPD units shall be UL approved for use with Lightning Protection Systems.

1.08 - REFERENCES

A. Underwriters Laboratory (UL):

B. Massachusetts Electric Code.

C. American National Standard Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):

1. ANSI/IEEE C62.41 - IEEE Guide for Surge Voltages in Low-Voltage AC Power Circuits
2. ANSI/IEEE C62.45 - IEEE Guide for Surge Suppressor Testing
3. National Electrical Manufacturers Association (NEMA):
4. NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum)
5. NEMA LS 1 - Low Voltage Surge Protection Devices

D. Military Standard: 220A - Radio Frequency Interference and Electromagnetic Interference.

E. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - ACCEPTABLE MANUFACTURERS

A. Transient voltage surge suppression components.

1. Eaton-Cutler Hammer
2. Schneider Electric
3. Siemens
4. Or equal.

2.02 - GENERAL

A. Electrical Requirements:

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277
L-N; L-G; N-G	400V	800V
L-L	800V	1800V

7. ANSI/IEEE C High Let-Through Voltage – The let through voltage based on an ANSI/IEEE C62.41 Category C High waveform (10kV, 10kA) shall not exceed the following:

Mode	208Y/120	480Y/277
L-N	560V	960V

8. ANSI/IEEE Cat. B Ringwave Let Through Voltage – The let-through voltage based on an ANSI/IEEE C62.41 Category B Ringwave (6 kV, 500 amps) shall not exceed the following:

Mode	208Y/120	480Y/277
L-N	160V	165V

B. SPD Design:

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      (1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

      (2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

      (3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

   b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

   c. Surge Counter

      (1) The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

      (2) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection - The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements - SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.03 - SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, motor control centers (MCC), and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards and MCC)	250 kA	125 kA
B	480 VAC Distribution Panelboards	160 kA	80 kA
A	208/120 VAC Panelboards	120 kA	60 kA

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.04 - LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.

5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.

6. The SPD shall be of the same manufacturer as the panelboard.

7. The complete panelboard including the SPD shall be UL67 listed.

B. Switchboard and MCC Requirements

1. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

2. The SPD shall be of the same manufacturer as the switchboard and MCC.

3. The SPD shall be factory installed inside the switchboard and/or MCC, at the assembly point by the original equipment manufacturer

4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchboard and/or MCC, as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.05 - SHOP TESTING

A. Provide a factory performance test for each unit. The tests shall be in accordance with the latest version of NEMA and UL Standards:

PART 3 - EXECUTION

3.01 - INSPECTION

A. Visually inspect delivered unit(s) and accessories for conformance with the Contract Drawings and specifications.

3.02 - INSTALLATION

A. Install unit in compliance with the manufacturer's printed instructions. All electrical installation Work shall be in accordance with UL Listing Requirements and applicable Massachusetts Electrical Codes.

3.03 - CHECKOUT AND TESTING

A. Provide checkout, field, and functional testing in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

3.04 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

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SECTION 16402

UNDERGROUND DISTRIBUTION SYSTEM

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3.01 - GENERAL 3
3.02 - INSTALLATION OF CONDUITS 3
3.03 - AS-BUILT DRAWINGS OF UNDERGROUND WORK 4
3.04 - CONTRACT CLOSEOUT 4

PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Underground Distribution Systems as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:
1. Submit shop drawings and manufacturers' product data for all components and materials used in the construction of underground distribution systems in accordance with requirements of SECTION 16050, ELECTRICAL WORK - GENERAL.
2. Provide "As-Built" drawings of underground ductbank system in accordance with SECTION 01030, SPECIAL REQUIREMENTS and 01300, SUBMITTALS.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Provide in accordance with SECTION 01400, QUALITY ASSURANCE.

1.08 - REFERENCES

A. Massachusetts Electrical Code.

B. National Electric Safety Code.

C. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.09 - DESCRIPTION

A. Provide underground distribution system as indicated and specified.

B. Conform to lines, grades, elevations, and dimensions. Resolve interferences with other underground conduit, piping or equipment, either new or existing with the Authority. Match components for installation.

C. Provide Schedule 40 polyvinylchloride (PVC) conduits for power and control circuits. Provide rigid galvanized steel conduits for instrumentation, communication, I/O, fire alarm and data highway cable circuits.

1.10 - SEISMIC REQUIREMENTS

A. Conform to the requirements as indicated on the Structural Drawing S-1 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

PART 2 - PRODUCTS

2.01 - ACCEPTABLE MANUFACTURERS

A. Polyvinylchloride (PVC) Conduit:

1. Specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEM Paragraph 2.01.B.

B. Rigid Steel Conduit, Galvanized:

1. Specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEM Paragraph 2.01.A.

2.02 - MATERIALS AND COMPONENTS

A. Conduit Spacers: Furnish conduit spacers made of plastic to maintain spacing between conduits.

B. Cable Supports in Handholes shall be provided as follows:

1. Cable racks, stainless steel.

2. Cable supports, stainless steel.

3. Insulators, high grade dry-process porcelain.

PART 3 - EXECUTION

3.01 - GENERAL

A. Perform Work in accordance with the Massachusetts Electrical Code and as indicated and as specified.

3.02 - INSTALLATION OF CONDUITS

A. Lay conduits, indicated to be direct buried in the ground.

B. Provide separation of power and control conduits of 3 inches both vertically and horizontally. Build ductbank layer by layer. Coordinate with General Contractor to backfill and compact each layer to provide support for next layer.

C. Separate power and control ducts from instrument telephone, fire alarm and signal ducts by 12 inches.

D. Provide yellow ductbank marker tapes, reading "Caution - Electrical Lines Below", over entire length of ductline. Locate tapes 12 inches below grade. Provide a tape for every 12 inches of width of ductline.

E. Install conduit, with spacers as specified. Rigid galvanized steel conduits to be painted with bituminous paint by others under SECTION 09940, FIELD PAINTING.

F. Install conduit runs following routing on drawing and running in straight lines. Provide end bells where ducts enter handholes of the same material as the duct system. Terminate steel conduit entering hand holes in grounding bushing. Where deviation from a straight line becomes necessary, install bends of radius which allow for rodding and installation of cable.

G. Accomplish changes in direction of runs exceeding total of 10 degrees, either vertical or horizontal, by long sweep bends having radius of curvature of 25 ft. Manufactured bends can be used at ends of short runs of 100-ft. or less, and then only at or close to the end of run. Provide long sweep bends made up of one or more curved or straight sections and/or combinations thereof. Install manufactured bends with radius of 36-in. where larger radius cannot be used.

H. Lay ductlines to slope of 4 inches per 100-ft. and slope to handholes from a high point between the handholes. Ductlines are to slope away from buildings.

I. Install spacers at intervals of 4 ft. and stagger between tiers of ducts to provide 12-in. of longitudinal separation. Install base spacers to provide 3-in. between bottom of trench and underside of bottom conduits. Coordinate with General Contractor to fill space with concrete under SECTION 03300, CAST-IN-PLACE CONCRETE. Firmly wire conduits and spacers together before concrete is placed.

J. Prior to placing of concrete under SECTION 03300, CAST-IN-PLACE CONCRETE, General Contractor to remove all dirt, sand, and any other debris from between conduits and from trench bottoms under SECTION 02210, EARTH EXCAVATION, BACKFILL, FILL AND GRADING. Hold conduits in place to prevent floating or accidental movement.

K. Stagger joints in conduits 6-in. Do not allow couplings to rest on bottom of trench. Install couplings for plastic conduit in accordance with manufacturer's recommendations.

L. General Contractor to install concrete encasements under SECTION 03300, CAST-IN-PLACE CONCRETE so clearance of 12-in. from concrete to parallel pipes, lines, and structures, is maintained. Where ducts cross, clearance of 6 inches is required.

M. At a point close to the handhole wall, drive a ground rod into earth. Extend ground rod 6-in. above finished handhole floor. After completion of handhole by General Contractor under SECTION 03300, CAST-IN-PLACE CONCRETE connect 6 foot length of No. 4 bar copper ground wire to ground rod. Connect grounding bushings, cable racks, covers, other metallic parts, splices, and ground wire installed with each feeder to ground loop.

N. Keep conduits clean of concrete, dirt, and other substances during the course of construction. After the ductlines have been completed, pull a standard flexible mandrel not less than 12-in. long, having a diameter 1/4-in. less than the inside diameter of the conduit, through each conduit, after which pull a brush with stiff bristles through each conduit to make certain that no particles of earth, sand, or gravel have been left in the line. Replace conduit runs that do not allow the passage of the mandrel at no additional cost to the Authority. Pneumatic rodding may be used to draw in the lead wire. Install in spare conduits a pull wire or rope, and plug and seal spare conduits after cleaning.

3.03 - AS-BUILT DRAWINGS OF UNDERGROUND WORK

A. Provide one set of marked copies of contract drawings, showing exact routing and depths of all underground conduit and duct handholes. Provide scaled plot plans, showing principal outline of buildings and structures. Reference conduits, ducts, and all bends deviating from straight line, dimensionally from fixed objects or structures.

3.04 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 16450

GROUNDING

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Grounding as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
    a. Failure to include a copy of the marked-up specification sections will result in rejection of the entire submittal with no further review and construction.
2. Submit shop drawings and manufacturers' product data in accordance with requirements of SECTION 16050, ELECTRICAL WORK - GENERAL.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C2: National Electrical Safety Code

B. National Fire Protection Association (NFPA):

1. NFPA 70: National Electric Code
2. NFPA 780: Lightning Protection Code

C. Massachusetts Electrical Code

D. American Society for Testing and Materials (ASTM):

1. B3: Soft or Annealed Copper Wire.
2. B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
3. B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

E. Underwriters Laboratories, Inc. (UL):

1. U.L. 44: Wires and Cables Rubber Insulated.
2. U.L. 83: Wires Thermoplastic-Insulated.

F. National Electrical Mfg's Association (NEMA):

1. WC 3: Rubber Insulated Wire & Cable.
2. WC 5: Thermoplastic Insulated Wire & Cable.
3. WC 7: Cross-Linked-Thermosetting Polyethylene-Insulated Wire & Cable.
4. WC 8: Ethylene-Propylene-Rubber-Insulated Wire & Cable.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.08 - DESCRIPTION

A. Provide a single, integrated grounding system, including conductors, raceways, and connections, indicated and specified, and in accordance with the Massachusetts Electrical Code Article 250 and the National Electrical Safety Code.

B. Include grounding of switchboard, motor control centers, electric equipment enclosures, generators, transformers, ground grid systems with ground rod and water pipe connections; structural steel, and lightning protection system.

C. Include grounding conductors completely inter-connecting water supply pipe, ground grid, substation, switchgear and motor control center ground buses, other distribution equipment, and other groundable equipment.

1.09 - SEISMIC REQUIREMENTS

A. Conform to the requirements as indicated on the structureal drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

PART 2 - PRODUCTS

2.01 - ACCEPTABLE MANUFACTURERS

A. Ground Rods:

1. Erico Products Inc.
2. Galvan Electrical Products.
3. Nehring Electrical Works.
4. Or equal.

B. Exothermic Welding:

1. Erico Products, Inc.
2. American Brass Mfg. Co.
3. Orgo-Thermit, Inc.
4. Or equal.

C. Connecting Hardware:

1. American Brass Mfg. Co.
2. Thomas and Betts
3. Anderson Electric Corp.
4. Or equal.

2.02 - MATERIALS AND COMPONENTS

A. Conductors:

1. Provide tinned copper grounding conductors , sized as indicated . Provide protection of conductors if physical damage would result from direct exposure.
2. Provide uninsulated conductors where conductors are buried in the earth or where they are embedded in the concrete.
3. In buildings, provide insulated grounding conductors with green insulation. Provide insulated grounding conductors with insulation rated at 600 volts.

B. Ground Bus:

1. Provide a 2-in. by 1/4-in. tinned copper bar with bolted type connectors as indicated.

C. Ground Rods:

1. Provide copper-clad steel or galvanized steel ground rods; type, diameter and length as indicated on drawings. Make cable to ground rod connection without passing over end of ground rod.

D. Connections:

1. Provide silicon bronze ground clamps for use on copper or brass pipes which are UL listed.
2. Provide ground clamps, for use on iron pipes, of galvanized or malleable iron, or of standard noncorrosive material.
3. Furnish ground clamps, for use on pipes, with rigid metal base providing solid contact by seating on the pipe. Do not use strap type clamps.

PART 3 - EXECUTION

3.01 - INSTALLATION OF GROUNDING CONDUCTORS

A. Install grounding conductors so that they will not be exposed to physical damage. Install connections firm and tight. Arrange conductors and connectors so no strain on connections.

B. Run grounding conductors associated with direct burial cables in common trenches above or if indicated beside cables.

C. Bury equipment grounding conductors 30 inches deep. Bring loops or taps up for connection to equipment or other items to be grounded.

D. Where raceways are used to contain and protect grounding conductors, install in accordance with Sections 16110 and 16402.

E. Where bare grounding conductors are contained within metallic raceways, bond ends of raceways to conductors.

F. Install loop type, low impedance, grounding system interconnecting all components so two grounding connections are provided for each item of electrical equipment. Ensure that severing of any single grounding conductor in this system does not remove grounding protection on any major item.

G. Connect structural steel at locations indicated to the grounding loop and connect to each vertical column by loop or tap. Provide exothermic weld connections. Connect two opposite points on external loop to two different points on grounding system.

H. Buried and concealed ground connections are to use exothermic welding.

I. Make accessible connections to structural members by exothermic welding process. Connections to equipment or ground bus shall be by bolted connectors.

3.02 - INSTALLATION OF GROUND RODS

A. Install ground rods in manholes and handholes in accordance with requirements specified under Section 16402, UNDERGROUND DISTRIBUTION SYSTEMS. Connect each grounding conductor entering a manhole or handhole to ground rod by exothermic weld.

B. Install ground rods where indicated. Install the top of the rod 12-in. below the ground surface.

C. Make connection to overall grounding system as indicated.

D. Ensure that final resistance of interconnected ground system is 3 ohms, or less. Measure ground resistance in normally dry conditions, and not less than 48 hours after rainfall.

3.03 - EQUIPMENT GROUNDING

A. Ground each piece of electrical equipment by means of a grounding conductor installed in raceway feeding that piece of equipment with copper wire sized in accordance with Massachusetts Electric Code. Grounding conductors installed in conduit with insulated conductors to be furnished with green, 600-volt insulation. Ground conductors are in addition to and not to be considered as the neutral wire of the system.

B. Connect power transformer cases and neutrals to grounding system. Connect neutral ground connection at transformer terminal. Provide two separate, independent, diagonally opposite, connections for power transformers so removal of one connection will not impair continuity of other.

C. Connect two separate ground connections from ground grid to ground bus of switchgear assemblies, motor control centers and outdoor generator. Confirm that each connection for item of equipment is from different section of ground grid.

D. Connect a grounding conductor between panelboard and grounding system. Where a grounding bar is furnished with panelboard, connect grounding conductor to bar.

E. Where conduits are not effectively grounded by firm contact with a grounded enclosure, apply grounding bushings on one end of conduit run.

F. Install a separate grounding conductor from ground system to motors of 100 hp. and larger, in addition to raceway system. Ground motor ground connection to motor frame, independent of mounting bolts or sliding base. Ground motor to nearest point on grounding system, unless otherwise indicated.

G. Connect grounding conductors from equipment in area where ground bus is required to ground bus. Connect ground bus to grounding system. Mount ground bus on 600V pedestal insulators.

H. Connect lightning arresters to ground system by suitable conductors. Where lightning arresters are furnished with electrical equipment and grounding connections are not inherently provided, confirm that separate grounding conductor connects lightning arresters with system ground.

I. Connect generator neutral to grounding system by a grounding conductor of size required by NEC, unless a larger size is indicated. Connect grounding conductor to generator disconnect enclosure and generator neutral on generator side of disconnect. Ground generator frame with two separate independent connections, so removal of one connection will not impair continuity of other.

J. Ground each street lighting standard or pole by ground rod driven near base of standard, in accordance with requirements of National Electric Safety Code. Connect ground rods to grounding conductor brought with street lighting feeder cable.

K. Ground transformers, lightning arresters, insulators and other appurtenances, installed on poles, poles and timber structures, or metal structure. Run grounding conductors between poles or structure and ground rods. Protect grounding conductor by molding applied for 8 ft. above ground, with both molding and conductor stapled. Install ground rod where indicated and driven until top of rod is 1 ft. below ground.

L. Interconnect the water piping systems with the grounding system per the Massachusetts Electrical Code.

M. Ground wire fences when used to enclose electrical equipment or when overhead electrical lines cross fence. Unless otherwise indicated, provide grounding by buried outside peripheral ground loop; connections to each corner fence post and nearby ground rod; flexible connections to each gate; and at least two connections to grounding system from approximately opposite positions on fence.

N. Connect the ground rods to the grounding conductor run with the direct burial cable.

3.04 - SIGNAL GROUNDING

A. Ground signal surge protection and shields of twisted, shielded cable using a signal bonding conductor. The signal bonding conductor shall be a continuous path from the instrument surge protection or shield to the grounding electrode conductor. The signal bonding conductor shall be isolated from the equipment grounding conductor for its entire path.

B. Where convenient several signal bonding conductors may be conbined, providing that all the following conditions are met:

1. The combined signal bonding conductor shall have the equivalent cross section of the conductors that it was combined from or three times the cross section of the largest conductor that it was combined from, whichever is less.

2. The combined signal bonding conductor shall be isolated from the equipment grounding conductor.

3. Where two signal bonding conductors are combined use a three port insulated splice.

4. Where three or more signal bonding conductors are combined, use a copper bus mounted on 600V insulators. Attach each conductors to the bus using an insulated ring tongue lug and screw terminal.

3.05 - TESTS AND CHECKOUTS

A. Provide checkout and testing of the entire grounding system in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

3.06 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 16900

ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT

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PART 1 - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Electrical Control and Miscellaneous Electrical Equipment as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit shop drawings and manufacturer's product data, brochures including wiring diagrams in accordance with SECTION 16050, ELECTRICAL WORK - GENERAL.
2. Wiring diagrams to show control interface points provided with other equipment.
3. Shop drawings to include:
    a. Outline drawings with elevations.
    b. Equipment arrangement drawings.
    c. Anchor bolt location drawings.
    d. Electrical schematics and wiring diagram using project specific equipment tags.
    e. Electrical fuse/circuit breaker characteristic.

f. Equipment performance curves and technical data.

g. Bill of installation/assembly materials.

h. Equipment weights.

i. Completed manufacturer’s data sheets clearly annotated to show all options being included.

j. Assembly sizes and weights.

4. Electrical Enclosures:

a. Bill of installation/assembly material using project specific equipment tags.

b. Outline drawings with elevations and anchor bolt locations.

c. Minimum dimensions for Electrical Enclosures are indicated on the Contract drawings only. Equipment Enclosure to be sized to accommodate all internal components provided under this Contract.

d. Submit elevation drawings showing locations and dimensions if all internal components devices.

e. Electrical Enclosure size shall be sized as required by submitted components and associated connections required for a complete and operational system including VFD’s, lighting panels, transformers, and distribution panels.

f. Dimensions for internal components be as indicated by approved submittal dimensions. Electrical Enclosure shall not be approved until all internal components have been submitted and approved.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - REFERENCES

A. Underwriter's Laboratories, Inc. (U.L.):

1. UL-467: UL Standard for Safety, Grounding and Bonding Equipment.

2. UL-489: UL Standard for Safety, Molded-Case Circuit Breakers and Circuit Breaker Enclosures.

3. UL-823: Electrical Heaters for Use in Hazardous (Classified) Locations.

B. National Electrical Manufacturers Association (NEMA):

1. 250: Enclosures for Electrical Equipment (1000 volts maximum).

2. ICS 1: General Standards for Industrial Control and Systems.

3. ICS 2: Industrial Control Devices, Controllers and Assemblies.

4. ICS 4: Terminal Blocks for Industrial Use.

C. American Society for Testing and Materials (ASTM) Publications:

1. D 178: Specification for Rubber Insulating Matting.

D. National Fire Protection Association (NFPA):

1. NFPA-70 National Electric Code (NEC).

E. Massachusetts Electric Code.

1.08 - SEISMIC REQUIREMENTS

A. Conform to the requirements as indicated on Structural Drawing 00-S-001 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

1.09 - DESCRIPTION

A. Provide and connect the electrical control equipment and miscellaneous electrical equipment, including such instruments and devices indicated and specified. Device enclosures for electrical equipment shall comply with the requirements of Massachusetts Electric Code including Hazardous Locations, Class, Division, and Group as indicated.

PART 2 - PRODUCTS

2.01 - ACCEPTABLE ELECTRICAL DISTRIBUTION MANUFACTURERS

A. Allen-Bradley.

B. General Electric Company.

C. Cutler-Hammer.

D. Square D Company.

E. Appleton Electric Company.

F. Crouse-Hinds Company.

G. O-Z/Gedney.

H. Or equal.

2.02 - ACCEPTABLE STAINLESS STEEL/GALVANIZED STEEL CHANNEL MANUFACTURERS

A. Unistrut Corp.

B. Power-Strut.

C. B-Line Systems, Inc.

D. Or equal.

2.03 - ACCEPTABLE FIBERGLASS CHANNEL MANUFACTURER

A. Omnistrut, Champion Fiberglass.

B. Durostrut, Enduro Composite Systems.

C. Struttech, Entrum Industries.

D. Or equal.

2.04 - SAFETY DISCONNECT SWITCHES

A. Provide heavy duty type, safety switches, with external operating handles, 3 PST, rated 600 volt, 60 Hertz with ampere rating as indicated, and having provisions for padlocking.

B. Provide rejection type fuses, 600 volts, 200,000 A.I.C., dual element, time delay, Class RK-5.

C. Heavy duty safety switches to be UL listed, and meet or exceed NEMA Standard KS1.

2.05 - PUSHBUTTON AND SELECTOR SWITCH STATIONS

A. Provide RUN-OFF-REMOTE (ROR) switches, start-stop, push buttons, tumbler switches and other accessory devices as necessary for the control of motors and other electrical equipment or devices as indicated where shown on the wiring schematics and/or plan drawings.

B. Provide pushbutton and selector switch stations made for heavy-duty service and with momentary or maintaining contacts as indicated or as necessary for starting and stopping of equipment with 10 amp contact ratings.

C. Acceptable manufacturers of heavy-duty switches and pushbuttons are Square D, Cutler-Hammer, Allen Bradley or equal. Indicating lights to be led cluster type.

D. At stations provide nameplates with white letters on black background.

E. Provide explosion proof stations approved for use in Massachusetts Electric Code, Class I, Division 1, Group C & D areas. Stations shall also meet NEMA 4X area requirements.

F. Provide galvanized cast-iron enclosures for NEMA Type 4 watertight stations.

G. Provide fiberglass reinforced polyester NEMA Type 4X enclosures for stations located in highly corrosive areas. Provide gaskets and Type 316 stainless steel screws, to prevent entry of chemicals.

2.06 - MANUAL MOTOR STARTERS

A. Provide manual motor starters where indicated and for 120-volt, 60-Hertz fractional horsepower motors.

B. Provide each manual motor starter with overload heater or heaters of suitable capacity for motor-running over-current protection for motor it controls. Provide manual starters as single or 2 pole, as necessary, and with toggle mechanisms indicating OFF and ON positions. Provide manual starters with built-in HAND-OFF-AUTO switches. Provide enclosures as indicated.

C. Manual starters to be located within sight of motors, as defined by Massachusetts Electric Code.

2.07 - WALL-MOUNTED COMBINATION STARTERS

A. Unless otherwise indicated, provide each combination starter with motor circuit protector and full-voltage magnetic starter. Provide starters in an enclosure that meets the requirements of the enclosure schedule. Provide motor circuit protectors and starters as specified in SECTION 16920, 600-VOLT MOTOR CONTROL CENTERS.

B. Indicating lights shall be LED cluster type, heavy-duty, oil-tight units. Lights shall be Red for “OFF” position, Green for “ON” position and Amber for “Alarms”.

2.08 - CONTROL PANELS AND ELECTRICAL ENCLOSURES

A. Provide NEMA 4X, 316 stainless steel, quad-door, back-to-back electrical enclosures.

B. Provide enclosures with back panels constructed of at least 14 gage steel and provided with terminal blocks for connection of external wiring. Provide door and body stiffeners in panels over 36 inches in length. NEMA 4X panels shall be provided with hand operated quick disconnects of 316 stainless steel material.

1. Provide electrical enclosure doors with heavy duty hydraulic hinges for opening/closing. Hinges to allow doors to open to 180°.

C. Provide nameplates for each panel and each device on panel. Nameplates of laminated plastic material, at least 3/32 in. thick, and with white letters on a black background.

D. Secure nameplates with self-tapping, Type 316 stainless steel metal screws.

1. Provide terminal blocks rated for 600 volts with screw type terminals.

2. Terminal blocks to be one piece with full barriers.

3. Acceptable manufacturers of terminal blocks are General Electric, Marathon, Weidmuller or equal.

E. Provide print pocket on inside of enclosure and include as-built drawings.

F. Where 480V AC and 120 VAC are required within the same enclosure, install components to insure separation of wiring for the panel voltage circuits.

G. Free standing enclosures shall be provided with light fixtures, light switch and 20 amp GFI protected receptacle. Light fixtures shall be UL listed for wet locations and provided with glass globe, metal guard and 100 watt incandescent lamp.

H. Where intrinsically safe wiring is required within the panels, the following requirements shall be met:

1. Within enclosures, conductors or intrinsically safe (IS) circuits shall be separated two inches from conductors of any non-intrinsically safe circuit. Within the enclosure the conductors shall be secured.

2. Intrinsically safe wiring shall not be routed in the same conduit as non-IS wiring.

3. Terminals in panels with IS wiring shall be identified in a manner that will prevent unintentional interference with the control circuits during testing and servicing.

I. Provide enclosures types to meet the requirement of the Area Classification Schedule indicated on the Contract Electrical Drawing 00 E-601.

J. Dimensions of Electrical Enclosures indicated on Contract drawings are shown as minimum dimensions only. Provide enclosures sized to accommodate submitted internal enclosure components.

K. Dimensions of Electrical Enclosures shall include space for future equipment and future variable frequency drives as indicated on Contract drawings.

L. Provide enclosures with 120VAC closed loop air conditioning to maintain maximum ambient temperature requirements of internal components.

1. Air conditioning rating shall be as required for submitted electrical enclosure components.

2. Provide NEMA 4X stainless-steel air-conditioning system with corrosion package.

M. Provide a 120VAC heater at both the front and back of the electrical enclosure.

1. Heaters to be provided with integral thermostat to maintain equipment minimum temperature requirements in accordance with manufacturer requirements.

N. Mount SCADA system radio antennas at height as required by results of radio path survey.

O. Provide UL listed and NEMA rated pushbuttons, LED cluster type indicator lights and switches of heavy duty, oil tight types. Provide relays of industrial types, with 120-volt, 60-Hertz operating coils, and contacts rated for intended service. Power from fused control power transformers.

P. All indicating lamps to be LED cluster type. Provide “Red” lights to indicate equipment on status. Provide “Green” lights to indicate equipment off status. Provide “Amber” to indicate alarm conditions.

Q. Where visual strobe or warning lamps are required, provide heavy duty beacon. Acceptable manufacturers are Edwards Signal Catalogue No. 93, Hubbell, Gamewell or equal.

R. Where audible horn alarms are required, provide from the following acceptable manufacturers: Edwards Signal 870P, Simplex, Faraday, or equal.

S.

2.09 - RUBBER MATS

A. Provide insulating rubber mats conforming to ASTM D-178 Type I, Class I: Mats shall be 3 ft. wide and have a length equal to the equipment before which they are to be placed. Provide two spare mats, each 12-feet long as spares.

B. Provide mats for transformers, switchboard, panelboards, motor control centers, control panels, SCADA racks, Fire Alarm Panels and variable frequency drives.

2.10 - CONTACTORS AND RELAYS

A. Provide mechanically held, heavy duty industrial type contactors (relays) for lighting control, rated 30 amps, 600 volts, with number of poles as indicated.

B. Provide contactor in the required NEMA enclosure suitable for wall mounting. Provide circuit breaker or fuse protection on each ungrounded pole. Provide mechanically held contactor from the following acceptable manufacturers: Automatic Switch Company 917 series, Cutler-Hammer, Square D or equal.

C. Provide control power transformer with primary and secondary fuse protection. Control power to be 120 volts, single phase.

D. Provide solid-state, industrial grade timing relays from the following acceptable manufacturers: Allen Bradley Series 700, Cutler-Hammer, Siemens or equal.

E. Provide industrial grade relays, NEMA rated, from the following acceptable manufacturers: Square D Class 8501, Cutler-Hammer, Allen Bradley or equal.

2.11 - NAMEPLATES

A. Provide nameplates for equipment (including pushbutton and selector switch stations) listed in this Section to designate the equipment controlled and their function.

B. Nameplates shall be laminated black bakelite with one-quarter inch (1/4-in.) high, white, recessed letters. Securely attach to the equipment with Type 316 stainless steel screws, or rivets. Adhesives, glue or cements will not be permitted.

C. Provide all junction boxes, pull boxes, disconnect switches and control panels with a nameplate to designate the system wiring contained within.

D. Install nameplates in a location near or on the equipment or devices.

2.12 - TERMINAL BLOCKS

A. Provide terminal blocks in all terminal boxes panels, control and instrumentation cabinets/panels requiring terminations as indicated on drawings or by wiring diagrams for equipment actually purchased. All terminals shall be rated 600V, 20 amp. All terminals shall be screw type with provisions for white wire markers.

2.13 - CHANNEL

A. Provide Type 316 stainless steel channel or fiberglass channel with corresponding accessories as specified in SECTION 16110, ELECTRICAL RACEWAY SYSTEMS and herein.

B. Provide hot-dipped galvanized after fabrication for steel channel and accessories.

C. Provide channel of the proper material to match equipment classifications, per SECTION 16110, ELECTRICAL RACEWAY SYSTEMS.

2.14 – AUTOMATIC TRANSFER SWITCH

A. Provide UL listed, 480VAC, 3-phase, 3-wire, automatic transfer switches (ATS) to automatically transfer between normal utility power source and standby generator power source GEN.04-1.

B. Provide open-transition, electrically operated automatic transfer switch of the current, voltage, and short circuit ratings indicated on the Contract drawings capable of switching all classes of load and fully rated.

C. Provide service entrance rated ATS.

D. Provide ASCO 7000 Series or approved equal.

E. Provide ATS with dry-type contacts to PLC for remote indication of transfer switch position and status:

1. Discrete Output – Utility Power Position
2. Discrete Output – Standby Generator Power Position

3. Discrete Output – Failure to Transfer Position
4. Discrete Output – General Fault
5. Discrete Input – Transfer to Utility Power
6. Discrete Input – Transfer to Standby Power

PART 3 - EXECUTION

3.01 - CHANNELS

A. Install Type 316 stainless steel for mounting of electrical equipment in outdoor areas, NEMA 4 or 4X areas, and on below grade, outside building and structure walls.

B. Install galvanized steel channels for interior building mounting of electrical equipment except for those locations listed herein.

C. Install fiberglass channel in chemical areas with NEMA 4X enclosures.

3.02 - PHYSICAL CHECKOUT AND TESTING

A. Provide field and functional testing in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 16920

600-VOLT MOTOR CONTROL CENTER

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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide 600-Volt Motor Control Centers as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Submit in accordance with SECTION 16050, ELECTRICAL WORK – GENERAL and SECTION 01300, SUBMITTALS and as specified herein.

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

B. Variable frequency drives (VFDs):

1. For VFDs installed integral to motor control centers submit a written statement signed by the VFD manufacturer that the VFD manufacturer has received the required information from each driven equipment manufacturer that the VFD is compatible with the driven equipment and is rated for the specified application. Statement shall certify that that the VFDs, motors and associated process equipment have been review and coordinated with the equipment selections.
2. Provide VFDs in accordance with SECTION 16260 – LOW VOLTAGE VARIABLE FREQUENCY DRIVES.
3. See Harmonic Analysis requirements per SECTION 16260 - LOW VOLTAGE VARIABLE FREQUENCY DRIVES.

C. Submit a Bill of Materials including manufacturer name, model number and quantities for all submitted components to be furnished.

D. Submit manufacturer's descriptive and technical literature, catalog cuts, installation instructions. Clearly annotate catalog cut sheets as to what options are being submitted.

E. Shop drawings shall contain wiring and unique and schematic diagrams for each compartment furnished, equipment layout, power cable termination material and size data, and any other details required to demonstrate that system has been coordinated and will function as a unit.

F. Shop drawings shall use equipment tags as provided on the Contract electrical, mechanical and instrumentation drawings.

G. Submit to-scale equipment elevations clearly indicated all device locations.

H. Submit catalog cut sheets and time versus current curves for each size of circuit breaker furnished.

I. Provide manufacturer's printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated on structural drawings.

J. Spare Parts Data: Provide a list of recommended spare parts.

K. Operating and Maintenance Instruction Manuals.

L. Performance Test Reports.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Provide quality assurance in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 01400, QUALITY ASSURANCE.

1.08 - REFERENCES

A. Underwriters' Laboratories, Inc. (UL):

1. U.L. - 845: Standards for Motor Control Centers

2. U.L. - 1008: Standard for Automatic Transfer Switches

B. National Electrical Manufacturers Association (NEMA):

1. ICS: Industrial Controls and Systems

2. ABI: Molded Case Breakers

3. KSI: Enclosed Switches

C. American National Standards Institute (ANSI):

1. C39.1: Electrical Analog Indicating Instruments

2. C57.13: Standard Requirements for Instrument Transformers

D. Federal Specifications (FS):

1. W-P-115-B, Panel, Power Distribution.

2. W-C-375, Molded Case Circuit Breakers.

3. QQ-S-365B, Silver Plating, Electro-Deposited.

E. National Fire Protection Association (NFPA):

1. NFPA-70: National Electrical Code (NEC).

F. International Electrical Testing Association, Inc. (NETA):

1. Acceptance Testing Specifications.

G. Massachusetts Electrical Code.

H. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.09 - DESCRIPTION

A. Motor control center manufacturer shall be the same manufacturer of the VFD supplied under Specification 16260.

B. Provide industrial grade motor control center, totally enclosed, free-standing, cabinet-type structure with main circuit breaker, motor starters, feeder circuit breakers, variable frequency drives (up to 25 HP), contactors, key interlocks, power monitoring, surge protection devices, and other equipment, as indicated and specified. Motor control center to distribute power at 480-volt, 3-phase, 3-wire, 60-Hertz.

C. The manufacturer of the motor control center shall be the same manufacturer of the variable frequency drives provided under SECTION 16260 – LOW VOLTAGE VARIABLE FREQUENCY DRIVES and the switchboard provided under SECTION 16366 – LOW VOLTAGE SWITCHBOARDS.

D. Motor control center to be designed, assembled, wired, and tested at the point of manufacture in accordance with the latest NEMA, UL, and ANSI standards. Use manufacturer's standard components when data is not specified. Provide motor control centers with UL listed/recognized components.

E. Provide Surge Protection Devices SPD as indicated and as specified in SECTION 16400, SURGE PROTECTION DEVICES.

F. Provide Variable Frequency Drive (VFD) units as indicated and specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

1.10 - SEISMIC REQUIREMENTS

A. Conform to the requirements as indicated on Structural Drawing 00 S-1 and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS and herein.

PART 2 – PRODUCTS

2.01 - ACCEPTABLE MANUFACTURERS

A. The Owner has standardized on 600V Motor Control Centers as manufactured by Rockwell Automation Group.

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - CONSTRUCTION

A. Motor control center construction shall be 600V class, and comply with UL Standard 845, of dead front construction, and incorporate horizontal and vertical power bus.

B. The MCC shall consist of one or more vertical sections bolted together to form a rigid, free standing assembly and shall permit future additions of vertical sections and interchanging of units by the user.

C. Starters shall comply with the requirements of NEMA ICS 2-322.

D. All instruments shall comply with ANSI C39.1.

E. The overall short circuit withstand and interrupt rating of the equipment and devices shall be as indicated on the contract drawings. Main and feeder circuit protective devices shall be rated for the specified short circuit duty. Systems employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL labeled for the indicated short circuit current in combination with the motor branch circuit protective device.

F. Enclosures:

1. Enclosures for motor control centers shall be provided in accordance with the Area Classification schedule as indicated on the Contract drawings.

2. Provide motor control centers with NEMA Class II-S, Type B wiring.

3. Provide equipment not exceeding the outline dimensions of the motor control centers with arrangement of equipment and devices as indicated.

4. Vertical sections shall be rigid, free standing structures.

5. Each vertical section shall be divided into six (6) space factors. The structure depth shall be 20 in.

6. Removable end plates shall be used to cover the horizontal power bus and horizontal wireway openings on each end of the MCC.

7. Each section shall be equipped with removable one piece top plate.

8. All enclosure metal Work will have rounded edges and be tightly fitted with no visible air gaps.

9. Horizontal wireways of standard sections, both top and bottom, shall extend the full depth of the control center. Each wireway shall provide 90 square inches of unobstructed wiring space. The horizontal wireway shall be 6-in. high and shall extend the length of the control center with a square inch opening between sections. The wireways shall be isolated from all bus by barriers. Horizontal wireways of back-to-back sections shall allow access from the front section through to the back section. Horizontal wireways shall have removable covers held closed by captive screws.

10. A full height vertical wireway shall be provided in each standard vertical section and shall be isolated from the horizontal and vertical bus. Vertical wireways shall be an integral part of each section and shall be independent of plug-in units.

11. A removable hinged door with latches shall cover the vertical wireway, and provide access to wiring without disturbing energized control units. In each section the vertical and horizontal wireways shall open to the front to allow wires to be laid in place.

G. Incoming Section:

1. Provide molded case, service entrance rated main circuit breakers with electronic trip units including full range of instantaneous, short time, and longtime trip settings.

2. Provide main sections as main lugs only (MLO) when indicated on Contract drawings.

a. Main lugs shall be sized for the bus size provided to handle cable size indicted on contract Drawings.

H. Bus Tie Sections:

1. Where indicated Bus Tie Breakers shall be molded case circuit breakers, manually operated, and provided with electronic trip units.

I. Buses:

1. The power bus system shall be tinned copper, supported, braced and isolated from front and back by a bus support molded of a high strength, non-tracking glass polyester material. Horizontal and vertical buses shall be fastened together with a bus clamp assembly. Bus bracing shall be 65,000A RMS symmetrical.

2. The horizontal bus shall be mounted in isolated, recessed channels of the bus support molding. The horizontal bus shall be continuously braced within each section and shall be continuous in each shipping section.

3. The horizontal power bus shall be tin plated copper with ratings as indicated on the drawings.

4. The splicing of the horizontal buses shall be accomplished using a splice kit of the same ampere rating as the horizontal power bus. Double stud bus clamp assemblies comprised of flat washers and pre-assembled nuts with conical washers shall be used. The splice connections shall be front accessible for servicing with a torque wrench. The location of all splices shall be indicated by a label located on the inside of the vertical wireway door.

5. The vertical bus shall be continuously braced and sandwiched in a high strength, non-tracking glass polyester molding with a polycarbonate molded cover. It shall be isolated from the other phases and the horizontal power bus.

6. The vertical power bus shall be tinned copper and rated at 300A. Provide 600A rated vertical bus on back-to-back control centers.

7. The horizontal ground bus shall be tinned copper and located in the bottom horizontal wireway along the entire length of the MCC.
8. The horizontal ground bus shall be 1/4" x 2" with a full and continuous rating.
9. Quantity two - two hole compression type ground lugs shall be mounted on the ground bus for field ground cables.
10. Main and vertical buses shall be 98 percent conductivity copper bars.
11. Contact surfaces of bar-to-bar connections and lug-to-bar connections shall be silver plated.
12. Phase rotation of vertical buses shall be same when viewed from front or from either side of motor control center.
13. Bolts and other hardware shall be hot-dip galvanized or stainless steel with locking washers.

J. Motor Control Center Units:

1. Vertical sections shall have hardware for a plug-in units. Each unit shall consist of an equipment assembly, unit support pan and unit door assembly.
2. Each plug-in unit shall be supported and guided by a removable unit support pan, so that different unit arrangements are accomplished. The rearrangement of a unit support pan from one location to another shall be accomplished without the use of tools.
3. After insertion, each plug-in unit shall be held in place by latches, located at the front of the unit.
4. Unit plug-in power stab assemblies, shall be electrolytically tin plated copper for a low resistance connection and be able to tighten during heavy current surges.
5. The stabs shall be backed by spring steel clips to provide and maintain a high pressure, two point connection to the vertical bus. They shall be free floating and self aligning during plug-in. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed at the rear of the unit. The power cable termination at the plug-in stab shall be a maintenance free crimp type and shall be mounted in a two piece support assembly. This support shall provide a separate isolated pathway for each phase minimizing the probability of a unit fault condition reaching the power bus system.
6. Size 1 through 5 non-reversing starters shall be plug-in units. Size 1, 2, and 3 starters shall utilize a stab assembly rated at 100A. Size 4 starters shall utilize a stab assembly rated at 240A. Size 5 starters shall utilize dual stab assemblies rated 240A each.
7. An industrial, heavy duty, flange mounted handle mechanism shall be supplied for the control of each disconnect switch or circuit breaker. This mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of unit door position.
8. The operator handles shall pivot up-down, with the down position as OFF. The ON-OFF condition of the disconnecting means shall be indicated by the handle position. It shall be possible to lock the handle in the OFF position.
9. Trip indication on circuit breaker handles (circuit breakers rated through 400A) shall be included.
10. The operator handle of all units shall be interlocked with the unit door so that the disconnect means cannot be switched to the ON position unless the unit door is closed. A means shall be provided for purposely defeating this interlock during maintenance or testing. This interlock shall also prevent opening the unit door unless the disconnecting means is in the OFF position. An externally operated defeater requiring the use of a tool, shall provide access to the unit without interrupting service.
11. The operator handle shall be interlocked with the unit, so that the unit cannot be inserted or withdrawn with the operator handle in the ON position.
12. Each unit shall be provided so that when its starter has been removed, its door may be closed to cover the opening.

13. Each unit shall be provided with a removable door mounted on removable pin type hinges which allow the door to swing open 110 deg. Doors shall be removable from any location in the center without disturbing any other doors. The unit doors shall be fastened to the stationary structure so that it can be closed to cover the unit space when the insert has been removed. The unit doors shall be held closed with latches that resist forces during fault conditions. Each starter door shall be provided with an external overload reset button.

14. Each unit shall have a unit wiring diagram affixed to the rear, inside surface of the cubicle door.

K. Motor Control Center Starter Units:

1. Provide combination starter, consisting of a circuit breaker, motor circuit protector and magnetic starter, as indicated.

2. Part winding, autotransformer, and full voltage contactor units shall be provided with thermal magnetic type breakers.

3. The starter unit withstand rating at 480V through Size 5 starters shall be 65,000A RMS symmetrical.

4. The unit withstand rating at 480V when the high interrupting capacity thermal magnetic circuit breakers are used in conjunction with starters will be up to 65,000A RMS symmetrical.

5. Motor circuit protectors shall be enclosed molded case devices with current sensing coil in each of 3 poles with adjustable magnetic trip via a single knob on front. Motor circuit protector shall be manually operable. Protector shall meet NEC requirement for motor full load and locked-rotor current ratings.

6. Momentary and interrupting ratings of circuit breakers, and fused disconnect switches shall match main bus bracing rating.

7. Type of starters, i.e., full voltage, reduced voltage, reversing, nonreversing, two-speed, are as indicated.

8. Furnish magnetic starters with thermal solid state overload protection on each phase with external manual reset nonambient-compensated and overload relays. Overload heaters for each motor shall be based on nameplate data and operating conditions of motor installed. Provide overload with auxiliary contact for remote indication of overload status.

9. Size 1 shall be minimum starter capacity.

10. Verify type (single- or 2-winding) of two-speed motor being installed. Furnish type of motor starter for control of motor. Furnish decelerating, time-delay relay for each two-speed starter.

11. Furnish starter operating coils for operation on 120V, single-phase, 60-Hertz.

12. Furnish normally open and/or normally closed auxiliary contacts for indicating lights, interlocking and other requirements as required by wiring diagrams on Contract Drawings.

13. Furnish within each starter compartment a control transformer with fuses. Secondary voltage 120 Vac, unless otherwise indicated.

14. Starters shall supply 120VAC device power for motor heaters as indicated on Contract single line diagrams. Heaters shall operate when motor is not running.

15. Starters shall supply 120VAC device power for relays and equipment protection devices as indicated on Contract wiring schematics.

16. Units shall be furnished with red-green LED cluster type pilot lights and heavy-duty control switches or push buttons in a door mounted control station. The control station shall be removable for the purpose of mounting and wiring the pilot devices and shall be held in place with captive mounting screws. Space permitting, contact blocks of the pilot devices shall be mounted in a recessed control station housing to reduce the hazard of accidental contact when the unit door is open. Dual function units may use flush mounted pilot devices.

L. Mechanical Key Interlocks:

1. Provide kirk-key interlocks between switchboard feeder breakers and motor control centers as indicated on the Contract drawings.

M. Circuit Breakers:

1. Unless otherwise indicated, furnish manually operable circuit breakers and provide thermal-magnetic, inverse-time-limit overload, and instantaneous, short-circuit protection.
2. U.L. listed circuit breakers conforming to NEMA Std. ABI.
3. Provide molded case type breakers, rated 480 volts, 3 pole and having 100-ampere or larger frames. Interrupting rating equal to bus bracing shall be required.
4. Furnish overload protection on all poles with trip settings as indicated.
5. Provide all circuit breakers 200A and larger with adjustable long-time, short-time and instantaneous protective relaying with adjustable rating plugs.
6. Where indicated, furnish circuit breakers with shunt trip.
7. Furnish time vs. current curves, ratings and cable lug data for each size of breaker furnished.

N. Contactors:

1. Provide contactors for electric heating, lighting and other non-motor loads with ratings similar to motor starters. NEMA size shall be as indicated, with 30 amperes rating for use on a tungsten lamp load.
2. Contactors for lighting loads shall be mechanically held.

O. Control Devices:

1. Control relays shall be heavy-duty, industrial or machine tool type with two normally open and two normally closed contacts. Coils shall be rated 120 volts, 60 Hertz. Plug-in-style relays with sockets shall not be used.
2. Relay contacts shall be rated 10 amperes, alternating current.
3. Provide time-delay relays adjustable, solid state, operated on 120 volts, 60 Hertz, with two normally open and two normally closed timed contacts.
4. Pushbuttons and selector switches shall be heavy-duty, oiltight units rated 10 amperes continuous current at 120 volts.
5. Indicating lights shall be LED cluster type, heavy-duty, oil-tight units.
    a. RUN – Red
    b. OFF – Green
    c. FAULT – Amber
6. Local/Off/Remote hand selector switches as indicated.
7. Control and selector switches shall be rotary type with enclosed contacts. Equip each switch with rectangular escutcheon and pistol-grip handle, except handles for instrument phase selector switches equipped with round knurled or slotted handles. Switch contacts shall be rated 10 amperes continuous, at 600 volts.

P. Nameplates: Furnish each motor control center and each unit of motor control center with engraved nameplate. Provide nameplates with nomenclature labels as indicated on Contract Drawings. Provide nameplates of laminated sheet plastic, 1/16-in. thick, engraved to provide white letters on black background. Fasten nameplates in place with corrosion-resistant screws.

Q. Variable Frequency Drives (VFD):

1. VFD units rated up to 25 HP shall be provided integral to the motor control centers.
2. VFD units provided within the MCC shall be 6 pulse type.

3. VFD units up to 25 HP shall be provided with 3% line reactors or passive harmonic filters when indicated on Contract electrical single line diagrams
4. VFD units with the MCC shall be provided with output filters when indicated on Contract electrical single line diagrams.
5. VFD units shall be rated for constant torque applications when indicated on the Contract electrical single lines and per driven equipment motor data.
6. Starters shall supply 120VAC device power for motor heaters as indicated on Contract single line diagrams. Heaters shall operate when motor is not running.
7. Starters shall supply 120VAC device power for relays and equipment protection devices as indicated on Contract wiring schematics.
8. Refer to Specification SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT for variable frequency drives requirements.

R. Finish:

1. All structural metal parts shall undergo a multi-step cleaning, rinsing, and painting process resulting in complete coverage of uniform thickness.
2. Shop applied rust resistant primer undercoat on all surfaces. All unpainted parts used in the assembly shall be plated for corrosion resistance.
3. All interior and exterior surfaces except back plates of unit inserts shall be shop painted ANSI 61 gray. The back plates of the unit inserts shall be shop painted high visibility gloss white.

2.03 - WIRING

A. Provide a project specific wiring diagram for each starter cubicle. Coordinate control requirements with Subcontractor.

B. Conductors shall be copper; size as required by load, except that no control wire is smaller than No. 14 AWG. Use 90 deg. C rated insulation that is flame retardant, and moisture and heat resistant.

C. Cables and conductors shall be bundled and tie wrapped in wireways furnished.

D. Identify internal wiring at terminations by plastic permanently marked wire markers.

E. All spare starter auxiliary contacts to be wired to terminal blocks.

F. Terminal Blocks:

1. Provide pull-apart terminal blocks for control wiring terminations.
2. Provide rated 600 volt for power with current rating as required by loads.
3. Terminal blocks shall be mounted within the unit insert in a horizontal plane up front for accessibility. Control terminal blocks shall be pull-apart on plug-in units and fixed on non plug-in factory mounted units.

2.04 - SPARE PARTS

A. Provide recommended spare parts list.

2.05 - FACTORY TESTS

A. Provide MCC assembled, wired, adjusted and tested at the factory. Submit detailed test procedure and test results for review.

B. Provide operational, dielectric, and other standard tests performed on the assembled MCC in accordance with applicable ANSI standards.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Provide all material, equipment, and labor to install motor control center units as indicated and as specified.

B. Install items in accordance with manufacturers' printed instructions. Provide all conduit, wiring, and grounding interconnections.

C. Set motor circuit protectors and circuit breakers based on load installed.

3.02 - FIELD TESTS

A. Perform following field tests in accordance with SECTIONS 16050, ELECTRICAL WORK - GENERAL and 16998, FIELD INSPECTION AND ACCEPTANCE TESTS and as specified herein.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

SECTION 16998

FIELD INSPECTION AND ACCEPTANCE TESTS

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1.01 - SCOPE 1
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PART 1 – GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Field Inspection and Acceptance Tests as specified herein and/or as shown on the Contract Drawings.

A. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.

2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.

3. "Provide" shall mean furnish and install.

4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Submit inspection and testing forms for all electrical distribution equipment to be inspected and tested under this section.
2. Submit data sheets for the insulation resistance testing of conductors and motors prior to performing operating testing. List all cables and motors to be tested.
3. Provide space on data sheet forms to enter the results of testing, instruments used with serial numbers, and name of personnel performing testing. This data to be filled out during testing.
4. After completion of the testing, submit all test results with observed notes and recommendations.

1.05 - PRODUCT HANDLING – Not Used

1.06 - DESIGN CRITERIA – Not Used

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated 1.08 - REFERENCES

B. All inspections and tests shall be in accordance with the following applicable codes and standards latest revisions except as provided otherwise herein.

1. National Electrical Manufacturer’s Association – NEMA
2. American Society for Testing and Materials – ASTM
3. Institute of Electrical and Electronics Engineers – IEEE
4. InterNational Electrical Testing Association – NETA – Acceptance Testing Specification for Electric Power Distribution Equipment and Systems (STD).
5. American National Standards Institute – ANSI:
    a. ANSI C2: National Electrical Safety Code
    b. ANSI Z244-1: American National Standard for Personnel Protection
6. State and Local Codes and Ordinances
7. Insulated Cable Engineers Association – ICEA
8. Association of Edison Illuminating Companies – AEIC
9. Occupational Safety and Health Administration:
    a. OSHA Part 1910; Subpart S, 1910.308

b. OSHA Part 1926; Subpart V, 1926.950 through 1926.960

10. National Fire Protection Association – NFPA:

a. ANSI/NFPA 70B: Electrical Equipment Maintenance

b. NFPA 70E: Electrical Safety Requirements for Employer Workplaces

c. ANSI/NFPA 70: National Electrical Code

d. ANSI/NFPA 780: Lightning Protection Code

e. ANSI/NFPA 101: Life Safety Code

C. All inspections and tests shall utilize the following references:

1. Project Design Specifications

2. Project Design Drawings

3. Manufacturer's instruction manuals applicable to each particular apparatus

1.09 - DESCRIPTION

A. Provide field inspections and acceptance testing as specified herein.

B. After electrical installation is complete, (a) adjust and set all protective devices (in accordance) with results of electrical studies, (b) perform tests to demonstrate that the entire system is in working order and in accordance with applicable codes, manufacturer's instructions, drawings and specifications. Test shall be performed per InterNational Electrical Testing Association (NETA): Acceptance Testing Specification for Electrical Power Distribution System and Equipment (STD). Tests are in addition to, and not a substitution for, tests of individual items at the manufacturer's facilities. Perform insulation and ground resistance tests before operating tests. Determine proper rotation of motors before permanent connections are made.

C. Tests are also intended to accomplish the following:

1. Provide initial acceptance tests and recorded data.

2. Ensure a successful start-up with a minimum of last minute interruptions and problems.

3. Determine the suitability of the equipment and systems for energizing and placing into operating service.

4. Ensure that each system component is installed satisfactorily, will perform and will continue to reliably perform its function.

D. Provide all necessary supervision, labor, materials, tools, test instruments or other equipment or services and expenses required to test, adjust, set, calibrate, functionally and operationally check all work and components of the various electrical systems and circuitry throughout the installation.

E. Engage the services of a nationally recognized Independent Electrical Tester to perform the required field inspections, test, and adjustments specified. The Independent Electrical Tester shall meet the following qualifications:

1. The testing firm is not to be a subsidiary, division, or department of the Contractor performing the work of Division 16.

2. The testing firm is not to be subsidiary, division, or department of the manufacturer of the equipment, materials or systems being inspected or tested.

3. The testing firm shall perform all testing in accordance with International Electrical Testing Association, Inc. (NETA), standards and procedures. All testing results shall be submitted on NETA forms and the testing data shall be certified by a Registered Professional Electrical Engineer. Test results shall indicate recommended action for sub-par test results. Results shall list recommended test values that should be obtained for a new installation.

4. Testing and checkout work shall be performed with personnel skilled and trained in the particular tests being conducted.

5. Evidence of the proposed testing firm's qualifications, accreditation, and experience shall be submitted for evaluation. Testing firm shall be member of NETA with minimum of five years of testing industrial electrical systems to NETA requirements and procedures.

F. The Independent Electrical Testing Contractor shall provide supervision, labor, materials, tools, test instruments, or other equipment, and services, required to adjust, set, calibrate, and test operate the components of the various electrical systems and circuits throughout the installation, the construction package, and as specified herein.

G. Perform these tests after the electrical installation is complete. These tests shall demonstrate that the entire electrical system is in proper working order and in accordance with: applicable codes; and the supplier's instructions, drawings, and specifications.

H. Testing by the Independent Electrical Tester in no way changes the requirements to perform the specified tests, checkouts, and inspections required under the equipment specification sections.

I. The listings and descriptions of the tests, and checks described herein is not to be considered as complete and all inclusive.

J. Retests required by defects and failures of equipment to meet specifications shall be conducted at no additional cost.

1. Replace wiring and equipment found to be defective, or failing to meet specified requirements, at no additional cost.

2. Supply electric current necessary for tests.

K. Where specified in other Division 16 sections, perform work under the supervision of factory trained technicians, representing the equipment being tested or inspected.

1.10 - SCHEDULING

A. The Contractor is responsible for the preparation of proposed procedures, testing and inspection forms, and schedules for all inspections, tests, settings and calibrations specified or otherwise required prior to or during the check out for start-up and acceptance of all the electrical components, equipment and systems. This work to be coordinated and to be compatible with the work of other crafts and the project schedule. The above must be organized and submitted with all proposed testing and NETA approved check out forms for the review. The procedures must provide specific instructions for the checking and testing of each component in addition to the system functional checks.

B. Prior to check out and testing for start-up, verify that all equipment and wiring is permanently identified with nameplates and tags. Check and tighten all terminals and connection points, remove all shipping blocks and hardware, thoroughly clean all equipment, repair all damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions. Make routine checks and tests as the job progresses to verify that all wiring and equipment are properly installed.

C. Safety practices shall include, but are not limited to, the following requirements:

1. Occupational Safety and Health Act

2. Accident Prevention Manual for Industrial Operations, National Safety Council

3. Applicable state and local safety operating procedures

4. Owner's safety practices

5. National Fire Protection Association

6. American National Standards for Personnel Protection

D. All tests shall be performed with apparatus de-energized. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

E. The testing firm shall have a designated safety representative on the project to supervise the testing operations with respect to safety.

F. Ensure that all testing and checkout work is conducted in a safe manner. Special safety precautions such as the following to be utilized where appropriate:

1. Locking and tagging procedures
2. Barricades
3. De-energization and/or isolation of equipment prior to testing
4. Review of procedures with site personnel
5. Erection of warning signs
6. Stationing of guards and watchmen
7. Maintenance of voice communications
8. Personnel orientation

G. Report all inspections, tests, and calibration in writing on NETA approved report forms. The recorded data from shall have the signatures of the persons conducting the tests and authorized witnesses. The forms shall serve as the test and inspection checklist for inspection requirements. Submit all test and check out data in accordance with SECTION 01300, SUBMITTALS prior to adjustments, repairs, drying out, or similar work prior to final testing and acceptance. “As-found” and “as-left” test data to be recorded and reported in writing.

H. Sequence tests and checks such that the equipment can be energized immediately after the completion of the applicable tests.

PART 2 - PRODUCTS

2.01 - TESTING EQUIPMENT

A. Calibration:

1. All calibration and setting checks by the Independent Electrical Test shall be performed with the laboratory’s calibrated test instruments. This test equipment to have calibrations traceable to the National Bureau of Standards. The Independent Electrical Tester dated calibration labels shall be visible on all test equipment. Calibrations over 6 months old will not be acceptable on field test instruments. All testing instruments shall be checked to verify satisfactory operation prior to proceeding with the tests. Serial and model numbers of the instruments used shall be recorded on the test forms.
2. Make necessary openings in circuits for testing instruments and place and connect all instruments, equipment, and devices, necessary for the tests. Upon completion of tests, remove instruments and instrument connections and restore all circuits to permanent condition.

2.02 - TESTING

A. Coordination:

1. Coordinate activities, and cooperate with others on project, to ensure that systems are ensure that systems are energized when required, loads applied, and other requirements are carried out on timely, coordinated basis.
2. Conduct tests in presence of the Owner’s representative. Provide ten calendar days or more advance notification of when any test is to be performed.
3. Conduct testing such that warranties or guarantees are not voided. Coordinate all testing with manufacturer’s factory trained technicians, where applicable. Where specified tests are not compatible with the manufacturer’s recommendations, obtain the manufacturer’s review prior to testing. Permit witnessing by the manufacturer’s representative if so requested.

B. Preparation:

1. Make up no low voltage connections at service entrance, transformers, motors, switchboard and motor control centers, permanently until correct phase rotation of all equipment is determined. Install and insulate these connections temporarily, if necessary, while determining proper rotation. Make permanent connections after proper rotation has been established and subsequent to completion of insulation resistance and dielectric tests.

PART 3 – EXECUTION

3.01 - INSULATION TESTS OF EQUIPMENT, CABLE, AND CIRCUITS

A. Independent Electrical Testing:

1. The Independent Electrical Tester shall perform all inspections and testing as specified herein.

B. List each circuit and measured resistance as test data.

C. Maintain records of all insulation resistance values. Identify conductor, or equipment, date that value was taken, and resistance value. Submit the information in neat tabular forms.

3.02 - SPECIFIC TESTS AND INSPECTIONS

A. General:

1. The following specific items or work shall be performed by the Independent Electrical Tester. The equipment and cable shall be de-energized and isolated as necessary to perform the tests.

2. Perform tests and inspections as specified throughout Division 16. Tests and inspections required by these sections are not necessarily repeated under this section.

3. Provide assistance as requested by the Independent Electrical Tester in performing its work.

B. Equipment Test and Inspection During Construction and Prior to Acceptance Testing:

1. Motors:

a. Visually inspect the motor for any physical damage.

b. Before energizing any machine, visually inspect for serviceability. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.

c. Test run all motors before placing into regular service. A check on the motor for rotation, speed, current and temperature rise shall be made and results recorded. Maintain the proper color codes for phase identifications. A motor phase rotation meter should be used prior to connection at motor to prevent later swaps of phase wires.

2. Grounding Systems:

a. All main plant building loops and major equipment grounds to be tested to remote earth or directly referenced to an extremely low resistance (3 ohm) reference ground bench mark. Visual inspection of all systems, raceway and equipment grounds to be made to determine the adequacy and integrity of the grounding. All ground testing results to be properly recorded, witnessed, and submitted.

b. Ground tests shall be performed in accordance with NETA using a J. G. Biddle Company low resistance, Null balance type, ground testing ohmmeter, and test lead resistance compensated for. The test instrument to be the type, which compensates for potential and current rod resistances.

c. Test entire grounding system for continuity of connections and for resistance. Ensure that ground resistance of conduits, equipment cases, and supporting frames does not vary appreciably from that of system as whole and does not exceed 3 Ohms.

3. Outdoor Pad Mounted Transformer:

a. At the time of equipment receipt, visually check the exterior for any damage or defects.

4. Low voltage Switchboard:

   a. At the time of equipment receipt, visually inspect the equipment for any damage or defects. Coordinate inspections with factory-trained technicians.

   b. Energize heaters for prolonged storage, if required.

   c. Perform complete inspections and electrical tests in accordance with SECTION 16366, LOW VOLTAGE SWITCHBOARDS and NETA.

5. Circuit Breakers – Low Voltage:

   a. At the time of equipment receipt, visually check the exterior for any damage or defects.

   b. Perform complete inspection and electrical test in accordance with NETA.

6. Motor Control Centers:

   a. At the time of equipment receipt, visually check the exterior for any damage or defects.

   b. Perform complete inspection and electrical test in accordance with SECTION 16920, 600-VOLT MOTOR CONTROL CENTERS and NETA.

7. Dry-Type Transformers:

   a. All 480 volt primary, air-cooled, transformers shall be given an insulation test, by means of a megger, after connections with the primary cables are complete. The supply cable shall be meggered with the primary winding and to the open air circuit breaker. Secondary leads may be meggered with the secondary windings to the open load breakers.

   b. Check continuity and correctness of connections of all windings and ratings.

   c. Perform inspection checks, and electrical tests in accordance with NETA.

8. 600 VAC Wire and Cable:

   a. Before energizing, the continuity and insulation resistance of all wiring shall be measured with a megger from each wire to all others and to ground.

   b. All cables and wires to be checked for proper identification numbering and/or color coding.

   c. Perform inspection checks and electrical tests in accordance with NETA.

9. Overhead Conduit Systems:

   a. The overhead conduit system to be checked for proper installation by using the following check list: (This list not to be considered all inclusive but as a guide for inspection).

      (1) Conduits are supported on appropriate independent supports (i.e., not on process piping, pipe ways, or piping hangers).

      (2) Exposed conduits are run in a neat workmanlike manner, parallel or perpendicular to structural members.

      (3) Conduits are routed as far away from possible fire hazards and heat sources as practical.

      (4) Conduits are supported at the required intervals.

      (5) Pull boxes and fittings are installed so that covers are easily removable. Verify that all covers are installed and tightly bolted with gaskets provided where needed.

      (6) Number of bends in the conduit does not exceed NEC requirements without a pull box installed.

      (7) Circular cross sectional area is uniform at conduit bends. Single bends do not exceed 90 degrees.

      (8) Conduits are terminated in threaded hubs or bushings to prevent damage to wire.

(9) Conduits joints have joint compound of the type specified and are tight and conduit ends are properly reamed and threaded not to engage less than 5 threads.

(10) Pull fittings are of adequate size such that cable can be installed and replaced at a later date without bending the cable less than code or manufacturer's requirements.

(11) Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture into equipment and/or where shown on plans.

(12) Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture.

(13) Flexible conduit is installed at motors and other equipment as specified or required. Verify that all cabling and conduit runs are properly identified at each end.

10. Panelboard electrical checks to be as included in the Wire and Cable section of this specification. Panelboards to be checked for proper circuit identification on the door schedule.

11. Sealing of Openings: Inspect the entire job to insure that all openings and holes provided or utilized are properly sealed as specified.

12. Where referenced NETA Standards indicate optional testing, perform these tests as described.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

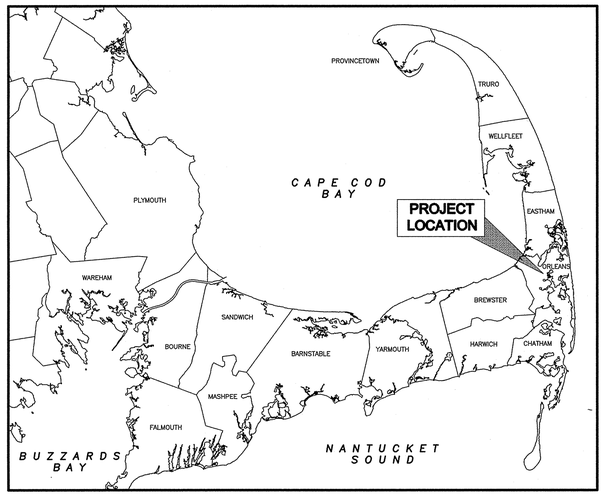
END OF SECTION

SECTION 99999

STORMWATER IMPROVEMENTS FROM GHD

TOWN OF ORLEANS, MA
CONSTRUCTION OF STORMWATER IMPROVEMENTS

CONTRACT No. 2009-SW-02



VICINITY MAP
SCALE: NTS

SEPTEMBER, 2009

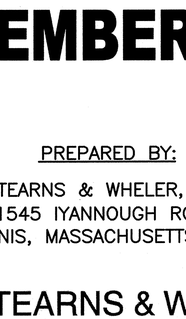
PREPARED BY:

STEARNS & WHELER, LLC
1545 IYANNOUGH ROAD
HYANNIS, MASSACHUSETTS 02601

STEARNS & WHELER LLC
Environmental Engineers & Scientists

LIST OF DRAWINGS

SHEET NO.	DWG. NO.	TITLE
1.	G-0	COVER SHEET
2.	C-1	SITE PLANS 1-6
3.	C-2	SITE PLANS 7-12



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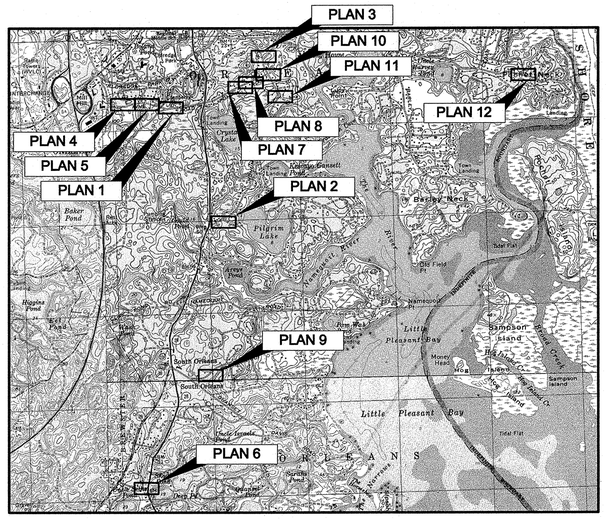
STEARNS & WHELER JOB NO. 81031



LOCATION MAP
SCALE: NTS

LEGEND

EXISTING

☼	LIGHT POST	OHW	OVERHEAD WIRES	GAS	UNDER GROUND GAS
EM	ELECTRIC METER	D	DRAIN PIPE	W	WATER MAIN
⊸	SIGN	T	UNDER TELEPHONE		MAPLE
CBDH find	CONCRETE BOUND FOUND		TREE LINE		TREE
	FIRE HYDRANT		MAJOR CONTOURS		CEDAR
UP	UTILITY POLE		MINOR CONTOURS		PINE
GM	GAS METER	30.15	SPOT ELEVATION		BIRCH
	CATCH BASIN	E	ELECTRIC MANHOLE		ELM
GV	GATE VALVE	D	DRAIN MANHOLE		SHRUB

PROPOSED

	SETTLING TANK	-SF-SF-	SILT FENCE\HAYBALE LIMIT
	LEACHING FIELD W\STONE LIMITS		LIMIT OF TEMPORARY PAVEMENT REPLACEMENT
	HDPE DRAIN PIPE		DRAINAGE MANHOLE
	4' DIA CATCH BASIN		

REVISED PER ADDENDUM No.1

CONSTRUCTION NOTES

1. THE LOCATIONS OF THE BUILDINGS, WETLANDS, AND PROPERTY LINES, UTILITIES ARE APPROXIMATE AND BASED ON THE TOWN OF ORLEANS ASSESSORS MAPS, GIS INFORMATION AND DIGSAFE MARKINGS. ALL UNDERGROUND UTILITIES ARE LOCATED AS MARKED BY DIG-SAFE.

2. LIMIT OF WORK SHALL BE WITHIN THE PUBLIC RIGHT OF WAY. NO WORK SHALL BE CONDUCTED ON PRIVATE PROPERTY UNLESS OTHERWISE NOTED.

3. CONTRACTOR SHALL RETURN ALL AREAS TO ORIGINAL CONDITION OR BETTER INCLUDING, BUT NOT LIMITED TO, ROADWAYS, BITUMINOUS CONCRETE, LANDSCAPED AREAS AND CURBING, UNLESS OTHERWISE NOTED.

4. THE MASSACHUSETTS HIGHWAY DEPARTMENT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES ARE INCORPORATED INTO THESE PLANS BY REFERENCE. THE TERM "MASS HIGHWAY" OR "SPECIFICATION" SHALL MEAN THE MASSACHUSETTS HIGHWAY DEPARTMENT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, DATED 1988. UNLESS OTHERWISE INDICATED, ALL MATERIALS AND METHODS SHALL BE IN CONFORMANCE WITH MASS HIGHWAY SPECIFICATIONS.

5. PROPOSED CONDITIONS SHOWN HEAVY. EXISTING CONDITIONS SHOWN LIGHT.

6. STORMWATER IMPROVEMENTS ARE BASED ON DESIGN GUIDELINES ESTABLISHED IN THE MASSACHUSETTS DEP & CZM STORMWATER MANAGEMENT STANDARDS VOL.1 AND 2 DATED MARCH 1997 AND THE MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS HIGHWAY DESIGN MANUAL.

7. ALL DRAINAGE PIPING SHALL BE 12" INSIDE DIAMETER CORRUGATED HDPE TYPE N-12 PIPE MANUFACTURED BY ADS SUITABLE FOR H-20 LOADING AT MINIMUM BURIED DEPTH OF 24". PIPE SHALL BE SUPPLIED IN 20 FT LENGTHS. JOINTS SHALL BE SOIL TIGHT PUSH ON JOINTS.

8. CATCH BASINS SHALL BE PROVIDED WITH SINGLE GRATE INLET PER MASS HIGHWAY STANDARDS, UNLESS OTHERWISE NOTED.

9. FINAL LOCATION OF ALL LEACHING PITS TO BE COORDINATED WITH RESIDENT PROJECT REPRESENTATIVE PRIOR TO STARTING WORK.

10. PIPE SHALL BE SLOPED AT A MINIMUM OF 1.0% UNLESS OTHERWISE NOTED.

11. CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL UTILITIES PRIOR TO EXCAVATION, INCLUDING UTILITIES NOT MARKED BY DIG-SAFE, NOT SHOWN ON THE SURVEY, OR NOT MARKED BY THE ORLEANS HIGHWAY DEPARTMENT. CONTRACTOR IS RESPONSIBLE FOR ANY AND ALL DAMAGES IF AN UNDERGROUND UTILITY IS DAMAGED DURING THE COURSE OF CONSTRUCTION.

12. IN THE EVENT THAT ANY UTILITY, UNDERGROUND OR OVERHEAD, IS DAMAGED DURING CONSTRUCTION, CONTRACTOR SHALL IMMEDIATELY NOTIFY ENGINEER, ORLEANS HIGHWAY DEPARTMENT, AND THE APPROPRIATE UTILITY COMPANY.

13. ALL PAVEMENT TO BE SAW-CUT.

14. ALL CONNECTIONS BETWEEN PRECAST CONCRETE SECTIONS SHALL BE SEALED WITH NON-SHRINK GROUT.

15. LEACHING PITS, SETTLING TANKS, AND INLETS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE MASSACHUSETTS HIGHWAY DEPARTMENT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, UNLESS OTHERWISE NOTED.

16. ALL PRECAST CONCRETE STRUCTURES SHALL BE RATED FOR AASHTO/H-20 LOADING.

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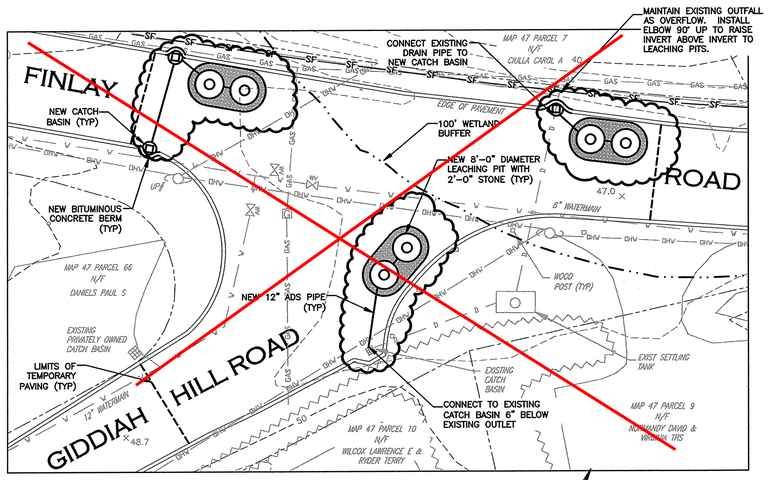
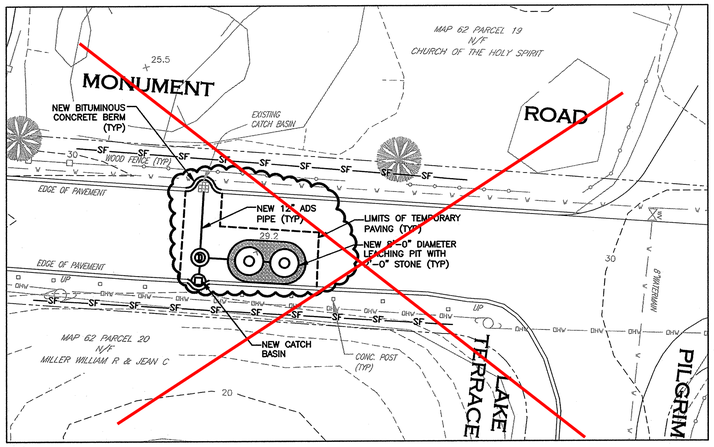
Latest Revision: Thursday, January 26, 2006



FINLAY & GIDDIAH HILL ROADS – PLAN 1

SCALE: 1"=20'-0"

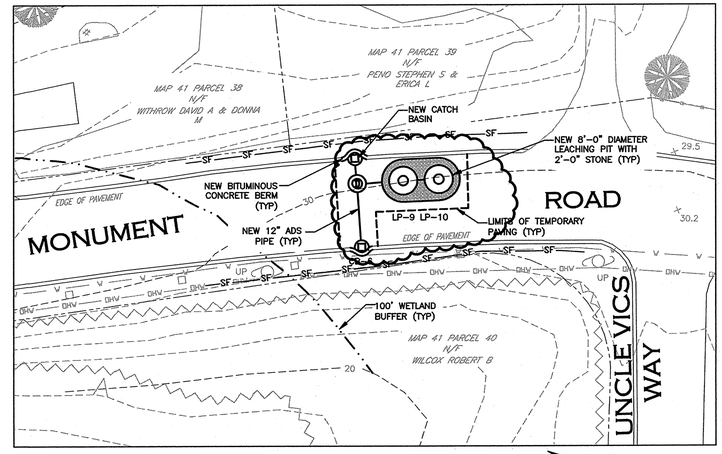
BID ALTERNATE # 1



MONUMENT ROAD & PILGRIM LAKE TERRACE – PLAN 2

SCALE: 1"=20'-0"

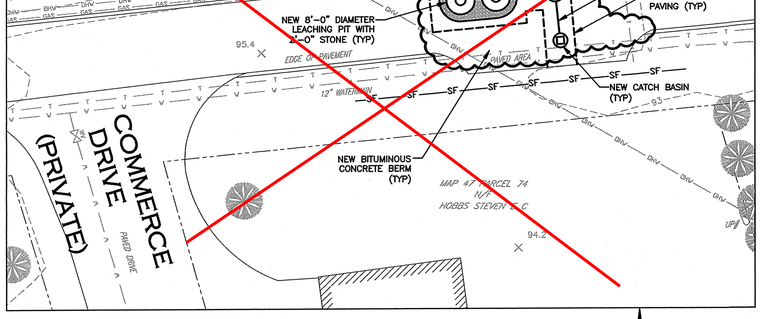
BID ALTERNATE # 2



MONUMENT AND UNCLE VICS WAY – PLAN 3

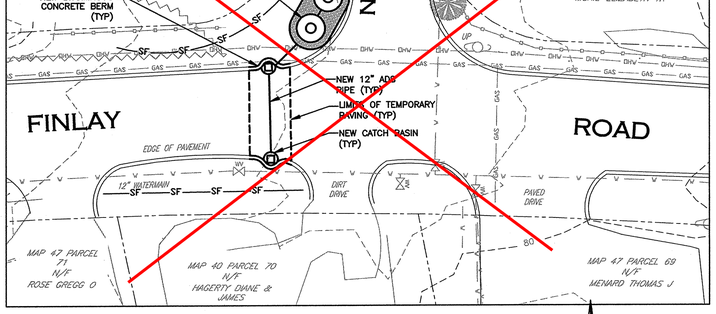
SCALE: 1"=20'-0"

BID ALTERNATE # 2



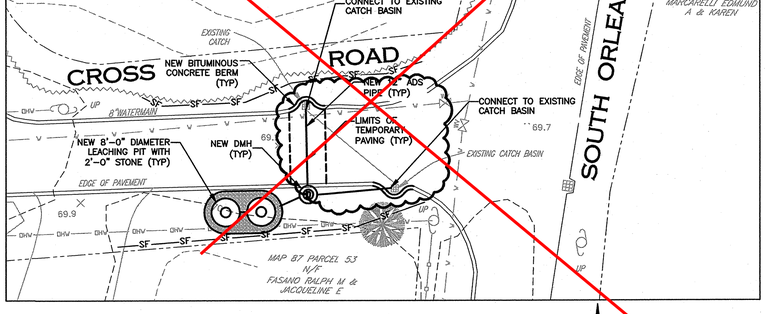
FINLAY ROAD AND COMMERCE DRIVE– PLAN 4

SCALE: 1"=20'-0"



FINLAY & NICKERSON ROADS – PLAN 5

SCALE: 1"=20'-0"



CROSS ROAD & ROUTE 28 – PLAN 6

SCALE: 1"= 20'-0"

EROSION & SEDIMENTATION CONTROL NOTES

1. ALL EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED BY THE CONTRACTOR DAILY AND IMMEDIATELY AFTER PERIODS OF RAINFALL. REPAIR AND/OR MAINTENANCE OF SEDIMENTATION AND EROSION CONTROL MEASURES SHALL BE MADE AS SOON AS NEEDED. THE CONTRACTOR IS RESPONSIBLE FOR THE IMPLEMENTATION AND MAINTENANCE OF ALL CONTROL MEASURES ON THIS SITE.
2. ALL FINAL DRAINAGE LOCATIONS WILL BE VERIFIED WITH ENGINEER PRIOR TO ANY EXCAVATION.
3. FINAL LOCATION OF ALL SEDIMENTATION CONTROL MEASURES SHALL BE COORDINATED WITH THE TOWN CONSERVATION OFFICE PRIOR TO CONSTRUCTION.
4. LAND DISTURBANCE SHALL BE KEPT TO A MINIMUM. RESTABILIZATION WILL BE SCHEDULED IMMEDIATELY AFTER ANY DISTURBANCE.
5. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSTALLED PRIOR TO ALL CONSTRUCTION ACTIVITIES.
6. ANCHOR ALL TOPSOIL STOCK PILES WITH STRAW MULCH AND RING WITH SILT FENCE, OR HAYBALE BARRIER.
7. DURING CONSTRUCTION, ALL EXPOSED SLOPES THAT WILL NOT RECEIVE PERMANENT SURFACE TREATMENT IMMEDIATELY, AND ALL PILES OF SOIL SHALL BE TEMPORARILY SEEDED WITH A MIXTURE OF PERENNIAL RYE GRASS, ANNUAL RYE GRASS AND WINTER GRASS, SHOULD CONSTRUCTION ACTIVITIES BE HALTED, THE CONTRACTOR SHALL STABILIZE DISTURBED AREAS BY APPROVED METHODS SUCH AS MULCHING AND HYDROSEEDING.
8. SEDIMENT REMOVAL FROM CONTROL STRUCTURES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. SEDIMENT SHALL BE DISPOSED OF IN A MANNER WHICH DOES NOT RESULT IN ADDITIONAL EROSION AND WHICH IS CONSISTENT WITH THE CONTRACT DOCUMENTS AND REGULATORY REQUIREMENTS.
9. THE EROSION AND SEDIMENTATION CONTROL MEASURES DESCRIBED HEREIN ARE INTENDED AS A GENERAL GUIDE FOR THE CONTRACTOR. IT IS THE CONTRACTOR'S RESPONSIBILITY TO PROVIDE ANY AND ALL WORK NECESSARY TO PREVENT EROSION OF SOIL FROM THE CONSTRUCTION SITE. TO PREVENT EROSION, THE CONTRACTOR SHALL PROVIDE SILT FENCES OR OTHER CONTROL MEASURES AS THE NEED ARISES DURING CONSTRUCTION AT NO ADDITIONAL COST TO THE OWNER.
10. PAVED ROADWAYS SHALL BE KEPT CLEAN AT ALL TIMES.
11. A TEMPORARY CRUSHED STONE PAD OR ROADWAY SHALL BE CONSTRUCTED AT ALL NON-PAVED PARKING AREAS, HEAVY USE AREAS, OR ROADWAYS WHERE THERE IS NO EXISTING PAVEMENT, OR WHERE PAVEMENT HAS BEEN REMOVED.
12. CATCH BASINS NOT SHOWN ON SURVEY WITHIN THE CONTRACTORS STAGING AREA MAY BE SUBJECT TO EROSION AND SEDIMENTATION CONTROL MEASURES IF SO DIRECTED BY THE ENGINEER.

GENERAL NOTES:

1. CATCH BASINS (EXISTING AND NEW) SHALL BE PROTECTED WITH FILTER FABRIC BAGS AS SHOWN THROUGHOUT THE CONSTRUCTION SEQUENCE AND UNTIL ALL DISTURBED AREAS ARE STABILIZED.
2. ALL PAVEMENT SHALL CONFORM TO MA HIGHWAY STANDARD SPECIFICATION M3.11.00.
3. ALL CRUSHED STONE TO BE "WASHED".
4. CONTRACTOR TO PROVIDE ALL FITTINGS, BENDS, GASKETS AND OTHER REQUIRED APPURTENANCES TO CONNECT AND INSTALL NEW LEACH PITS AND DRAINAGE STRUCTURES AS SHOWN ON PLANS.

1"=30'-0" (30 0 30 60)

Login name: JJO
Filename path: J:\900001\91092\30\Drawings\Civil
Filename: 91092011.dwg
Latest Revision: ####

NOTES:
Underground facilities, structures, and utilities have been plotted from available surveys and records, and therefore their locations must be considered approximate only. There may be others, the existence of which is presently not known. Anyone using utility information and data provided herein shall "Call Dig-Safe" at 1-888-344-7233 seventy two (72) hours, 3 business days in advance to verify the location of utilities prior to start of construction.

ISSUE NO.	DRAWN	DATE	CHECKED	DESIGNER	APPROVED	DATE
3	FOR CONSTRUCTION JJO	09/09	RHK	RHK	WM	
2	FOR APPROVAL JJO	07/09	RHK	RHK		
1	FOR REVIEW JJO	07/09		RHK		

PROJECT SUPERVISOR: David A. Elliott — DEPARTMENT SUPERVISOR

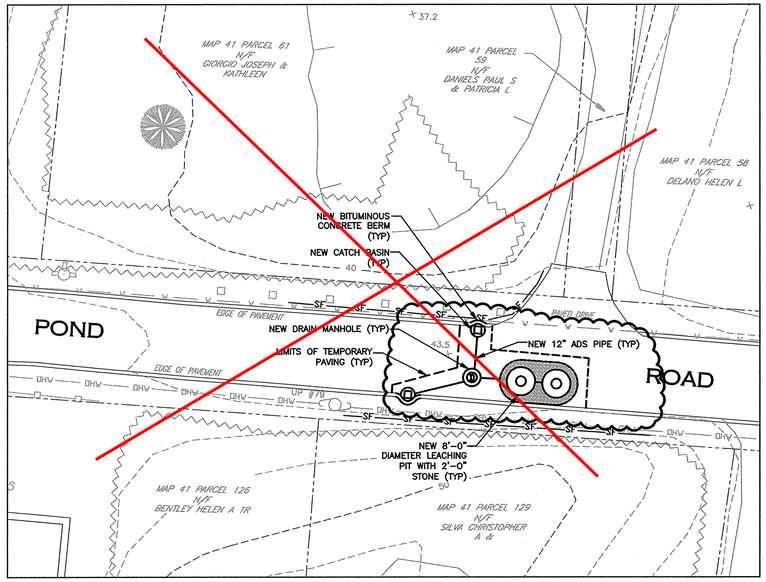
ISSUE NO.	DRAWN	DATE	CHECKED	DESIGNER	APPROVED	DATE
3	REVISED PER ADDENDUM No.1 JJO	09/09	RHK	RHK		

COMMONWEALTH OF MASSACHUSETTS — WILLIAM R. HALL, JR. — SANITARY — 24761037 — REGISTERED PROFESSIONAL ENGINEER

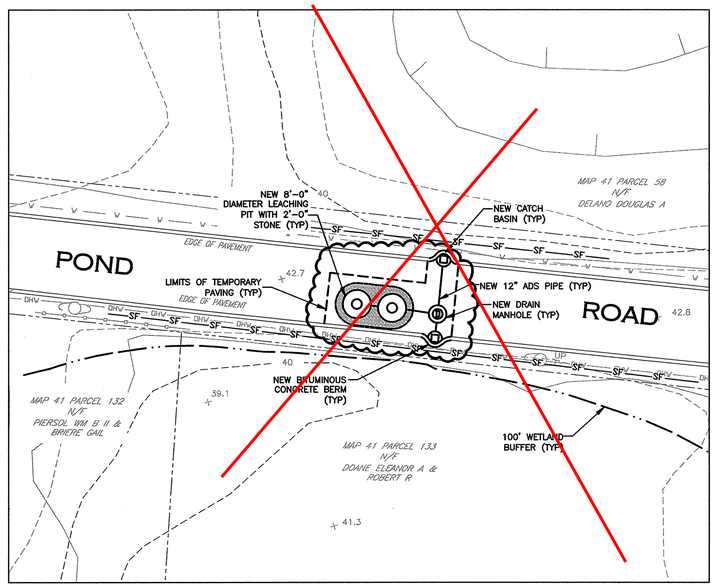
STEARNS & WHELER LLC
Environmental Engineers & Scientists
HYANNIS, MASSACHUSETTS

TOWN OF ORLEANS, MASSACHUSETTS
TOWN-WIDE STORMWATER IMPROVEMENTS
PLAN 1 – PLAN 6

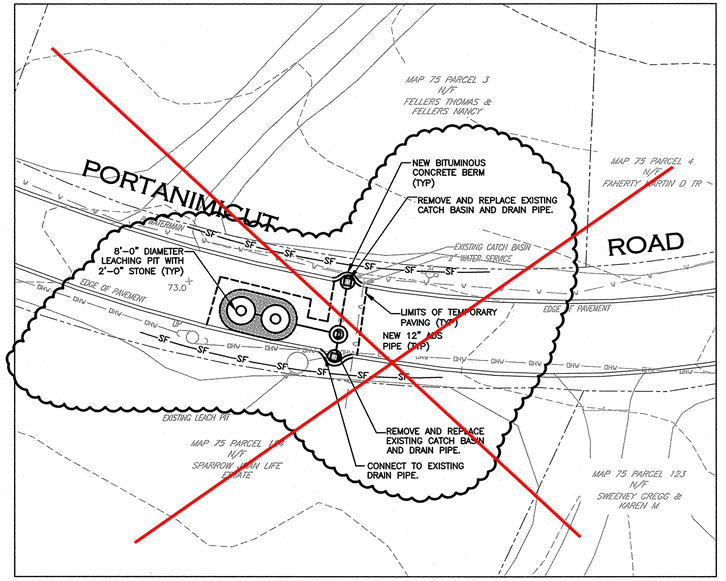
JOB NO. 861246601 | CONTRACT 2009-SW-02 | SHEET C-1



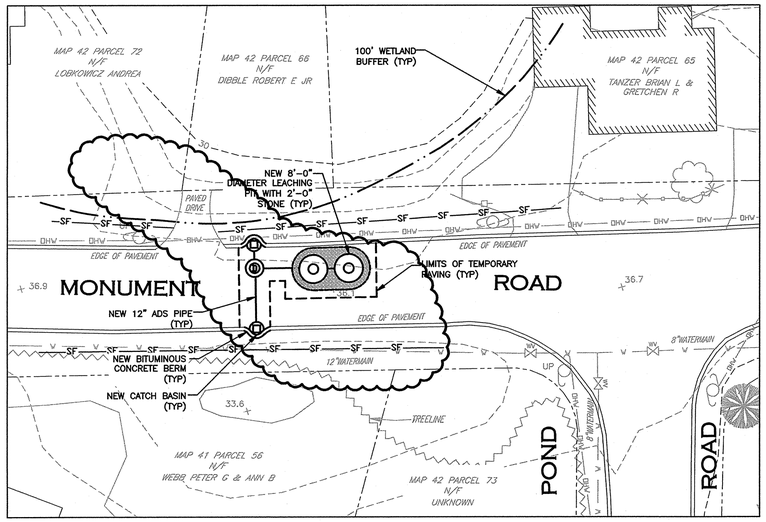
POND ROAD – PLAN 7
SCALE: 1"=20'–0"



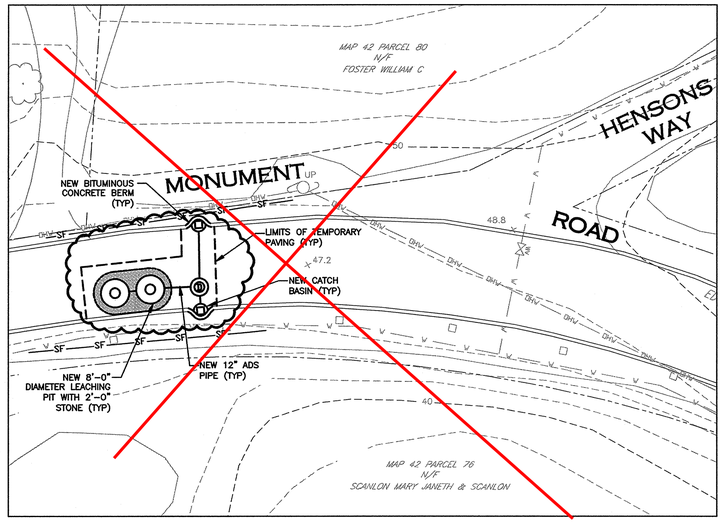
POND ROAD – PLAN 8
SCALE: 1"=20'–0"



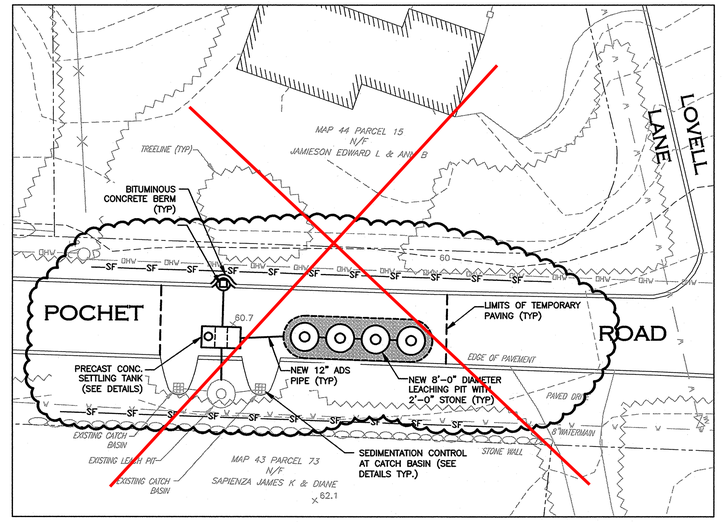
PORTANIMICUT ROAD – PLAN 9
SCALE: 1"=20'–0"



POND AND MONUMENT ROADS – PLAN 10
SCALE: 1"=20'–0"



MONUMENT ROAD AND HENSON WAY – PLAN 11
SCALE: 1"=30'–0"



POCHET ROAD – PLAN 12
SCALE: 1"=20'–0"

1"=20'–0" (20 0 20 40)

Login name: JJO
Filename path: J:\J00000\J01092\J3\Drawings\Civil
Filename: 91092002.dwg
Latest Revision: Thursday, September 24, 2009

NOTES:

Underground facilities, structures, and utilities have been plotted from available surveys and records, and therefore their locations must be considered approximate only. There may be others, the existence of which is presently not known. Anyone using utility information and data provided herein shall "Call Dig–Safe" at 1–888–344–7233 seventy two (72) hours, 3 business days in advance to verify the location of utilities prior to start of construction.

ISSUE NO.	DRAWN	DATE	CHECKED	DESIGNER	APPROVED	DATE
3	JJO	09/09	RHK	RHK		
FOR CONSTRUCTION						
2	JJO	07/09	RHK	RHK		
FOR APPROVAL						
1	JJO	07/09		RHK		
FOR REVIEW						

PROJECT SUPERVISOR _____ DEPARTMENT SUPERVISOR _____

ISSUE NO.	DRAWN	DATE	CHECKED	DESIGNER	APPROVED	DATE
3	JJO	09/09	RHK	RHK		
REVISED PER ADDENDUM No.1						

COMMONWEALTH OF MASSACHUSETTS
WILLIAM R. HALL, JR.
SANITARY
No. 29031
REGISTERED PROFESSIONAL ENGINEER

STEARNS & WHELER LLC
Environmental Engineers & Scientists
HYANNIS, MASSACHUSETTS

TOWN OF ORLEANS, MASSACHUSETTS
TOWN–WIDE STORMWATER IMPROVEMENTS
PLANS 7–12

JOB NO. 861246601 | CONTRACT 2009–SW–02 | SHEET C–2

Contract Documents

Volume II

Meetinghouse Pond Area Collection System and Pumping Station

Contract No. 2022-01 and SRF No. 7150

Town of Orleans, MA

Prepared For

Department of Public Works & Natural Resources

AECOM Technical Services, Inc.

March 2023

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Stormwater Improvements from GHD 99999

VOLUME II

2019-01 AND 2019-02 PROPRIETARY EQUIPMENT SHOP DRAWINGS

NOTE: Bidders shall check the attached documents with the above list before submitting a bid.

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2019-01 AND 2019-02 PROPRIETARY EQUIPMENT SHOP DRAWINGS

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Mechanical Process Group

PROJECT:	Orleans, MA Downtown Area WWTF and Effluent Disposal	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-01	DATE:	3/17/2021
SUBMITTAL NO:	153 (11308-001-1)	REVIEWER:	CM/CG
SUBJECT:	SBR Transfer Pumps Resubmittal	SPECIFICATION:	11308- Recessed Impeller Pumps and Appurtenances

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only (6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	Specification Compliance	2	The pump supplier indicates that they are not providing a number of items such as field testing, VFD's, drain and vent piping etc. See specification compliance section for the specific items. Contractor to provide these items as specified.
2.	Specification Compliance	5	It is noted that when available, the following will be submitted for review: • O&M to be submitted under separate cover. • Hydrostatic test results to be submitted following completion. • Dynamic impeller balancing certification to be submitted following completion. • List of recommended spare parts to be included in O&M. • Field inspection reports to be submitted following completion. • Shop pump testing and motor testing results will be submitted following completion. • Field service engineer qualification will be submitted prior to startup • Short and long term storage instruction to be included in O&M. • Shop and field test procedures. • Vibration test results will be included with field test reports. • Field alignment measurements to be included with field test reports. • Seismic Design Calculations/Stamped Certificate of Unit Responsibility.
3.	Submittal Data Sheets	2	As a result of bid alternate item No. A-4 being declined, 3 SBR Transfer pumps will be provided in lieu of 4 at this time. The submittal data sheet lists a quantity of four (4) pump/motor units to be supplied. Revise quantity to three (3) pump/motor units.
4.	Seal Faces	1	It is noted factory installed seal faces will be provided.
REVIEWER SIGNATURE	Mini, Christopher	Mini, Christopher cn=Mini, Christopher, ou=USCHL1, email=Christopher.Mini@aecom.com	
APPROVER SIGNATURE	Galligan, Chris	Digitally signed by Galligan, Chris DN: cn=Galligan, Chris, ou=USCHL1, email=Chris.Galligan@aecom.com Date: 2021.03.17 15:58:05 -04'00'	

Town of Orleans, MA
Downtown Area WWTF and Effluent Disposal
Contract No. 2019-01 SRF No. 4486

Contractor Certification Stamp

Submittal No. 11308-001-1 Submittal Title: SBR Transfer Pumps Resubmittal

Drawing No N/A Spec. Paragraph: _____

Deviations: N/A

Contractor – Daniel O'Connell's Sons
Subcontractor/Supplier – Hayes Pumps
Date of Submission – 3/5/21

Daniel O'Connell's Sons

Representation is made to Owner and Engineer that Contractor has reviewed this submittal in accordance with Section 1300, Par. 3.01 and that the Contractor herby approves this submittal.

MAC (Initials) 3/5/21 (Date)

Engineer's Review:

- [ ] NO EXCEPTION TAKEN
- [ ] MAKE CORRECTIONS NOTED
- [ ] AMEND AND RESUBMIT
- [ ] REJECTED; SEE REMARKS
- [ ] FOR INFORMATION ONLY
- [ ] NOT REQUIRED FOR REVIEW

_____ (Reviewed by) _____ (Firm) _____ (Date)

HAYES PUMP, INC.

66 Old Powder Mill Road
West Concord, MA 01742
PH: 978-369-8800
Fax: 978-369-8461

March 4, 2021

Mr. Robert Bailey
Daniel O'Connell's Sons
1000 Franklin Village Drive – Suite 205
Franklin, MA 20238

REFERENCE: Downtown Area WWTF & Effluent Disposal – Contract 2019-01
Orleans, MA
Submittal #76 – 11308-001
Section 11308 – Recessed Impeller Pumps
SBR Transfer Pumps – SBR.TP-1 thru 3

Dear Bob:

The following are responses to AECOM's Shop Drawing Review Comments in their transmittal dated 1/13/2021:

1.) Noted.

2.) Noted. Additional documentation to be provided when available following completion.

3.) Specification Compliance - Comment #20 - Seismic design calculations with recommended anchor bolt sizes will be submitted following completion after order is release to production. These will be stamped by registered PE.

4.) Specification Compliance - Comment #22 - Scope of supply has been changed to quantity three (3) pump/motor units.

5.) Submittal data cover sheet typo is noted. Corrected sheet showing 255 GPM design flow condition is included in resubmittal.

6.) Specification Compliance – Comment #44 - Contract Drawing 00 D-004 - Process Pump Schedule – SPB Transfer Pump Notes - Copy of submittal curve with NPSH-R data is included in resubmittal. Impeller trim will be 8.40" diameter to meet the full speed secondary rating point of 500 GPM @ 54 FT TDH as specified. NPSH-R ratings are 29 FT at 255 GPM and 22 FT at 500 GPM. Since this is a flooded suction application, there's sufficient NSPH-A (available) to satisfy NPSH-R (required) at all specified operating conditions.

7.) Specification Compliance - Comment #24 - Because of the Ni-Hard 650 Brinnell construction material for the pump casing, drilled and tapped casing high point and/or drain connections cannot be provided. Casing is self-venting, so high point air vent is not required. For drain purposes, suction piping adjacent to the pump suction flange will be equipped with drilled, tapped, and plugged drain connection. This will be located between the pump suction connection and the suction side isolation valve.

8.) Specification Compliance - Comment #25 - Fairbanks is not able to provide ASTM A48 Class 40 cast iron for the bearing frame material. For the entire Fairbanks solids handling pump product line including the 2400, 5400, and 5700 series, Fairbanks uses ASTM A48 Class 30 cast iron material for all bearing frame sizes T20 through T80. Class 30 cast iron is also used for the S & M bearing frame sizes used for the vortex pump product line. The cast iron material used has the proper metallurgical properties, tensile strength, and thickness to meet the calculated load requirements. Per the bearing life statement included in the submittal, bearing life will be in accordance with the specified minimum L/B-10 life rating of 100,000 hours per part 2.02.G.3. Note that the bearing frame cast iron material is not a wear component.

9.) Specification Compliance - Comment #26 - Fairbanks offers an optional shaft sleeve with 620 BHN hardness. However, this sleeve can only be used for packing applications. This hardness rating is not suitable for use with the split mechanical seals specified for this project. The proposed 450 BHN shaft sleeve material is required for the seal set screws to function properly.

10.) Pump/motor unit will be provided with fully enclosed OSHA approved coupling guard for personnel protection. This is indicated on the setting plan drawing 0911842SP by the rectangular box with triangle referencing the warning note in upper left-hand corner.

11.) Specification Compliance - Comment #29 - Motors will be constructed to meet Class B maximum temperature rise rating of 80°C @ 1.00 SF. Operating temperature will not exceed this rating. However, because of the inverter duty rated motor requirements, the nameplates will be stamped Class F insulation with Class F temperature rise. That is why the motor performance submittal data states maximum temperature rise of 105°C.

12.) Specification Compliance - Comment #34 - Fairbanks production uses a standard assembly procedure for split mechanical seals, factory installing solid (non-split) faces which allows for better quality control and minimizes leakage. As noted in Chesterton's published literature and per their O & M instructions, split seals are designed to leak. Fairbanks has found to use of solid faces greatly reduces and/or eliminates leakage during initial start-up and operation. When the mechanical seal needs to be replaced in the future, the faces are easily broken in half during disassembly to enable installation of replacement split faces.

Please forward this response on to the engineers. In the meantime, this order will remain on Hold for Approval status pending final review and approval.

HAYES PUMP, INC.

J. Craig Huff III
Vice President
Contract Sales

PENTAIR FAIRBANKS NIJHUIS™

December 11, 2020

Hayes Pump, Inc.
66 Old Power Mill Rd
West Concord, MA 01742

Attn: Craig Huff

Subject:	Purchase Order Number:	00116822
	Sales Order Number:	52503272
	Project:	Town of Orleans - 0911842

Craig:

Submittal data for the above order is attached. This submittal is for your review and approval prior to release for manufacturing.

We require submittal return with your review comments and/or approval to release within 35 days for production scheduling purposes. At time of release, please advise firm “on-site” requirement dates for this equipment.

Very Truly Yours,

Specifications Department
Pentair Flow Technologies

Return Submittal to: **fmproduct@pentair.com**

cc:

Enclosures: () sets submittal
() O & M Manual

Pentair Flow Technologies

General Clarifications

1. The supply and installation of the following items are by others unless otherwise identified in this submittal.
   - Anchor bolts, nuts and washers
   - Gauges, valves and miscellaneous fittings and adapters.
   - Connecting piping and/or supports
   - Maintenance lubrication piping and related equipment.
   - System control apparatus
   - Installation

HAYES PUMP, INC.
66 Old Powder Mill Road
West Concord, MA 01742
PH: 978-369-8800
FAX: 978-369-8461

Flow solutions since 1898

SUBMITTAL DATA

JOB NAME:	**Downtown Area WWTF & Effluent Disposal – Contract 2019-01**
	Orleans, MA
ENGINEER:	**AECOM**
	Chelmsford, MA
REFERENCE:	**Specification Section 11308 – Recessed Impeller Pumps & Appurtenances**
	SBR Transfer Pumps – SBR.TP.1 thru 4
QUANTITY:	**Four (4) Pump/Motor Units**

PUMP DESCRIPTION

MANUFACTURER:	**Fairbanks Nijhuis**	**MODEL:**	**4623CE**	**SIZE:**	**4" x 4"**
FLOW (GPM):	**255**	**TDH (FT):**	**53**	**SPEED (RPM):**	**1750**
CONSTRUCTION:	**Cast Iron, Ni-Hard 650 BHN**		**STUFFING BOX:**	**Mechanical Seal**	
BASEPLATE:	**Fabricated Steel**		**COUPLING:**	**Flexible w/ Guard**	
OTHER:	**None**				

MOTOR DESCRIPTION

HORSEPOWER:	**25**	**SPEED (RPM):**	**1800**	**ENCLOSURE:**	**TEFC**
VOLTAGE:	**3/60/230-460**	**FRAME:**	**284T**	**MANUFACTURER:**	**Nidec USEM**
OTHER:	**See Details Included in Submittal Package**				

ORDER INFORMATION

SOLD TO:	**Daniel O'Connell's Sons**	**P. O. NUMBER**	**2020-113-006**
	800 Kelly Way		
	Holyoke, MA 01040		

HAYES ORDER #:	**Not Assigned Yet**	**BY:**	**Craig Huff**	**DATE:**	**REV - 3/4/2021**

SUBMITTAL DATA

JOB NAME:	**Downtown Area WWTF & Effluent Disposal – Contract 2019-01**
	Orleans, MA
ENGINEER:	**AECOM**
	Chelmsford, MA
REFERENCE:	**Specification Section 11308 – Recessed Impeller Pumps & Appurtenances**
	SBR Transfer Pumps – SBR.TP.1 thru 4
QUANTITY:	**Four (4) Pump/Motor Units**

SPECIFICATION COMPLIANCE CHECK THE SPEC

The following is a list of Specification Section 11308 comments and clarifications:

1.) **Page 1, Part 1.1.A – Scope of Supply**
Contractor is responsible for providing VFD's.

2.) **Page 3, Part 1.04.B.9 - Submittals**
O & M manuals will be submitted under separate cover following shop drawing approval.

3.) **Page 3, Part 1.04.B.10**
There are numerous installations of Fairbanks 4600 Series recessed impeller pumps. Specific installation references and contact names are not readily available, but can be researched upon request.

4.) **Page 3, Part 1.04.B.11**
Hydrostatic test results will be submitted following completion.

5.) **Page 3, Part 1.04.B.12**
Dynamic impeller balancing certification will be submitted following completion.

6.) **Page 3, Part 1.04.B.13**
Maximum recommended operating temperature of bearing housing outside surface is 190 degrees F.

7.) **Page 3, Part 1.04.B14**
List of recommended spare parts will be included in O & M manual.

8.) **Page 3, Part 1.04.B.15**
Field inspection reports will be submitted following completion.

9.) **Page 3, Parts 1.04.B.17 & 18**
Shop pump testing and motor testing results will be submitted following completion.

10.) **Page 3, Part 1.04.B.19**
Field service engineer qualifications will be included in field testing procedure package. This will be submitted prior to start-up.

11.) **Page 3, Part 1.04.B.20**
Short and long term storage instructions will be included in O & M manual.

12.) **Page 3, Part 1.04.B.21**
Shop and field test procedures will be submitted after equipment is released to production.

13.) **Page 3, Part 1.04.B22**
No special tools are required.

14.) **Page 3, Part 1.04.B.23**
Specified number of service person-days total will be provided for installation inspection, functional testing, field performance testing, and vendor training. Field service rate is $720.00 per eight hour day.

15.) **Page 3, Part 1.04.B.24**
Vibration test result will be included with field test reports.

16.) **Page 3, Part 1.04.B.25**
For purposes of accuracy, it's recommended that suction and discharge locations be located upstream and downstream from the pump flanged connections.

17.) **Page 3, Part 1.04.B.29**
Field alignment measurements will be included with field test reports.

18.) **Page 3, Part 1.04.B.30**
Scaled drawing of installation is not included on our scope of supply.

19.) **Page 4, Part 1.05 – Product Handling**
Contractor is responsible for Jobsite offloading, handling, and storage.

20.) **Page 4, Part 1.06 – Seismic Design Requirements**
Seismic design calculations with recommended anchor bolt sizes will be submitted separately when complete. Contractor is responsible for foundation design. Calculations will be stamped by registered engineer.

21.) **Page 5, Part 1.07.F.1.a & b – Quality Assurance**
VFD's are not included in our scope of supply.

22.) **Page 6, Part 2.01.B – System Description**
Quantity three (3) SBR Transfer Pumps will be provided per the base bid.

23.) **Page 7, Part 2.03.E.2.b – Pump Construction**
Pumps will have radial vane impellers with one piece casing.

24.) **Page 8, Part 2.03.E.8**
Because of the Ni-Hard 650 Brinnell construction material for the pump casing, drilled and tapped casing high point and/or drain connections cannot be provided. Casing is self-venting, so high point air vent is not required. For drain purposes, suction piping adjacent to the pump suction flange will be equipped with drilled, tapped, and plugged drain connection. This will be located between the pump suction connection and the suction side isolation valve.

25.) **Page 8, Part 2.03.F.1**
Fairbanks is not able to provide ASTM A48 Class 40 cast iron for the bearing frame material. For the entire Fairbanks solids handling pump product line including the 2400, 5400, and 5700 series, Fairbanks uses ASTM A48 Class 30 cast iron material for all bearing frame sizes T20 through T80. Class 30 cast iron is also used for the S & M bearing frame sizes used for the vortex pump product line. The cast iron material used has the proper metallurgical properties, tensile strength, and thickness to meet the calculated load requirements. Per the bearing life statement included in the submittal, bearing life will be in accordance with the specified minimum L/B-10 life rating of 100,000 hours per part 2.02.G.3. Note that the bearing frame cast iron material is not a wear component.

26.) **Page 8, Part 2.03.H.3.b**
Fairbanks offers an optional shaft sleeve with 620 BHN hardness. However, this sleeve can only be used for packing applications. This hardness rating is not suitable for use with the split mechanical seals specified for this project. The proposed 450 BHN shaft sleeve material is required for the seal set screws to function properly.sleeve will be 450 BHN hardened A 314 type 440C stainless steel.

27.) **Page 9, Part 2.03.K**
Suction handhole cleanouts are not applicable for pumps type being provided for this project.

28.) **Page 10, Part 2.04.K - Motors**
Per specifications in Section 01171, motors will be equipped with bimetallic winding temperature thermostats with normally closed contacts. Contacts to be wired to pump control panel and/or SCADA system for shutdown upon high motor temperature condition.

29.) **Page 10, Part 2.04.M**
Motors will be constructed to meet Class B maximum temperature rise rating of 80°C @ 1.00 SF. Operating temperature will not exceed this rating. However, because of the inverter duty rated motor requirements, the nameplates will be stamped Class F insulation with Class F temperature rise. That is why the motor performance submittal data states maximum temperature rise of 105°C.

30.) **Page 10, Part 2.05 – Drain Vent & Piping**
Drain and vent piping is not included in our scope of supply.

31.) **Page 10, Part 2.06 – Pressure Gauges**
Pressure gauges are not included in our scope of supply.

32.) **Page 11, Part 2.08.B.6 – Shop Testing**
VFD testing is not included in our scope of supply.

33.) **Page 11, Part 3.01 - Installation**
Contractor is responsible for installation.

34.) **Page 12, Part 3.01.F – Field Painting**
Fairbanks production uses a standard assembly procedure for split mechanical seals, factory installing solid (non-split) faces which allows for better quality control and minimizes leakage. As noted in Chesterton's published literature and per their O & M instructions, split seals are designed to leak. Fairbanks has found to use of solid faces greatly reduces and/or eliminates leakage during initial start-up and operation. When the mechanical seal needs to be replaced in the future, the faces are easily broken in half during disassembly to enable installation of replacement split faces.

35.) **Page 12, Part 3.02 – Field Painting**
Contractor is responsible for field touch-up painting.

36.) **Page 12, Part 3.03 – Clean Up**
Contractor is responsible for clean up.

37.) **Page 12, Part 3.07.B.1.b – Spare Parts**
Spare split mechanical seal kit for each pump will be provided. Spare restriction bushing will not be provided with seal kits as this component is not a wear item and/or user field replaceable.

38.) **Page 12, Part 3.07.B.2.a**
No special tools are required.

39.) **Page 12, Part 3.07.B.3**
Spare rotating assembly is not indicated/listed as a requirement per the Process Pump Schedule on Contact Drawing 00 D-004

40.) **Page 13, Part 3.08.A**
Contractor is responsible for pipe strain testing.

41.) **Page 13, Part 3.08.B**
Contractor is responsible for field testing equipment including gauges, flow meter, and calibration certificates.

42.) **Page 13, Part 3.08.C.1**
Field signature vibration testing by independent agent is not included in our scope of supply.

43.) **Page 13, Part 3.08.C.5**
Contractor is responsible for test gauges and calibrated flow meter for testing purposes.

44.) **Contract Drawing 00 D-004 – Process Pump Schedule**

SPB Transfer Pump Notes - NPSH-R data is shown on submittal curve. Impeller trim will be 8.40” diameter to meet the full speed secondary rating point of 500 GPM @ 54 FT TDH as specified. NPSH-R ratings are 29 FT at 255 GPM and 22 FT at 500 GPM. Since this is a flooded suction application, there’s sufficient NSPH-A (available) to satisfy NPSH-R (required) at all specified operating conditions.

SECTION 11308

RECESSED IMPELLER PUMPS AND APPURTENANCES

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PART 1 - GENERAL

1.01 - SCOPE

Comment #1

A. Provide and test recessed impeller pumps, motors, variable frequency motor controllers, and appurtenances as indicated and in compliance with Contract Documents.

B. Attention is directed to the DOCUMENT 0700, GENERAL CONDITIONS and all the sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENTS AND PAYMENT.

1.03 - DEFINITONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include but are not limited to the following:

1. Data regarding pump and motor characteristics and performance:
   a. Prior to fabrication and testing, provide guaranteed performance curves based on actual shop tests of mechanically duplicate pumps, showing they meet indicated and specified requirements for head, capacity, horsepower, efficiency and NPSHr.
      (1) For units of same size and type, provide curves for a single unit only.
   b. Provide catalog performance curves at maximum pump speed indicated and specified for each service showing maximum and minimum impeller diameters available, acceptable operating range (AOR) and preferred operating range (POR).
   c. Results of shop performance tests as specified.
   d. Submit curves for guaranteed performance, and shop performance tests on 8-1/2-inch by 11-inch sheets, one curve per sheet.
2. Characteristic curves for variable speed pumps for maximum pump speed and for speeds required to obtain minimum pump flow and head conditions specified and indicated. Identify curves by speed and provide all curves on one sheet. Provide NPSH3 curve for each speed.
3. Motor data in accordance with SECTION 01171 – ELECTRIC MOTORS, Paragraph 1.04 – Submittals.

4. Wiring diagrams for motors.
5. Motor FLA data.
6. Shop drawing data for accessory items.
7. Certified setting plans, with tolerances, for anchor bolts.
8. Manufacturer's literature as needed to supplement certified data.

Comment #2 9. Operating and maintenance instructions and parts lists.

#3 10. Listing of reference installations as specified with contact names and telephone numbers.

#4 11. Certified results of hydrostatic testing.

#5 12. Certified results of dynamic balancing.

#6 13. Bearing temperature operating range for the service conditions specified.

#7 14. List of recommended spare parts other than those specified.

#8 15. Shop and field inspection reports.

16. Bearing Life: Certified by the pump manufacturer. Include design data.

#9 17. Pump shop test results.

18. Motor shop test results.

#10 19. Qualifications of field service engineer.

#11 20. Recommendations for short and long-term storage.

#12 21. Shop and field testing procedures, pump and piping set up, equipment to be used and ANSI/HI testing tolerances to be followed.

#13 22. Special tools.

#14 23. Number of service person-days provided and per diem field service rate.

#15 24. Results of field vibration test data including a vibration signature for each pump and drive assembly. Provide vibration testing procedure for review.

#16 25. Recommended location of suction and discharge pressure gauges.

26. Manufacturer’s product data, specifications and color charts for shop painting.

27. Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

28. The latest ISO 9001 series certification.

#17 29. Certified statement of pump, motor and shafting alignment within manufacturer tolerances.

#18 30. Provide a scaled drawing for each pump service showing the pumps, motors, hoists including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.

31. Material Certification:

a. Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the Owner.

b. Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

C. A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required" or provide a statement that no changes are required.

1. Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

D. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

1. If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

2. Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

Comment #19

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

C. Comply with the requirements specified in SECTION 01610, DELIEVERY, STORAGE AND HANDLING.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. All equipment shall be provided by the same manufacturer.

C. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

D. Seismic Design Requirements

Comment #20

1. Conform to the requirements indicated on the structural drawings and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

2. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

3. Provide all equipment bases, anchorage, supports and foundations designed in accordance with the seismic requirements indicated and specified.

4. Additionally, provide with the Certificate of Unit Responsibility, certification for all equipment signed by a registered structural engineer stating that computations were performed and that all components have been sized for the seismic forces specified and indicated.

1.07 - QUALITY ASSURANCE

A. Comply with the requirements specified in SECTION 01400, QUALITY ASSURANCE.

B. Pumps shall be the product of one manufacturer.

C. Pumps shall be manufacturer's standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

D. Welding: In accordance with latest applicable American Welding Society Code or equivalent.

E. Shop tests as specified.

F. The Contractor shall obtain the pumps, motors, and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

Comment #21

1. The pumping system must be a complete and integrated package to insure proper coordination and compatibility and operation of the system.

   a. The Contractor shall coordinate the variable frequency motor controllers supplied under Division 16 with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

   b. Variable frequency motor controllers shall be supplied under Division 16 in accordance with SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

   c. Provide certificate of co-ordination signed by pump, motor and variable frequency motor controller manufacturer.

   d. Provide motors in accordance with SECTION 01171 – ELECTRIC MOTORS.

G. Services of Manufacturer's Representative as stated in SECTION 01400, QUALITY ASSURANCE and as specified herein.

H. Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

1. Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

2. Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

3. Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connection:

   a. 1 person-days.

4. Functional Testing: Calibrate, check alignment and perform a functional test with water. Tests to include all items specified.

   a. 1 person-days.

5. Field Performance Testing: Field performance test equipment specified.

   a. 1 person-days.

6. Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

   a. 1 person-days.

7. Credit to the Owner, all unused service person-days specified above, at the manufacturer's published field service rate.

8. Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the Owner.

I. Manufacturer of pumps shall have a minimum of five (5) operating installations with pumps of the size specified and in the same service as specified operating for not less than five (5) years.

J. If equipment proposed is heavier or taller, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the Owner.

1. If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.08 - REFERENCES

A. American Bearing Manufacturers Association (ABMA):

B. American National Standards Institute (ANSI):

1. S1.11: Standard Octave-Band and Fractional-Octave-Band and Digital Filters.

C. American Society of Mechanical Engineers (ASME):

1. Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

D. ASTM International (ASTM):

1. A36/A36M: Standard Specification for Carbon Structural Steel.

2. A48/A48M: Standard Specification for Gray Iron Castings.

3. A322: Standard Specification for Steel Bars, Alloy, Standard Grades.

4. A532: Standard Specification for Abrasion-Resistant Cast Iron.

5. A743/A743M: Standard Specification for Castings, Iron-Chromium, Iron-Chromium Nickel, Corrosion Resistant, for General Application.

E. Hydraulic Institute (HI):

1. Current Standards.

2. 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

F. National Electrical Manufacturers Association (NEMA):

1. MG1: Motors and Generators.

G. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 - SYSTEM DESCRIPTION

A. Pump capacities and operating data are indicated in the Process Pump Schedule.

B. SBR Transfer Pumps (SBR.TP-1 through 4): Pump raw municipal wastewater that has been through a screen with 6 mm openings and pump from the aerated pre-equalization tanks.

Comment #22

C. Sludge Transfer Pumps (SL.TP-1 and 2): Pump waste sludge and septage from the aerated waste sludge storage tanks to the rotary drum thickeners, with solids concentration up to 1.0 percent.

D. Coordinate pump dimensions and weights with hoists as specified in Sections 14300.

E. Pumps normally operate with a flooded suction except that pumps will be subject to a suction lift if indicated in the Process Pump Schedule.

F. Provide equipment rated in accordance with the Environmental Classification Schedule on Contract drawing 00 E-601.

2.02 - MANUFACTURERS

A. Recessed Impeller Pumps

1. Egger Series
2. Fairbanks Nijhuis
3. KSB

2.03 - PUMP CONSTRUCTION

A. Pumps: Recessed impeller, vortex type, single-stage, centrifugal pumps. Driven as indicated in the Process Pump Schedule.

B. Pump Configuration: As indicated in the Process Pump Schedule.

C. Design and proportion all parts of pump specially adapted for the service specified and indicated.

D. Pump Mounting: Provide type as indicated and specified.

1. Horizontal Pumps:

a. Mount each pump and drive on a common base.

(1) Material: ASTM A36 fabricated structural steel.

(2) Provide structural steel shape bases, bent form bases are not acceptable.

(3) Provide bases with provisions for grouting and for anchor bolts.

(4) Design baseplates to support pump and driver.

(5) Provide planed surfaces of bearing pads for pumps and drives.

E. Pump Casing, Fronthead and Wear Plate:

1. Provide materials for the pump services as follows:

a. Pump Services: SBR Transfer Pumps and Sludge Transfer Pumps.

(1) Cast Iron ASTM A48 Class 35B

(2) Ni-Hard, ASTM A532 Class I, HC 600 or ASTM A532 Class IIIA

(3) Minimum 650 BHN.

2. Design casings for removal of rotating parts without disconnecting suction and/or discharge piping.

a. ~~For pumps with cup type impellers provide a two (2) piece radially split casing with separate suction piece~~.

Comment #23

b. For pumps with radial vane impellers provide a one (1) piece casing. Pumps requiring a replaceable wear element completely surrounding the impeller are not acceptable.

3. Provide lifting devices on pump casings for handling.

4. Provide ribs or reinforcing required to withstand the specified hydrostatic test pressure, to prevent deflection caused by hydraulic thrust and to support the motor.

5. Provide flanged slotted suction and discharge connections or face and drill flanges of suction and discharge connections, in accordance with ANSI/ASME B16.1 Class 125-lb. ANSI Standard.
6. Provide components with machined registered concentric shoulder fits for precision alignment. Equipment
7. without registered fits is not acceptable.

Comment #24

8. Provide high point of casing with an air vent or provide a self-venting casing and low point with a drain.

F. Main Frame:

Comment #25

1. Cast iron ASTM A48/A48M Class 40.
2. Fit to casing with machined registered joints.
3. Provide main frame designed to resist without distortion, all stresses due to impeller thrust and bearing loads.
4. Provide main frame designed to support shaft and impeller and to contain stuffing box and bearings.

G. Bearings:

1. Outboard bearing to be combination thrust and radial type; inboard bearing radial type.
2. Provide bearings in a dust and moisture proof enclosures.
3. Provide bearings with minimum LB-10 life rating of 100,000 hours at specified operating conditions and 40,000 hours minimum at 25 percent of the BEP at highest speed, based on latest ABMA and ANSI Standards.
4. Grease lubricated anti-friction type.
   a. Provide means in bearing housing, such as removable plug diametrically opposite grease fitting, to prevent over greasing of bearing.
   b. Grease fittings: Alemite.

H. Pump Shaft:

1. ASTM A322-C4140 heat treated steel or stainless steel type 420 or 430, machined.
2. Protect shaft from wear at stuffing box and from contact with pumped liquid by removable and replaceable sleeve.
3. Sleeves:
   a. Extend sleeves through stuffing box.

Comment #26

   b. Pumps of hard metal construction: Type GGK-FP with Eut. 12496 coating, 55 to 62 HRC.

I. Impeller:

1. Type: Recessed radial curved vane or cupped type solids handling single suction.
   a. Straight vane impellers are not acceptable
2. Pump capable of passing a sphere size as indicated in the Process Pump Schedule.

J. Material:

1. Ni-Hard, ASTM A532 Class I, HC 600, or ASTM A532 Class IIIA minimum 650 BHN, or hardened duplex stainless steel CD4MCu for pumps specified with Ni-Hard or High Chrome Iron Casing.
2. Key-seat or taper and hold impeller to shaft by a streamlined bolt or locknut capable of holding in event of motor reversal under full torque. Impeller fasteners: Type 416 stainless steel.
3. Statically and dynamically balance each impeller.

K. Handhole Cleanouts:

Comment #27

1. Locate handholes in suction nozzle or separate suction piece for horizontal pumps to provide access to impeller and interior parts.
2. Equip handholes with covers designed for easy removal.
3. Shape interior surface of cover to maintain contour of interior of casing to which it is attached to maintain efficiency and to prevent lodging of solids.
4. Gaskets: Neoprene or Buna-N.
5. Hardware: Type 316 Stainless Steel.

L. Seals:

1. Split Mechanical Seal:
   a. Manufacturer: Chesterton Style 442
   b. Materials:
      (1) Gland: Type 316 stainless steel.
      (2) Rotary Holder: Type 316 stainless steel.
      (3) Hardware: Type 316 stainless steel.
      (4) Springs: Hastelloy C or Elgiloy
      (5) Rotating Faces: Silicon Carbide.
      (6) Stationary Faces: Silicon Carbide
      (7) Elastomers: Viton
      (8) Restriction Bushing: Split type, ESC Carbon Graphite PTFE or Type 316 SST.
   c. For pumps specified and indicated not requiring seal water, provide Enviroseal Spiraltrac bushing version D, type A
   d. Seals will be installed in the pumps at the jobsite by the seal manufacturer's field service technician. Seals installed at the pump manufacturer's facility are not acceptable.

M. Couplings: Horizontal Pumps:

1. Non lubricated, polyurethane flex material type.
2. Split design.
3. Spacer type.
4. Manufacturer: Rexnord Omega or acceptable equivalent product.
5. Provide guards for protection for personnel, conforming to OSHA requirements.
   a. Guards and Hardware: Type 316 stainless steel.

2.04 - MOTORS

A. Provide in accordance with SECTION 01171, ELECTRIC MOTORS and as specified and indicated.

B. Horsepower rating of motors: Not less than maximum brake horsepower requirements of pumps under any condition of operation specified and indicated without operating in the motor service factor.

C. Motor enclosure and motor speed: As indicated in the Process Pump Schedule.

D. Provide motors for horizontal pumps with mounts for bolting to baseplate.

E. In addition to the requirements for bearings specified in SECTION 01171, ELECTRIC MOTORS, provide pump motors with ball or roller bearings. Provide bearing with a minimum LB-10 life of 100,000 hours.

F. Overall sound-pressure level of each motor shall not exceed 88 decibels when measured on flat network using an octave-band frequency analyzer conforming to ANSI/ASA S1.11. Determine overall sound-pressure level as average of four or more readings at evenly spaced points, 3 feet (1 meter) from motor.

G. Operate without overheating at the speeds specified and indicated.

H. Provide motor service factor of 1.0 in accordance with NEMA MG-1 requirements for VFD driven motors.

I. Premium efficiency with nominal and minimum efficiencies per NEMA MG1.

J. Rating: 460V, 3-phase, 60 Hertz.

Comment #28

K. Provide VFD driven motors with normally-closed winding thermistors for motor over-temperature protection.

L. Provide motors as inverter duty rated for use with VFD's per NEMA MG1.

Comment #29

M. Insulation: Class F with Class B temperature rise, 40 degree C ambient.

N. Site Altitude: Less than 3300 feet above sea level.

O. Provide Inpro/Seal bearing isolators.

2.05 - DRAIN AND VENT PIPING

Comment #30

A. Drain and vent piping: Schedule 5 Type 316L stainless steel with Pressfit connections or Schedule 40 Type 316L stainless steel with socket welded connections. Provide a sufficient number of unions to permit removal of each valve and in-line device.

B. Provide pipe and fittings in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

C. Valves: Provide size and type as indicated and in accordance with SECTION 15101, PROCESS VALVES AND APPURTENANCES.

2.06 - GAUGES

Comment #31

A. Provide gauges assemblies for suction and discharge of each pump in accordance with SECTION 15370, PROCESS PIPING AND APPURTENANCES and as indicated.

B. Suction Gauges: compound type.

1. Scale: inches Hg to psi

C. Discharge gauges: Provide standard range with top limit above pump shutoff head at maximum pump speed.

1. Scale: psi

2.07 - SHOP PAINTING

A. Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with SECTION 09940, SHOP PAINTING.

B. Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

C. Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

2.08 - SHOP TESTING

A. Provide motor shop testing in accordance with SECTION 01171, ELECTRIC MOTORS.

B. Pump Tests:

1. Test pump casings under a hydrostatic head of at least 75 psi or 150 percent of rated shutoff head, whichever is greater. Test casing with pump assembled.

2. Provide certified performance tests as specified herein for all pumps and spare rotating assemblies.

3. Certified performance testing.
   a. Run pump at full speed rating point for 60 minutes prior to start of any testing.
   b. Full speed tests:
      (1) Test pumps at the conditions specified and indicated and take not less than seven operating points between shut-off and run out. Test points must be at the conditions specified and indicated.
      (2) Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.
      (3) Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available. Test with the job submergence as indicated.
   c. Variable speed tests:
      (1) Conduct tests as specified above for full speed at reduced speeds except that tests for cavitation at run out are not required.
      (2) Run one speed test at speed required to discharge the minimum rating point specified and indicated with one point of test at the minimum rating point.
      (3) Run a second test at a speed approximately midway between full and minimum speed.
      (4) Run additional tests for each reduced speed operating condition specified and indicated.
   d. Factory tests on pumps:
      (1) Use factory calibrated test drives.
   e. Provide a minimum of 30 days written notice to the Engineer prior to shop testing.
   f. Do not test pumps with job split seals.
4. Run all tests in accordance with the latest standards of the Hydraulic Institute and as specified.
5. Testing Acceptance Grade and Tolerances:
   a. ANSI/HI 14.6 Acceptance Grade: 1U.
   b. Efficiency Tolerance: -0 percent.
   c. If pumps do not meet the tolerances specified, trim the impeller and retest until the specified results are obtained.
6. Tests of variable frequency motor controllers specified in SECTION 16260, LOW VOLTAGE VARIABLE FREQUENCY DRIVE UNIT.

Comment #32

7. In the event that specified tests indicate that pump, motor, or variable frequency drive will not meet specifications, Engineer has the right to require additional complete witnessed tests for all pumps, motors, and variable frequency drives at no additional cost to the Owner.
8. Repeat tests until specified results are obtained.
9. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Install items in accordance with accepted shop drawings, manufacturer's printed instructions and as indicated.

Comment #33

B. Install pumping units on a concrete pad and align thereon.

1. Install as indicated.

2. Coupling halves must be disconnected and only reconnected after alignment.

Comment #33

3. Set base on plastic or stainless steel shims placed directly under the part of the base carrying the greatest weight and spaced close enough to provide uniform support. The use of leveling nuts is not acceptable

C. Horizontal pumps: Dowel pump and drive to baseplate after alignment in field to facilitate realignment after disassembly.

D. Final Coupling Alignment:

1. Perform only after base is installed and piping is connected and pump nozzle connections tested as specified herein.

2. If realignment is required piping must be disconnected prior to alignment, piping reconnected and alignment checked prior to connecting coupling halves.

E. After alignment is correct, grout using high grade non-shrink grout.

1. For horizontal pumps fill entire base and leave no gaps or voids.

Comment #34

F. Split Mechanical Seals: Install seals with installation by the seal manufacturer's field service technician.

3.02 - FIELD TOUCH-UP PAINTING

Comment #35

A. After installation and accepted testing by the Engineer, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.03 - CLEAN UP

Comment #36

A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment.

B. Spillage of lubricants used in servicing the system shall be cleaned from all equipment and concrete surfaces.

3.04 - MANUFACTURER'S FIELD SERVICES

A. Manufacturer's Field Services shall be provided as specified herein

3.05 - MANUFACTURER'S TRAINING

A. Manufacturer's training shall be provided as specified herein.

3.06 - LUBRICATION REQUIREMENTS

A. All lubricating oils required for the first year of operation shall be provided.

3.07 - SPARE PARTS

A. Comply with the requirements specified in SECTION 01600, CONTROL OF MATERIALS.

B. Provide spare parts that are identical to and interchangeable with similar parts installed.

1. For each pump:

a. One complete set of gaskets and O-rings.

Comment #37

b. One mechanical seal repair kit and restriction brushing for each pump provided with mechanical seals.

c. One shaft sleeve.

2. For each set of pumps of the same size and performance.

Comment #38

a. One set of all special tools required.

3. Provide spare rotating assemblies as indicated in the Process Pump Schedule.

Comment #39

a. The assembly shall consist of a complete bearing frame, shaft and impeller.

3.08 - FIELD TESTING

A. Test piping connections to prove the pump nozzles are installed with the pipe in a free supported state and without need to apply vertical or horizontal pressure to align piping with pump nozzles. This must be performed and the piping acceptable prior to any field performance testing.

Comment #40

B. Field testing will not be conducted without an accepted procedure, calibration certificates for all testing equipment, gauges and flow meters and a completed and signed pretesting check list. See Division 01 for checklist.

Comment #41

C. After installation of pumping equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each pump in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

1. During tests, observe and record head, capacity, pump bearing housings and motor bearing temperature, noise and vibration and motor inputs.

Comment #42

a. Provide vibration signature test data for each pump and drive assembly.

(1) Limit: 50 percent of ANSI/HI allowable limits.

b. Bearing Temperature: Bearing temperature not to exceed 180 degrees F.

c. Test Duration: Determined by the Engineer, but not less than three hours of continuous operation at each condition specified and indicated.

2. Run each pump for minimum four hours prior to taking temperature readings of the pumps, motors, and shafting.

3. Immediately correct or replace all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

4. Repeat tests until specified results are obtained.

5. Contractor to provide all water, labor, piping, testing equipment, equipment, flow meters and test gauges for conducting tests.

Comment #43

a. Contractor shall provide calibrated test gauges for all permanently installed gauges and portable calibrated flow meters for all pumping systems even in those cases where permanent flow meters are installed.

b. All calibrations must be within 30 days of the field testing.

c. The testing will not be started and will not be accepted until the calibrated testing equipment stated above is operational and all certifications have been submitted.

d. Contractor is responsible for delivery and disposal of water used for testing.

D. Make all adjustments necessary to place equipment in specified working order at time of above tests.

E. Test pump on product only. If product is not available, test with water. Water for testing furnished by Contractor.

F. Remove and replace defective equipment at no additional cost to the Owner with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Engineer that equipment will perform the service specified, indicated and as submitted and accepted.

3.09 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

PROCESS PUMP SCHEDULE

TAG NO.	NO. OF UNITS	NAME	LOCATION	PUMP TYPE AND CONFIGURATION	RATING POINT				MIN. SUCTION/ DISCHARGE SIZE (IN.)	NOMINAL MAX. PUMP SPEED (RPM)	SEAL TYPE	MOTOR				SPEC. SECTION	SUCTION GAUGE TYPE	DISCHARGE GAUGE TYPE	BASIS OF DESIGN AND MODEL	REMARKS
					CAPACITY (GPM)	HEAD (FEET)	MIN. EFF. %	MINIMUM SHUTOFF HEAD (FT.)				HP	RPM	ENCL.	DRIVE TYPE					
FS.P-1	1	FOAM SPRAY PUMP	BASEMENT PUMP ROOM	DRY PIT END SUCTION CENTRIFUGAL	140	63	55	69	3/2	1750	SPLIT MECH W/ SPIRALTRACK	5	1800	TEFC	DIRECT	11316	IX	IX	FLOWSERVE D814	
EFF.P-1, THRU 3	3	EFFLUENT PUMPS	BASEMENT PUMP ROOM	DRY PIT END SUCTION CENTRIFUGAL	340	139	62	143	4/3	1784	SPLIT MECH W/ SPIRALTRACK	30	1800	TEFC	DIRECT	11316	IX	IX	GOULDS MODEL 3756	
SAN.P-1, 2	2	SANITARY PUMPS	IN-PLANT PUMP STATION	SUBMERSIBLE SOLIDS HANDLING PROGRESSIVE CAVITY	11	92	---	---	6/1.25	1725	MECH	1	1800	TEFC	DIRECT	11306	---	---	---	
SBR. TP-1 THRU 3	3	SBR TRANSFER PUMPS	BASEMENT PUMP ROOM	DRY PIT RECESSED VORTEX	255	53	35	59	4/3	1750	SPLIT MECH	25	1800	TEFC	DIRECT	11308	I	I	EGGER TV 51-80	
SBW.P-1, 2	2	SPENT BACKWASH PUMPS	DISK FILTER ROOM	END SUCTION CENTRIFUGAL	130	23	---	---	2/2	1750	---	2	1800	TEFC	DIRECT	---	---	---	---	SEE NOTES
SL.TP-1, 2	2	SLUDGE TRANSFER PUMPS	BASEMENT PUMP ROOM	DRY PIT RECESSED VORTEX	200	30	39	34	4/3	1180	SPLIT MECH W/ SPIRALTRACK	10	1200	TEFC	DIRECT	11308	I	I	KSB SEWATEC F100-254	
TSL.P-1, 2	2	THICKENED SLUDGE PUMPS	BASEMENT PUMP ROOM	DRY PIT CHOPPER	450	58	58	62	6/4	1170	SPLIT MECH	20	1200	TEFC	DIRECT	11309	III	III	VAUGHAN	
W3.P-1 THRU 3	3	PLANT WATER PUMPS	BASEMENT PUMP ROOM	VERTICAL MULTI-STAGE CENTRIFUGAL	125	227	72	262	3/3	3500	SPLIT MECH W/ SPIRALTRACK	30	3600	TEFC	DIRECT	11316	---	---	GRUNDFOS CRN45	

NOTES:

FOAM SPRAY PUMP:
1. VARIABLE FREQUENCY MOTOR CONTROLLER
2. FULL SPEED SECONDARY RATING POINT: 175 GPM AT 57 FEET WITH NO MORE THAN 5 FEET OF NPSH3.
3. MINIMUM SPEED RATING POINT: 150 GPM AT 67 FEET
4. PROVIDE PUMPS CAPABLE OF PASSING A MINIMUM 0.5-INCH DIAMETER SPHERE.

EFFLUENT PUMPS:
1. VARIABLE FREQUENCY MOTOR CONTROLLER
2. FULL SPEED SECONDARY RATING POINT: 550 GPM AT 120 FEET WITH NO MORE THAN 19 FEET OF NPSH3.
3. MINIMUM SPEED RATING POINT: 150 GPM AT 67 FEET
4. PROVIDE PUMPS CAPABLE OF PASSING A MINIMUM 0.5-INCH DIAMETER SPHERE.

SBR TRANSFER PUMPS:
1. VARIABLE FREQUENCY MOTOR CONTROLLER
2. FULL SPEED SECONDARY RATING POINT: 500 GPM AT 54 FEET WITH NO MORE THAN 14 FEET OF NPSH3.
3. MINIMUM SPEED RATING POINT: 50 GPM AT 15 FEET
4. PROVIDE PUMPS CAPABLE OF PASSING A MINIMUM 3-INCH DIAMETER SPHERE.

SPENT BACKWASH PUMPS
1. THE BACKWASH PUMP SHALL BE PROVIDED BY THE DISK FILTER MANUFACTURER.
2. BACKWASH PUMP CONNECTIONS ARE 2" NPT. BACKWASH PIPING IS 3" DIAMETER. CONTRACTOR TO PROVIDE 3" X 2" REDUCER FITTINGS AT EACH PUMP PORT.

Comment #44

SLUDGE TRANSFER PUMPS:
1. VARIABLE FREQUENCY MOTOR CONTROLLER
2. FULL SPEED SECONDARY RATING POINT: 400 GPM AT 25 FEET WITH NO MORE THAN 17 FEET OF NPSH3.
3. MINIMUM SPEED RATING POINT: 50 GPM AT 10 FEET
4. PROVIDE PUMPS CAPABLE OF PASSING A MINIMUM 4-INCH DIAMETER SPHERE.

THICKENED SLUDGE PUMPS:
1. VARIABLE FREQUENCY MOTOR CONTROLLER
2. FULL SPEED SECONDARY RATING POINT: 975 GPM AT 75 FEET WITH NO MORE THAN 8 FEET OF NPSH3.
3. MINIMUM SPEED RATING POINT: 250 GPM AT 11 FEET

PLANT WATER PUMPS:
1. VARIABLE FREQUENCY MOTOR CONTROLLER
2. SKID MOUNTED SYSTEM WITH BLADDER TANK
3. MINIMUM SPEED RATING POINT: 75 GPM AT 210 FEET

SANITARY PUMPS:
1. SECONDARY RATING POINT: 15 GPM AT 0 FEET.
2. MINIMUM RATING POINT: 8 GPM AT 185 FEET.

BLOWER AND COMPRESSOR SCHEDULE

TAG NO.	NUMBER OF UNITS	NAME	LOCATION	TYPE	CAPACITY (SCFM)	PRESSURE (PSIG)	INLET LOSSES IN H_2O	INLET TEMP. (DEG. F)	BAROMETRIC PRESSURE (PSIA)	BLOWER SPEED (RPM)	MOTOR DATA			DRIVE TYPE	SPEC. SECTION	BASIS OF DESIGN	REMARKS
											HP	RPM (MAX.)	ENCL. TYPE				
MIX.BLW-1, 2	2	MIXING BLOWERS	BASEMENT PUMP ROOM	ROTARY LOBE	1019	8	---	100	14.5	3170	50	1800	TEFC	BELT	11377	AERZEN	
MIX.BLW-3	1	MIXING BLOWER	BASEMENT PUMP ROOM	ROTARY LOBE	607	7	---	100	14.5	3310	30	1800	TEFC	BELT	11377	AERZEN	
MIX.BLW-4	1	MIXING BLOWER	BASEMENT PUMP ROOM	ROTARY LOBE	806	8	---	100	14.5	3720	40	1800	TEFC	BELT	11377	AERZEN	
SBR.BLW-1 THRU 3	3	SBR BLOWERS	BASEMENT PUMP ROOM	ROTARY LOBE	530	10.5	---	100	14.5	3762	50	1800	TEFC	BELT	11377	AERZEN	

SLIDE GATE SCHEDULE

TAG NO.	NUMBER OF UNITS	LOCATION	GATE TYPE	GATE SIZE W(IN.) X H(IN.)	CONFIGURATION	HEAD TYPE	OPERATING HEAD (MAX. WATER TO GATE ℄) (FT.)	GATE DESIGN HEAD (FT.)	OPERATING LEVEL TO GATE INVERT (FT.)	FRAME TYPE	THIMBLE TYPE	CLOSURE TYPE	OPERATOR TYPE	MOTOR DATA			SPEC. SECTION	REMARKS
														HP	RPM (MAX.)	ENCL. TYPE		
RWW.SG-1 THRU 4	4	HEADWORKS	FABRICATED	20 X 40	SELF CONTAINED	SEATING/UNSEATING	1.5	3.5	3.5	EMBEDDED	---	FLUSH	MOTOR	0.5	1800	XPROOF	15103	
RWW.SG-5, 6	2	HEADWORKS	FABRICATED	10 X 10	SELF CONTAINED	SEATING	3	3.5	3.5	WALL MOUNT	---	FLUSH	CRANK	---	---	---	15103	
EQ.SG-1	1	PRE-EQUALIZATION TANK NO. 2	FABRICATED	36 X 36	CONVENTIONAL	SEATING/UNSEATING	12.33	14	22.17	WALL MOUNT	---	FLUSH	FLOOR BOX	---	---	---	15103	
SL.SG-1	1	WASTE SLUDGE TANK NO. 1	FABRICATED	36 X 36	CONVENTIONAL	SEATING/UNSEATING	14.33	16	19.5	WALL MOUNT	---	FLUSH	FLOOR BOX	---	---	---	15103	
SBR.SG-1, 2	2	SBR TANKS NO. 1 & 2	STANDARD	6 X 6	CONVENTIONAL	SEATING	22	22.33	24.83	WALL MOUNT	F	FLUSH	CRANK	---	---	---	15103	

STOP LOG SCHEDULE

TAG NO.	NUMBER OF UNITS	LOCATION	CHANNEL WIDTH (IN.)	CHANNEL GROOVE DEPTH (IN.)	TOTAL NUMBER OF SECTIONS	SECTION HEIGHT (FT.)	HEAD TYPE	MAX. HEAD (FT.)	SPEC. SECTION	REMARKS
RWW.SL-1 THRU 3	3	HEADWORKS	20	6.33	12	1	SEATING/UNSEATING	3.5	15113	---

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

OWNER

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER

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REGISTRATION

COMMONWEALTH OF MASSACHUSETTS
CHRISTOPHER M. GALLIGAN
No. 40563
REGISTERED PROFESSIONAL ENGINEER
1/17/2020

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60587515

Designed By:	T. WASSELL/C.MINI
Drawn By:	N. RUBINI
Dept Check:	C. GALLIGAN
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

MECHANICAL PROCESS

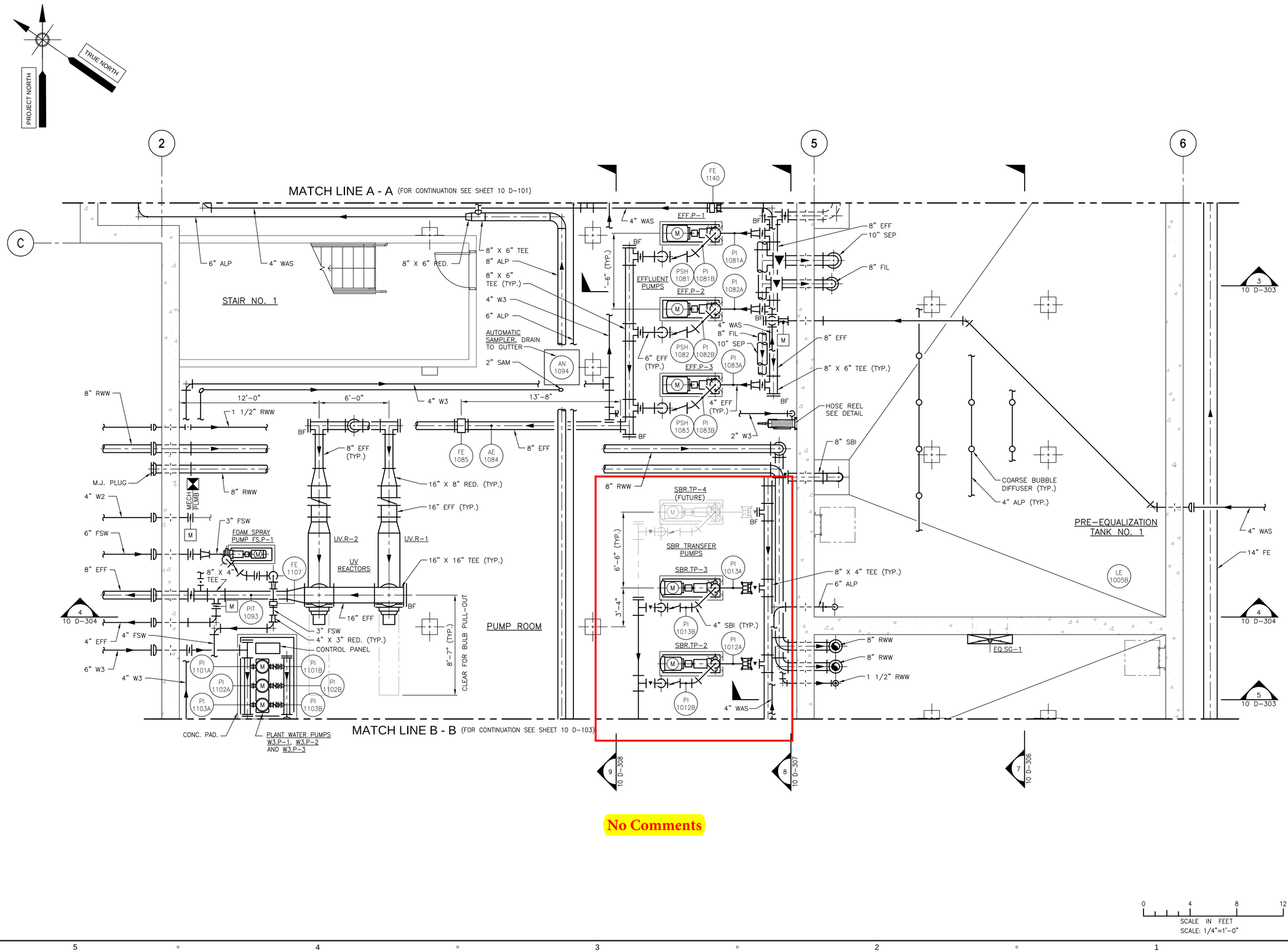
SHEET TITLE

SCHEDULES I

SHEET NUMBER

00 D-004

PATHFILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\D00 D-004.DWG
LAST UPDATE: Friday, January 10, 2020 10:45:14 AM
PLOT DATE: Friday, January 17, 2020 9:04:50 AM



No Comments

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LAST UPDATE: Friday, October 04, 2019 10:27:02 AM
PLOT DATE: Friday, January 17, 2020 9:05:37 AM

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

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1/17/2020

ISSUE/REVISION

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PROJECT NUMBER

60587515

Designed By:	T. WASSELL/C.MINI
Drawn By:	N. RUBINI
Dept Check:	C. GALLIGAN
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

MECHANICAL PROCESS

SHEET TITLE

FACILITY LOWER PLAN II

SHEET NUMBER

10 D-102

No Comments

MATCH LINE B - B (FOR CONTINUATION SEE SHEET 10 D-102)

TRUE NORTH

PROJECT NORTH

BLADDER TANK W3.ST-1

6" X 4" RED.

FE 1105

4" W3

4" X 3" TEE

4" W3

SBR.BLW-4 (FUTURE)

CONC. PAD (TYP.)

SBR.BLW-3

10" X 6" TEE (TYP.)

4" FSW

SBR.BLW-2

6" ALP (TYP.)

10" ALP

SBR.BLW-1 SBR BLOWERS

8'-0" (TYP.)

6'-6"

THERMAL MASS INSERTION FLOW METER, SEE DETAIL

FE 1125

MIX.BLW-4

MIX.BLW-3

MIX.BLW-2

MIX.BLW-1 MIXING BLOWERS

8" ALP

6" ALP

8" ALP (TYP.)

SBR.TP-1

PI 1011A

PI 1011B

FE 1015

4" SBI

6" ALP

8" FIL

8" X 3" TEE

10" SEP

1" PACL

1" SH

CHEMICAL DIFFUSER SEE DETAIL (TYP.)

6" SBI

12" ALP

8" X 4" TEE

8" SBI

1 1/2" SAM

3" X 1 1/2" RED. FLG.

LE 1006A

4" WAS

BF

PRE-EQUALIZATION TANK NO. 2

14" FE

4" WAS

COARSE BUBBLE DIFFUSER (TYP.)

4" ALP (TYP.)

10'-0" (TYP.)

6'-11"

STAIR NO. 2

6" ALP

LE 1006B

ACCESS LADDER

AE 1006A

AE 1006B

10" ALP TO INLET SILENCER

15'-0"

10'-0"

4" FSW

4" W3

BOLTED SPILT SLEEVE COUPLING (FXE) (TYP.)

1'-0"

3'-0"

32'-0"

12" ALP TO INLET SILENCER

10" ALP

4" FSW

4" W3

6" SBI

6 10 D-305

9 10 D-308

8 10 D-307

7 10 D-306

3

5

6

E

G

0 4 8 12

SCALE IN FEET

SCALE: 1/4"=1'-0"

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\D\10 D-103.DWG

LAST UPDATE: Wednesday, September 11, 2019 6:47:08 AM

PLOT DATE: Friday, January 17, 2020 11:28:22 AM

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

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ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60587515

Designed By:	T. WASSELL/C.MINI
Drawn By:	N. RUBINI
Dept Check:	C. GALLIGAN
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

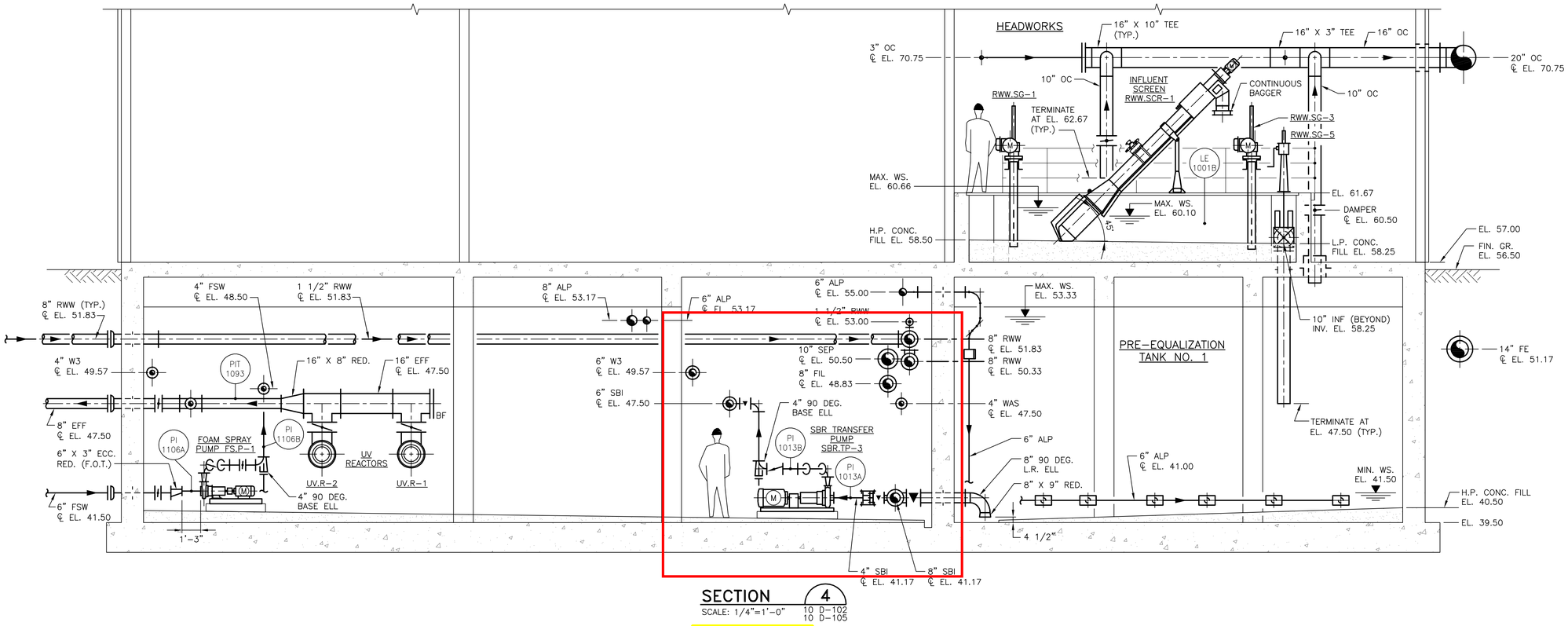
MECHANICAL PROCESS

SHEET TITLE

FACILITY LOWER PLAN III

SHEET NUMBER

10 D-103



SECTION 4
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10 D-102
10 D-105

No Comments

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LAST UPDATE: Wednesday, September 11, 2019 10:03:18 AM
PLOT DATE: Friday, January 17, 2020 9:06:37 AM

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

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1/17/2020

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60587515

Designed By:	T. WASSELL/C.MINI
Drawn By:	N. RUBINI
Dept Check:	C. GALLIGAN
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

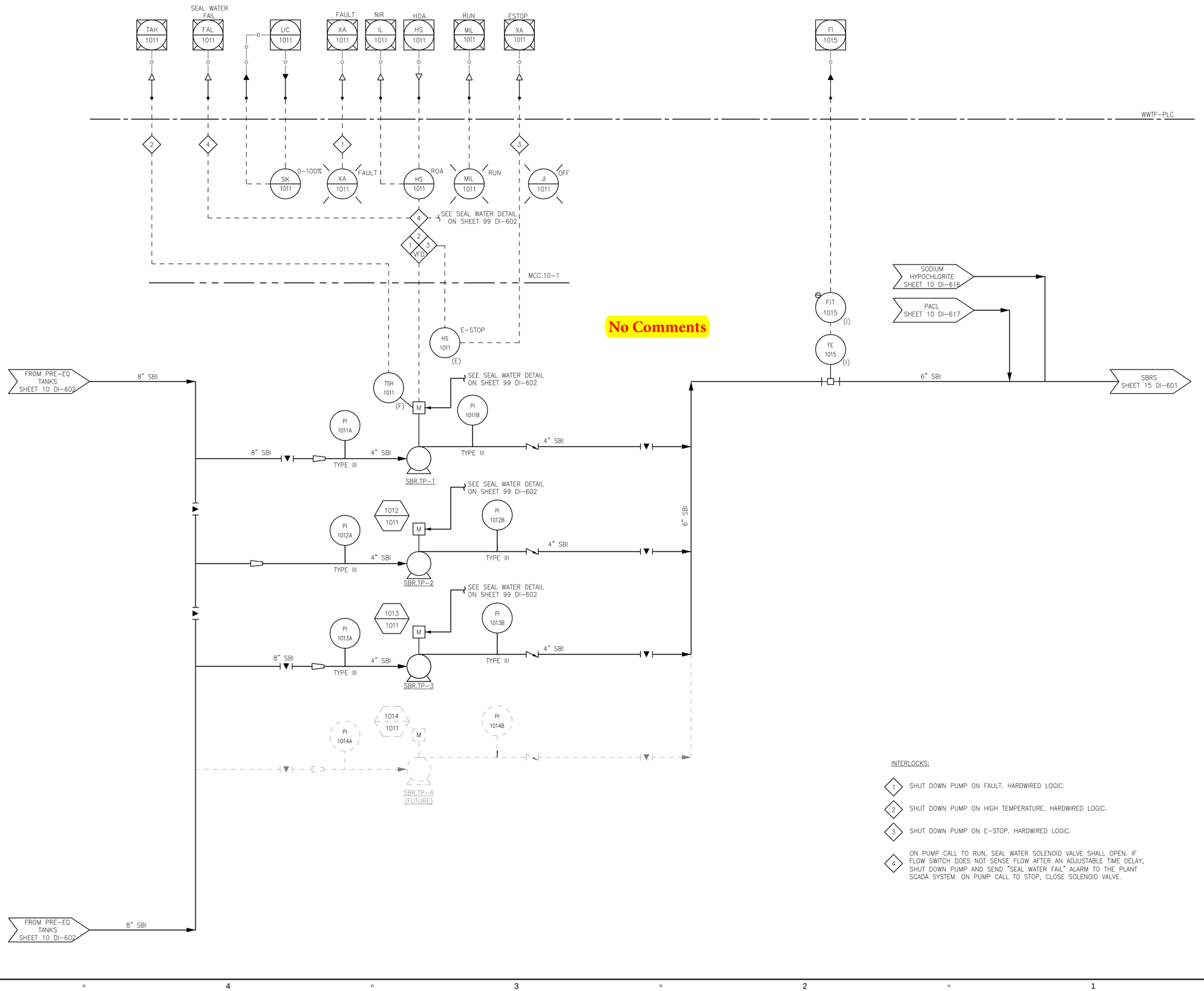
MECHANICAL PROCESS

SHEET TITLE

SECTIONS IV

SHEET NUMBER

10 D-304



No Comments

INTERLOCKS:

1. SHUT DOWN PUMP ON FAULT. HARDWIRED LOGIC.
2. SHUT DOWN PUMP ON HIGH TEMPERATURE. HARDWIRED LOGIC.
3. SHUT DOWN PUMP ON E-STOP. HARDWIRED LOGIC.
4. ON PUMP CALL TO RUN, SEAL WATER SOLENOID VALVE SHALL OPEN. IF FLOW SWITCH DOES NOT SENSE FLOW AFTER AN ADJUSTABLE TIME DELAY, SHUT DOWN PUMP AND SEND "SEAL WATER FAIL" ALARM TO THE PLANT SCADA SYSTEM. ON PUMP CALL TO STOP, CLOSE SOLENOID VALVE.

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

OWNER

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
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ENGINEER

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60587515

Designed By:	S. PAPAZIAN
Drawn By:	S. PAPAZIAN
Dept Check:	Y. RIZK
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

INSTRUMENTATION

SHEET TITLE

SBR TRANSFER PUMPS P&ID

SHEET NUMBER

10 DI-603

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\DI\10 DI-603.DWG
LAST UPDATE: Friday, January 24, 2020 4:36:47 PM
PLOT DATE: Monday, January 27, 2020 2:57:26 PM

MCC.10-1

480VAC, 600 AMP BUS, 3 PHASE,
3 WIRE, 60 HZ, 65,000 AIC SYMMETRICAL
WWTF ELECTRICAL ROOM

TO SWBD.10-1A (SEE SHEET 10 E-003)

TO SWBD.10-1B (SEE SHEET 10 E-003)

LEGEND:

K1 KIRK KEY INTERLOCK SO ONLY TWO OF THE THREE BREAKERS COULD BE CLOSED AT ANY SINGLE TIME.

CT PROVIDE CONSTANT TORQUE VFD

BUS A

BUS B

6 PULSE VFD WITH 5% LINE REACTOR (TYP)

PROVIDE SPACES FOR LOADS INDICATED AS FUTURE (TYP)

CLF, PM, K1, 600:5 (3), MLO, N.O., 600A 600A

55A VFD [PE] 30 EFFLUENT PUMP EFF.P-3

55A VFD [PE] 30 EFFLUENT PUMP EFF.P-1

MCP FVNR 1 [PC] 30A J [VSC] 10 SBR MIXER SBR.MIX-1 (900 RPM)

50A VFD [PE] 25 SBR TRANSFER PUMP SBR.TP-3

50A VFD [PE] 25 SBR TRANSFER PUMP SBR.TP-1

100A HARMONIC FILTER, 30A SPD

No Comments

60A [PF] QC-CP [PF] 60A 30 ODOR CONTROL EXHAUST FAN QC.F-1

50A VFD [PE] 25 SBR TRANSFER PUMP SBR.TP-2

50A VFD 25 SBR TRANSFER PUMP SBR.TP-4 (FUTURE)

MCP FVNR 1 [PC] 30A J [VSC] 10 SBR MIXER SBR.MIX-2 (900 RPM)

55A VFD [PE] 30 EFFLUENT PUMP EFF.P-2

40A CT VFD [PD] 20 THICKENED SLUDGE PUMP TSL.P-1 (1200 RPM)

25A VFD [PC] 10 SLUDGE TRANSFER PUMP SL.TP-1 (1200 RPM)

MCP FVNR 1 [PB] 30A J [VSC] 5 EQ. MIXER EQ.MIX-1 (1200 RPM) (SUBMERSIBLE)

20A SEP-1-CP [PB] 2 SEPTAGE RECEIVING SEP-1

20A DF-1-CP [PB] [VSC] 1 DISK FILTER DRIVE DF-1; [PB] 2 SPENT BACKWASH PUMP SBW.P-1

40A SBR-CP [PD] [PB] [PB] 30A 30A J J [VSC] [VSC] 5 5 SBR DECANT WEIR SBR.DEC-1, SBR DECANT WEIR SBR.DEC-2

LOCATED AT SBR TANKS NO.1/NO.2 (15 E-101)

MCP FVNR 1 SPARE

FVNR 1 SPARE

90A [PJ] W3.P-CP (VFD VFD VFD) 30 30 30 PLANT WATER PUMPS W3.P-1/2/3

PLANT WATER SKID

20A VFD [PB] 5 FROTH SPRAY PUMP FS.P-1

20A DF-2-CP [VSC] [PB] 1 DISK FILTER DRIVE DF-2; [PB] 2 SPENT BACKWASH PUMP SBW.P-2

MCP FVNR 1 TERMINAL BOX (TYP.) [PB] 30A J [VSC] 5 EQ. MIXER EQ.MIX-2 (1200 RPM) (SUBMERSIBLE)

25A VFD [PC] 10 SLUDGE TRANSFER PUMP SL.TP-2 (1200 RPM)

40A CT VFD [PD] 20 THICKENED SLUDGE PUMP TSL.P-2 (1200 RPM)

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E\10\E-006.DWG
LAST UPDATE: Tuesday, April 09, 2019 1:07:04 PM
PLOT DATE: Monday, January 27, 2020 5:06:20 PM

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

OWNER

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER

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REGISTRATION

COMMONWEALTH OF MASSACHUSETTS
ANDREA ABRAHAM
ELECTRICAL
NO. 54966
REGISTERED PROFESSIONAL ENGINEER

01-24-2020

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60587515

Designed By:	A. ABRAHAM
Drawn By:	A. ABRAHAM
Dept Check:	Y. RIZK
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

ELECTRICAL

SHEET TITLE

WWTF - ELECTRICAL SINGLE LINE DIAGRAM II - MCC.10-1

SHEET NUMBER

10 E-006

SUBMITTAL DATA

JOB NAME:	**Downtown Area WWTF & Effluent Disposal – Contract 2019-01**
	Orleans, MA
ENGINEER:	**AECOM**
	Chelmsford, MA
REFERENCE:	**Specification Section 01171 – Electric Motors**
	SBR Transfer Pumps – SBR.TP.1 thru 4
QUANTITY:	**Four (4) Pump/Motor Units**

SPECIFICATION COMPLIANCE CHECK THE SPEC

The following is a list of Specification Section 01171 comments and clarifications:

1.) **Page 3, Part 1.04.B.5**
Motor test results will be submitted when available

2.) **Page 3, Part 1.04.B.6**
List of recommended spare parts will be included in O & M manual. No special maintenance tools are required.

3.) **Page 4, Part 1.07C**
VFD's are not included in our scope of supply.

4.) **Page 5, Part 2.03.A**
Not applicable. Motors installed indoors.

5.) **Page 6, Part 2.03.F.1.c**
Not applicable.

6.) **Page 6, Parts 2.03.F.1.d**
Not applicable.

7.) **Page 6, Part 2.03.G.1**
Not applicable

8.) **Page 6, Part 2.03.G.2**
Not applicable

9.) **Page 7, Part 2.03.H.1**
Not applicable

10.) **Page 8, Part 3.01**
Installation BY OTHERS.

SECTION 01171

ELECTRIC MOTORS

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PART 1 - GENERAL

1.00 - SUBBID REQUIREMENTS

A. This section is part of the filed sub-bid for DIVISION 16, ELECTRICAL. See SECTION 16050, ELECTRICAL WORK - GENERAL

1.01 - SCOPE

A. The Work of this section includes all labor, materials, tools, and equipment required for the furnishing of all materials required to provide Low Voltage Electric Motors and Accessories as specified herein and/or as shown on the Contract Drawings.

B. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

C. Unless otherwise specified, all electric motors furnished and installed by the Contractor shall conform to the requirements specified herein.

1. Motors rated at 460 V which are powered from Variable Frequency Drives shall be inverter duty rated as per NEMA-MG-1.

2. Motors shall be NEMA Premium Efficient as per NEMA-MG-1.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. "Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

1.04 - SUBMITTALS

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. Descriptive literature and motor characteristics, including thermal limit curves and speed vs. torque curves. Provide thermal limit curves for motors 75 Hp and greater and all motor data.
2. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
    a. Failure to include a copy of the marked-up specification sections will result in return of the entire submittal without further review and consideration until the marked-up specification are re-submitted with the entire package.
3. Submit motor data with the associated driven equipment submittals.
4. Shop drawings and descriptive data to include:
    a. Complete list of all motors to be furnished.
    b. Outlines, dimensions, weights, and wiring diagrams.
    c. Location of main and accessories boxes with size of conduit entrance.
    d. Efficiency and power factor at 1/2, 3/4 and full load.
    e. Bearing life data and grease requirements.
    f. Nameplate data.
    g. Prototype test data.

h. Ground pad locations.

i. Strip heaters KW and voltage ratings.

j. Statement certifying that motor insulation system is compatible with output of VFD system provided under SECTION 16260, VARIABLE FREQUENCY DRIVES.

k. Full load current

l. Locked rotor current

m. Full load torque in lb.-ft.

n. Starting and breakdown torque in percent of full-load torque

o. Number and frequency of permissible starts under specified conditions

p. Horsepower versus current curves

q. Moment of inertia of rotor

r. The zero load, rated speed (with no load connected) kW and kvar input

s. The locked rotor KVA and power factor at rated voltage

t. Service factor

u. Descriptive bulletins or catalog cuts with full description of the insulation system

v. Manufacturer, type, size and rating of bearings

w. Motor thermal limit or damage curves

Comment #1 5. Submit certified copies of all factory shop test results.

Comment #2 6. Submit list of recommended spare parts and maintenance tools for each type of motor.

7. Provide manufacturer's printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated on the structural drawings.

8. Performance Test Reports: Upon completion of installed system, submit in booklet form all field tests performed.

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. Motors shall comply with the latest reference standards specified.

B. Routine tests shall be performed on representative motors less than 100 Hp in size and shall include the information described on NEMA MG1-12.54 Report of Test Form for Routine Tests on Induction Motors. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

C. The Contractor shall obtain the pumps, motors, and appurtenances from the pump manufacturer, as a complete and integrated package to insure proper coordination and compatibility and operation of the system.

Comment #3

1. Where motors are driven by variable frequency drives (VFDs) the Contractor shall coordinate the variable frequency motor controllers with the pump and motor manufacturer and submit as part of the shop drawings a written statement signed by the Contractor, pump manufacturer, motor manufacturer and variable frequency motor controller manufacturer that the variable frequency motor controller manufacturer has received the required information from the pump and motor manufacturers and that all parties have reviewed the system and coordinated the equipment selection. Also include all motor data and information that has been used for the coordination.

2. Variable frequency drives shall be provided in accordance with Specification SECTION 16260, VARIABLE FREQUENCY DRIVES.

D. Provide equipment rated in accordance with the Area Classification Schedule on Contract Electrical drawing 00 E-601.

1.08 - REFERENCES

A. National Electrical Code (NEC)

B. Massachusetts Electrical Code

C. Underwriters Laboratories, Inc. (UL)

D. National Electrical Manufacturers Assoc. (NEMA)

1. NEMA Standard MG-1 – Motors and Generators

2. NEMA WP-1 – Enclosed Electric Motor

E. American Bearing Manufacturers Association (ABMA)

F. American National Standard Institute (ANSI)

G. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE Standard 112 – Test Procedures for Polyphase Induction Motor and Generators

2. IEEE Standard 85 – Airborne Sound Measurements on Rotating Electric Machinery, Test Procedure for

3. IEEE Standard 429 – Evaluation of Sealed Insulation Systems for AC Electric Machinery Employing Form – Wound Stator Coils

4. IEEE Standard 841 – Service Duty Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Induction Motors

PART 2 - PRODUCTS

2.01 - ACCEPTABLE MOTOR MANUFACTURERS

A. Reliance Electric

B. Toshiba

C. U.S. Electric Motors

D. Or equal

2.02 - ELECTRIC MOTOR RATINGS

A. Voltage Ratings:

1. Unless otherwise specified, motors with ratings of 1/2 to 500 Hp shall be rated 460-volt (nameplate rating), three-phase, 60-Hertz; motors of 1/3 Hp or less to be rated 115-volt, single-phase, 60 Hertz.

B. The following specific motor requirements shall be identified in each equipment specification:

1. RPM.

2. Motor enclosure type.

2.03 - MOTOR REQUIREMENTS

A. Motor heaters shall be supplied on all motors located outdoors. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 volt, single phase with wattage. The heater wattage and voltage shall be embossed on the motor nameplate.

Comment #4

B. Every motor shall be of capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit at rated voltage. Each motor shall develop the necessary torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where indicated on the electrical drawings to be operated on a reduced voltage starter, the motor shall develop the necessary torque under the conditions imposed by the reduced voltage starting method.

C. The motor shall have capacity to operate the driven equipment as given in the equipment detail specifications. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

D. Type of Motors

1. All motors shall be NEMA Design B or of a type having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be for full-voltage starting.

E. Insulation

1. All motors shall have Class B (fractional horse power only) and Class F insulation for all other size motors.

2. Insulation systems shall be manufacturer's premium grade, resistant to attack by moisture, acids, alkalies and mechanical or thermal shock for 480 Volt motors. Provide a Class F insulation system for an ambient temperature motor operation of 0 to 40 degrees C at no more than 3300 feet above sea level for inverter duty motors. This temperature rise shall be met when motors are operated and controlled with the VFD(s). The motor insulation system shall have full capability to handle the common mode voltage conditions imposed by the VFD.

3. Motors shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.

4. Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H insulation shall be used.

F. Enclosures

1. Motors shall have a steel or cast-iron frame and a cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-in. diameter, shall be provided inside the conduit box for motor frame grounding.

a. Totally enclosed fan cooled: TEFC motors shall have a steel or cast-iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40 degrees C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

b. Totally enclosed non-ventilated: TENV motors shall include the same rating and accessories as specified for TEFC motors.

c. Explosion proof motors shall comply with all requirements of Class I, Division 1, Group D, hazardous locations as defined by the National Electrical Code and with all other safety codes pertaining thereto.

Comment #5

d. Motors in NEMA 4, NEMA 4X and classified areas shall be provided with severe duty rating. Motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as “Corro-Duty”, “Mill and Chemical”, “Custom Severe Duty”, or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box and 1.15 service factor at 40 degrees C and tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).

Comment #6

G. Special Purpose Motors

1. Hermetically sealed air conditioning units, hoists, cranes and other devices complying with special safety codes shall be furnished with motors, control equipment, accessories and safety devices, in accordance with the manufacturer's standards and to be rated for the duty cycle as specified for the driven equipment. Service factor 1.15 above 3 hp.

Comment #7

2. Submersible motors shall be equipped with three thermal switches (one in each phase winding) connected to stop motor operation if the temperature exceeds 125 deg. C (255 deg. F). Also a leakage sensor for sensing water intrusion into the stator housing shall be provided.

Comment #8

3. Inverter duty rated: Motors for operation on variable frequency drives shall meet current power quality levels published in NEMA MG1, Part 31.

a. Enclosures shall be equal to those furnished for severe duty or explosion proof motors. Motor shaft and bearings shall be insulated.

b. Motors nameplate service factor shall be 1.0. Internal service factor shall be 1.15 that of the nameplate.

c. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics. Rotors shall be configured to minimize skin-effect heating.

d. Provide each variable frequency drive motor with an internal normally closed motor thermostat per phase wired in series

e. Provide VFD driven motor shafts with grounding rings.

H. Auxiliary Devices

1. Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and to be provided with a single conduit box.

Comment #9

I. General Design of Motors

1. Motors shall comply with the latest NEMA Standards Publication No. MG1 for Motors and Generators, unless otherwise specified.

2. All polyphase non-explosion proof motors shall be provided with energy efficient operation and meet the requirements of MG1-12.53 a and b.

3. Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with an insulating compound that protects against moisture and slightly acid or alkaline conditions.

4. Bearings shall be of the self-lubricating type, provided so that there is proper alignment of rotor and shaft and to prevent leakage of lubricant.

   a. Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment.

   b. Bearings for totally enclosed and explosion proof motors shall be of the ball type.

   c. Bearing L-10 fatigue life in hours at 100 percent load shall be 50,000.

   d. Bearing grease shall be of the 120 deg. C thermal capability type.

   e. Bearings for 50 HP and larger VFD driven motors shall be isolated type bearings.

5. Vertical motors shall be provided with thrust bearings for all thrusts to which they can be subjected in operation.

6. All three phase two speed motors shall be of the two-winding design.

7. All non-VFD driven three phase motors shall be provided with a 1.15 service factor.

8. Three phase motors shall be of cast iron construction including frame and end brackets.

9. Motor nameplates shall be Type 316 stainless steel.

10. Motor Terminal Boxes and Leads:

    a. Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections, and with flexible leads of sufficient length to extend for a distance of not less than 4 in. beyond the face of the box. Solderless lugs shall be furnished. Totally enclosed and explosion proof motors to have cast-iron terminal boxes.

    b. Leads for space heaters shall be brought out into an auxiliary, cast, conduit box on the motor side opposite to the main terminal box. Auxiliary box to have 1" threaded conduit openings and shall be so constructed that conduit entrance may be placed at top, bottom, or either side.

    c. A grounding terminal shall be provided in the main terminal box and a bronze grounding bolt to be furnished at the conduit side of the motor frame.

    d. For inverter rated motors, provide oversized terminal boxes with oversize conduit opening and oversized cable lugs for cables as indicated.

J. Motor Efficiencies

1. Three phase motors rated 1 Hp and larger shall be of the premium efficiency, “Design E”, type per Table 12.1 of NEMA MG1 Part 12. Efficiency values shall be based on tests performed in accordance with IEEE Publication No. 112, Method B. Motors with horsepower or rpms not listed shall conform to comparable standards of construction and materials as those for listed motors.

K. Shop Painting

1. Unless otherwise specified, motors shall be given a shop application of paint filler or enamel sealer, a flat coat of undercoater for enamel, and two coats of enamel or, in lieu of this treatment, other corrosion-resistant treatment customary with the manufacturer.

L. Motor Data

1. The Contractor shall furnish five certified copies of characteristic curves of each motor furnished, except 115-volt motors. Curves shall be supplied as a part of the driven equipment submittal.

M. Motor Shop Tests

1. Motor shop tests shall be made in accordance with the IEEE Test Codes as specified in the NEMA MG1 Standards for Motors and Generators. NEMA report-of-test forms to be used in submitting test data.

2. Motor efficiency shall be determined by use of IEEE Standard 112 Test Method B, and by use of MGI-12.53 a and b.

3. For motors rated 100 hp and larger, complete tests of each motor furnished to be made and certified test data sheets to be submitted. Each motor shall be tested at rated voltage for: efficiency and power factor at 25, 50, 75, and 100 percent of it rated horsepower; for temperature rise, torque, no-load current, starting current, full load current, and dielectric strength; and for compliance with all specified performance requirements.

4. For induction motors 5 hp, up to 100 hp, copies of routine test reports of electrically duplicate motors shall be furnished.

5. For motors 3 hp or less, no test data need be furnished.

6. Where required by the load equipment specifications, provide testing support for shop testing at the equipment manufacturer’s facility.

PART 3 - EXECUTION

3.01 - INSTALLATION

Comment #10

A. Verify heaters are energized when supplied on motors.

B. After motor installation but before connection to power wiring, test motor winding insulation.

C. After connection to power wiring, check for operating temperature, correct rotation, vibration, alignment and operating current drawn under load.

D. Submit all motor test results for review and record.

3.02 - TESTING

A. Inspect physical and mechanical condition.

B. Inspect for correct anchorage, mounting, grounding, connection, and lubrication.

C. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturers published data.

D. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.

E. Megger test motor winding insulation.

F. Provide testing in accordance with SECTION 16998, FIELD INSPECTION AND ACCEPTANCE TESTS.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF SECTION

CERTIFICATE OF REGISTRATION

This is to certify that

Pentair Flow Technologies, LLC

Kansas City Operations
3601 Fairbanks Avenue, Kansas City, Kansas 66106-0999 USA

operates a

Quality Management System

which complies with the requirements of

ISO 9001:2015

for the following scope of certification

The design/development, manufacture and servicing of water, wastewater, fire protection, agricultural and industrial pumps.

Certificate No.:	CERT-0107099	Original Certification Date:	February 11, 1997
File No.:	006845	Certification Effective Date:	November 14, 2017
Issue Date:	November 15, 2017	Certificate Expiry Date:	November 13, 2020

Nicole Grantham
General Manager SAI Global Certification Services

ISO 9001

Registered by:
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SAI GLOBAL
INFORM. INSPIRE. IMPROVE.

Fairbanks Morse Pump
Submittal Data For
City of Orleans
Orleans, MA

Supplier:	Hayes Pump, Inc. 66 Old Power Mill Rd West Concord, MA 01742
Manufacturer: Pump	Fairbanks Morse Pump 3601 Fairbanks Ave. Kansas City, Kansas 66106-0906 (913) 371-5000 Fax: (913) 371-2272
Project Number:	0911841
Sales Order No.:	52503143
Quantity:	4
Pump Size & Type:	4x4 4623CE
Coupling:	Rexnord Corp. 1217 Corporate Dr. Arlington, TX. 76006 (817) 640-3332
Motor:	U S Electrical Motors P. O. Box 3946 St. Louis, MO 63136 (314) 553-2000 www.usmotors.com

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- Wiring Diagram A109145
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Included Features

- Certified Non Witness Hydro Test at 75 PSI
- Certified Non Witness Performance Test with Certified Test Motor
- Multi Speed Testing 2 Added Speeds (Speed for 50 GPM @ 10 Ft TDH and halfway between 50 GPM @ 10 Ft TDH and Full Speed)
- Curve Approval prior to shipment
- Test Logs provided
- Structural Steel Base
- Chesterton 442 Mechanical Seal with Silicon Carbide vs. Silicon Carbide Faces
- SpiralTrac Bushing
- Heat Treated Cast Iron, Certified Dynamically Balanced Impeller
- Ni-Hard Construction
- 316 Stainless Steel Coupling Guard and Hardware
- Clockwise Rotation, In-line mounted
- 25 HP, 1800 RPM, 284T Frame Horizontal Motor
- Tnemec Epoxy Paint

Specifications

Wet End / Wearing Elements

All cast parts exposed to wear are constructed of Ni-Hard cast iron conforming to ASTM A532 and are minimum 650 Brinell Hardness (BHN).

The pump is specifically designed to optimize wear resistance and maintain hydraulic performance as wear occurs.

Impeller

The pump is a fully recessed, Slurry Type design, with the impeller mounted completely out of the flow path between the pump inlet and discharge connection, so that solids are not required to flow through the impeller. All flow path clearances within the pump(s) are equal to or greater than the discharge diameter, so that all solids that will pass through the discharge will pass through the pump.

The impeller is specifically designed to maintain hydraulic pumping performance as wear occurs.

The impeller is a cupped design with a thick-sectioned rim surrounding the tips.

Pump Case

The pump casing is a one-piece design, so that the impeller can be withdrawn without the need to remove the discharge casing or disturb the discharge piping.

Wearplate

A removable wearplate, provided in back of the impeller, is designed to direct flow from behind the impeller to the center of the volute for maximum protection of the backplate. The gland housing is an integral part of the backplate.

Flange

The pump is equipped with slotted raised-face flanges, ground smooth, to receive 125-lb. standard bolting. Special case slots are cast in to retain bolts and to fasten the case to the bearing housing and to the intake for easy case removal.

Bearing Housing

The bearing housing is cast iron, ASTM A48CL-30 material.

Shaft and Bearings

The pump shaft is 4140 heat treated carbon steel and designed to handle the rotational, axial, and radial loads imposed by the process.

Bearings are grease lubricated. Bearing housing shall be dust and moisture-proof type. The thrust bearings shall consist of double row, angular contact ball bearings for maximum protection from all thrust loads. The radial bearings shall consist of single-row radial ball bearings for maximum protection from all radial loads. The bearings are rated for a minimum B10 life of 100,000 hours at best efficiency point.

Mounting

A common pump and motor base constructed of a minimum 3/8” thick fabricated steel, suitably reinforced to support the full weight of pump and motor.

An approved coupling guard is provided to safely enclose the coupling.

A Rexnord Omega Flexible Coupling will be provided.

Mechanical Seal.

A Chesterton 442 split-face mechanical seal with a water flush is furnished in the pump. The seal utilizes a single high-reliability cartridge seal with silicon carbide versus silicon carbide seal faces, Viton elastomers, and 316 stainless steel parts. A stainless steel SpiralTrac restrictor bushing is supplied.

Shaft Sleeve

A sleeve is provided to protect the shaft from abrasive wear and O-ring sealed to prevent leakage between the shaft and the sleeve. The sleeve is constructed of 420 type Stainless Steel having a minimum hardness of 450 BHN.

Nameplate

Each pump will have a stainless steel nameplate. The information on the nameplate should be used when contacting the factory for parts or service.

Technical Clarifications & Exceptions

1. Refer also to clarifications that may be included on the vendor submittal .

PENTAIR FAIRBANKS NIJHUIS

4" 4623CE SUBMITTAL CURVE

CURVE NO.:	0911842 C	REV.:	1

SPEED	IMPELLER	DIAMETER	STAGE
1750	STD	8.40"	ONE
SPHERE	DRIVER	DATE	BY
4"	25 HP	2/19/2021	JCM

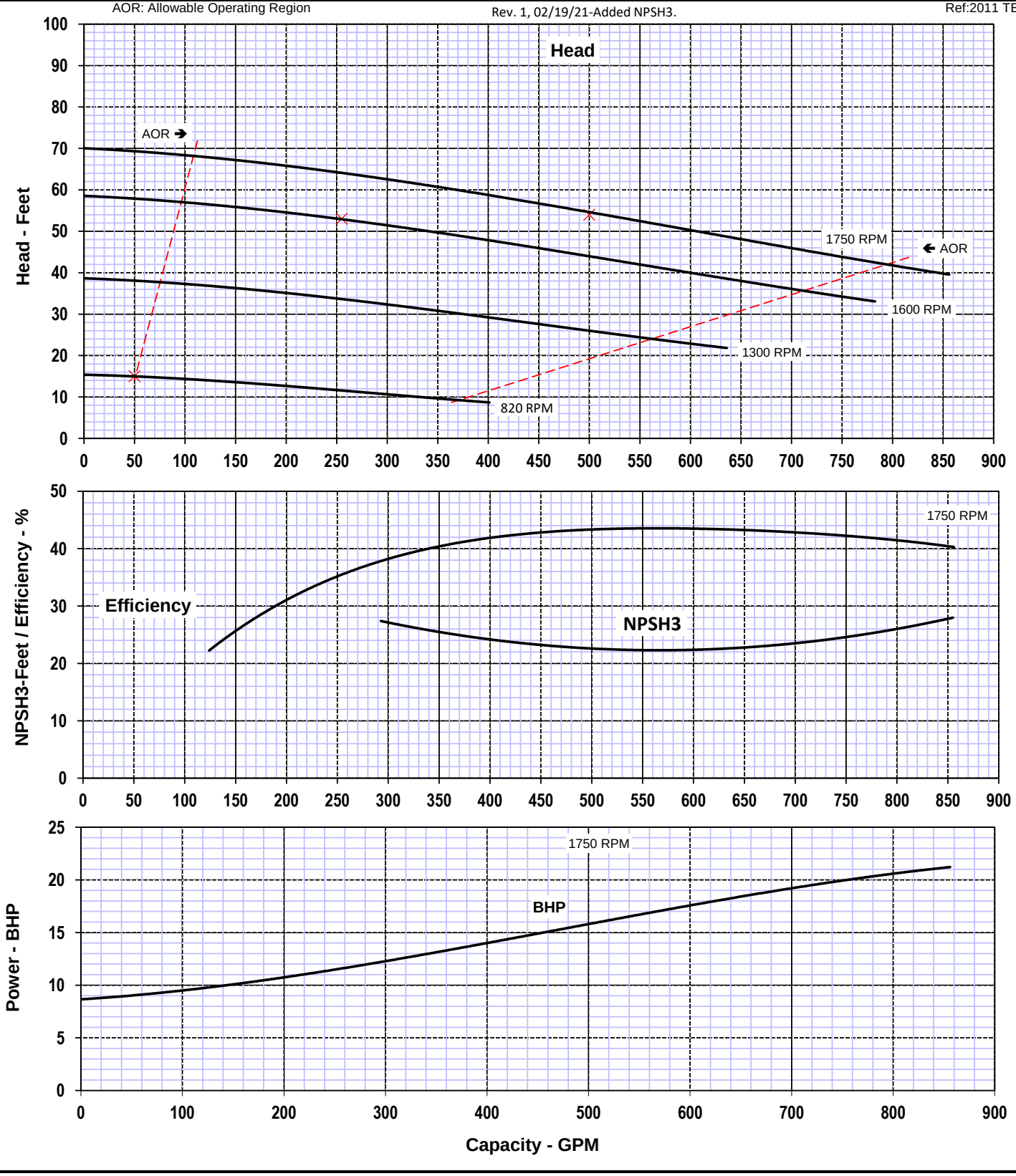
THIS CURVE IS BASED ON THE ACTUAL TEST PERFORMANCE OF A SIMILAR PUMP. ONLY THE INDICATED POINT(S) IS GUARANTEED.

GUARANTEED VALUES			
FLOW	HEAD	% EFF	BHP
255	53.0		
500	54.0		
50	15.0		

AOR: Allowable Operating Region

Rev. 1, 02/19/21-Added NPSH3.

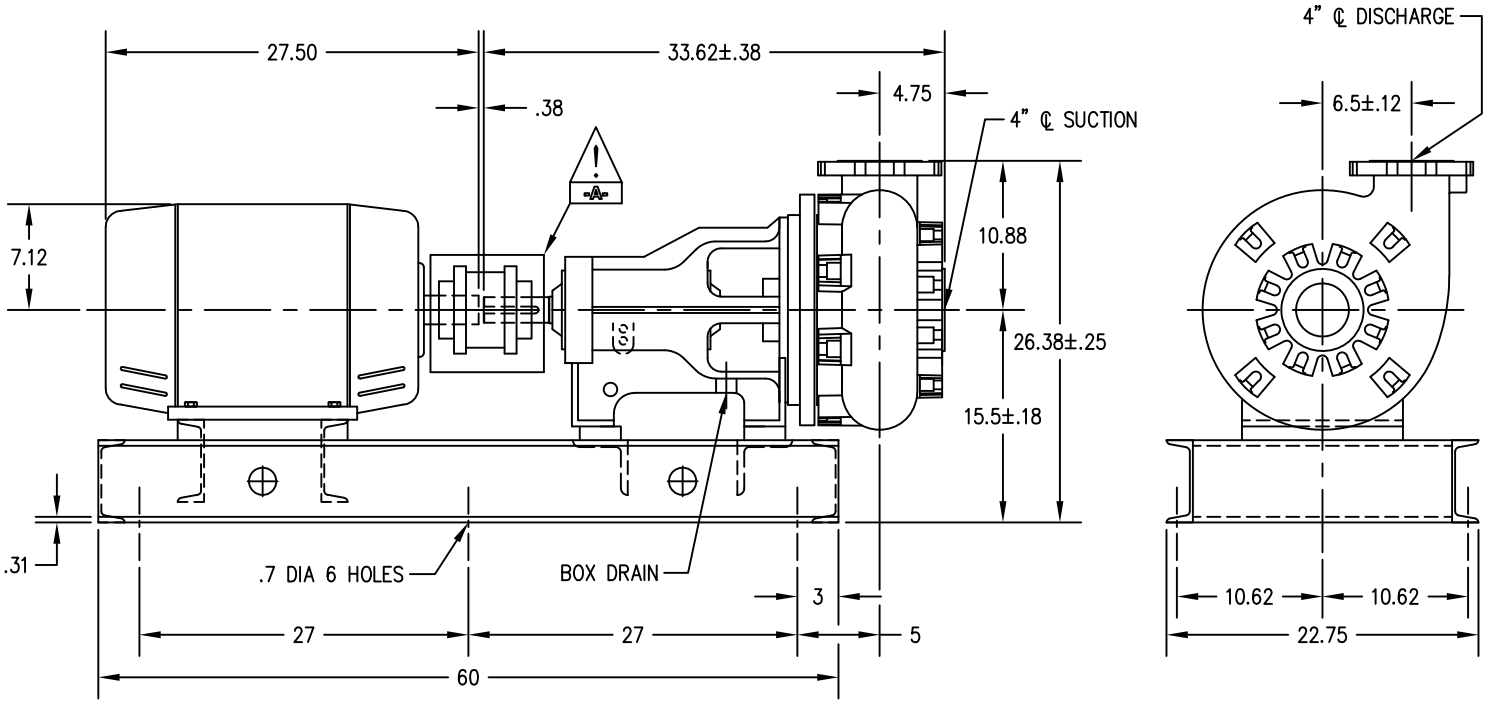
Ref:2011 TEST



⚠ WARNING

DO NOT OPERATE THIS MACHINE WITHOUT PROTECTIVE GUARD IN PLACE. ANY OPERATION OF THIS MACHINE WITHOUT PROTECTIVE GUARD CAN RESULT IN SEVERE BODILY INJURY.

–A– SUPPLIED BY FMPC –B– SUPPLIED BY OTHERS



NOTES:

(1) ALL FLANGES ARE 125# ANSI DRILLING UNLESS NOTED.
(2) ALL DIMENSIONS ARE IN INCHES UNLESS NOTED OTHERWISE.
(3) SUCTION AND DISCHARGE GAUGE CONNECTIONS ARE NOT AVAILABLE AND SHOULD BE LOCATED ON ADJACENT PIPING.
(4) AVAILABLE IN CLOCKWISE ROTATION ONLY.
(5) BASES ARE DESIGNED TO BE COMPLETELY FILLED WITH GROUT.
(6) CASING AND SUCTION FLANGES ARE PROVIDED AS CAST. PIPING SHOULD BE FITTED TO PUMP WITH HEAVY NEOPRENE GASKETS AFTER PUMP IS SET AND LEVELED.
(7) NOT FOR CONSTRUCTION, INSTALLATION, OR APPLICATION PURPOSES UNLESS CERTIFIED. DIMENSIONS SHOWN MAY VERY DUE TO NORMAL MANUFACTURING TOLERANCES.

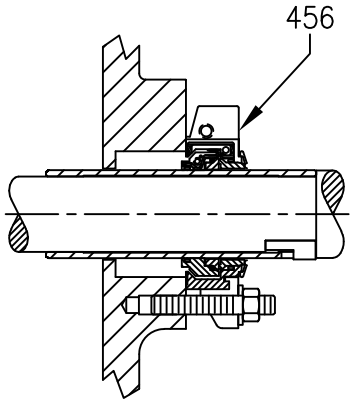
* SEE PERFORMANCE CURVE FOR DETAILS

CUSTOMER: HAYES PUMP					P.O. NO.: –		PENTAIR
JOB NAME:					TAG NAME: SBR TP–1 THRU –4		SETTING PLAN 4623CE STRUCTURAL BASE
PUMP SIZE AND MODEL: 4" 4623CE		GPM: *	TDH: *	RPM: *	ROTATION: CW	DISCH POS: STD	
MOTOR: U.S. ELECTRIC	HP: 25	FRAME: 284T	PHASE: 3	HERTZ: 60	VOLTS: 230/460	ENCLOSURE: TEFC	
CERTIFIED FOR: PROJECT NO. 0911842			CERTIFIED BY: HP		DATE: 7/20		DWG NO: 0911842SP REV NO: A

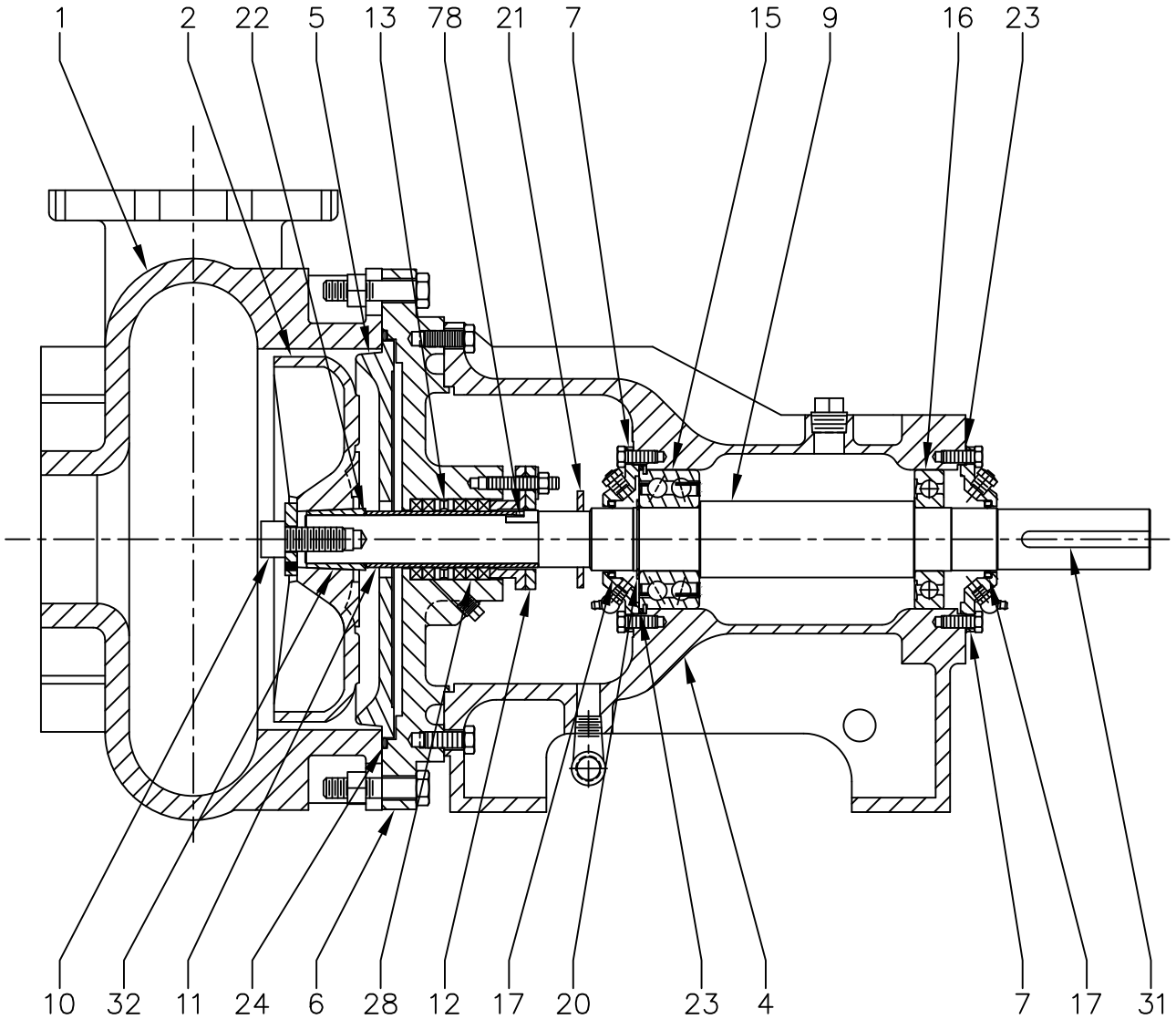
Material Specifications

Item	Description	Material[1]	Specification
1	Case	Cast Iron, Ni-Hard, 650 BHN Min	A532 CLI Type D Mod
2	Impeller	Cast Iron, Ni-Hard, 650 BHN Min	A532 CLI Type D Mod
4	Bearing Housing	Cast Iron	A48 Class 30
5	Wearplate	Cast Iron, Ni-Hard, 650 BHN Min	A532 CLI Type D Mod
6	Backplate	Cast Iron	A48 Class 30
7	Bearing Cap	Cast Iron	A48 Class 30
9	Shaft	Steel	A322 Grade 4140
10	Lockscrew, Impeller	Stainless Steel	Commercial
11	Shaft Sleeve	Stainless Steel, 450 BHN, Min.	A314 Type 440C Mod
13	Lantern Ring*	Teflon	Commercial
15	Bearing, Thrust	Commercial	Commercial
16	Bearing, Radial	Commercial	Commercial
17	Seal, Oil	Steel & Rubber	Commercial
20	Ring, Snap*	Steel	Commercial
21	Slinger	Neoprene	Commercial
22	O-Ring, Shaft Sleeve	Viton	Commercial
23	Gasket, Bearing Cap	Nylon	Commercial
24	O-Ring, Case Gasket	Viton	Commercial
28	Packing Ring*	Polymide Yarn & PTFE	Crane 1345 or equal
31	Key, Square Shaft	Steel	A108 Grade 10180
32	Collet	Stainless Steel	Commercial
78	Key, Sleeve Drive	Steel	Commercial
	Plate, Serial*	Stainless Steel	Commercial
	Drive Screw*	Stainless Steel	Commercial

[1] All material specifications are ASTM unless otherwise noted and are or description of chemistry only.
* Item not shown



OPTIONAL SPLIT
CARTRIDGE SEAL



ASSEMBLY
2"–6" 4623CE

PENTAIR FAIRBANKS NIJHUIS

DWG NO	0911842AP	REV NO	0

Technical Data[2]

Pump Size	4
Suction Size, Standard	4
Shaft Diameter:	
at Impeller (tapered)	1 1/2
at Sleeve	1 1/2
at Coupling	1 7/8
Keyway at Coupling	1/2 X 1/4
Thrust Bearing Number	NTN W5310 ZNR 99-11
Radial Bearing Number	NTN BL310Z
Sealing Box:	
Type	CHST-442
Recommended Flush Water	
Pressure, PSI (above operating pressure)	1-10
Flow, GPM	1/2-1
Sleeve OD	1.75
Box ID	2 3/4
Box Depth	2.15
Gland Bolt Size	3/8-16
Number of Gland Bolts	4
Casing Working Pressure, Maximum, PSI	75
Hydrostatic Test Pressure, Maximum, PSI	125
Nominal Thickness	
Casing	3/4
Shipping Weight, lb.	
Basic Pump	525

[2] Data shown is in inches unless otherwise noted.

PENTAIR FAIRBANKS NIJHUIS™

Bearing Life Statement

Project Number:	0911842
Sale Order Number	52504272
Project Name:	Town of Orleans
Pump Size/Model:	4x4 4623CE
Bearing Frame:	Vortex-type

Specified Conditions

GPM	255	500	50
TDH (FT)	53	54	15
Sync. Speed (RPM)	1600	1750	820

Bearing Life

Bearing Life meets or exceeds 100,000 hours, ABMA L-10, at the Specified Conditions above.

Certified by: *Max Du* 2020-08-07

PRODUCT ENGINEER.

Typical Pump Bearing Lubricants

Typical Products

Manuf.	Lubricant Brand Name	NLGI #
BP	BP Energrease® LC EP 2	2
Castrol	Pyroplex Red	2
Chevron	Delo® Greases EP	2
Exxon	Ronex® MP	2
Mobile	Mobiltith® AW2	2
Shell	Retinax® LC	2
Texaco	Starplex® 2	2
76	76 Multiplex EP	2

Furnished Spare Parts

Ref. No.	Description	Quantity
11	Shaft Sleeve	4
22	O-Ring, Shaft Sleeve	4
24	O-Ring, Case Gasket	4
456	Mechanical Seal Repair Kit	4

Paint Specifications

- **Coating Manufacturer** Tnemec
- **Surface Preparation** SSPC-SP6, Commercial Blast Cleaning.
- **Finish Coat** Series 69
  - **Number of Coats** Standard
  - **Dry Film Thickness** 3 Mils
  - **Color** Pentair Blue
- **Surfaces to be coated** Exterior of Pump

TNEMEC

PRODUCT DATA SHEET

HI-BUILD EPOXOLINE® II SERIES N69

PRODUCT PROFILE

GENERIC DESCRIPTION Polyamidoamine Epoxy

COMMON USAGE An advanced generation epoxy for protection and finishing of steel and concrete. It has excellent resistance to abrasion and is suitable for immersion as well as chemical contact exposure. Contact your local Tnemec representative for a list of chemicals. This product can also be used for lining storage tanks that contain demineralized, deionized or distilled water.

COLORS Refer to Tnemec Color Guide. **Note:** Epoxies chalk with extended exposure to sunlight. Lack of ventilation, incomplete mixing, miscatalyzation or the use of heaters that emit carbon dioxide and carbon monoxide during application and initial stages of curing may cause yellowing to occur.

FINISH Satin

SPECIAL QUALIFICATIONS A two-coat system at 4.0-6.0 dry mills (100-150 dry microns) per coat passes the performance requirements of **MIL-PRF-4556F** for fuel storage.

PERFORMANCE CRITERIA Extensive test data available. Contact your Tnemec representative for specific test results.

COATING SYSTEM

SURFACER/FILLER/PATCHER 215

PRIMERS **Steel:** Self-priming or Series 1, 27, 37H, 66, L69, L69F, N69F, V69F, 90E-92, 90-97, H90-97, 90G-1K97, 90-98, 91-H_2O, 94-H_2O, 135, 161, 394, 530
Galvanized Steel and Non-Ferrous Metal: Self-priming or Series 66, L69, L69F, N69F, V69F, 161
Concrete: Self-priming or Series 130, 215, 218
CMU: Self-priming or 130, 215, 218, 1254

TOPCOATS 22, 46H-413, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, 84, 104, 113, 114, 141, 156, 157, 161, 175, 180, 181, 287, 446, 740, 750, 1028, 1029, 1070, 1070V, 1071, 1071V, 1072, 1072V, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N69: Immersion Service—Surface must be scarified after 60 days. Atmospheric Service—After 60 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N69 is 21 days for atmospheric service. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL **Immersion Service:** Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 60 days or longer and N69 is the specified topcoat.

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
Non-Immersion Service: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

GALVANIZED STEEL & NON-FERROUS METAL Surface preparation recommendations will vary depending on substrate and exposure conditions. Contact your Tnemec representative or Tnemec Technical Services.

CAST/DUCTILE IRON Contact your Tnemec representative or Tnemec Technical Services.

CONCRETE Allow new concrete to cure 28 days. For optimum results and/or immersion service, abrasive blast referencing SSPC-SP13/NACE 6, ICRI CSP 2-4 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

CMU Allow mortar to cure for 28 days. Level protrusions and mortar spatter.

PAINTED SURFACES **Non-Immersion Service:** Ask your Tnemec representative for specific recommendations.

ALL SURFACES Must be clean, dry and free of oil, grease, chalk and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS 67.0 ± 2.0% (mixed) †

RECOMMENDED DFT 2.0 to 10.0 mils (50 to 255 microns) per coat. **Note:** MIL-PRF-4556F applications require two coats at 4.0-6.0 mils (100-150 microns) per coat. Otherwise, the number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME AT 5 MILS DFT Without 44-700 Accelerator

Temperature	To Handle	To Recoat	Immersion
90°F (32°C)	5 hours	7 hours	7 days
80°F (27°C)	7 hours	9 hours	7 days
70°F (21°C)	9 hours	12 hours	7 days
60°F (16°C)	16 hours	22 hours	9 to 12 days
50°F (10°C)	24 hours	32 hours	12 to 14 days

Curing time varies with surface temperature, air movement, humidity and film thickness. **Note:** For faster curing and low-temperature applications, add No. 44-700 Epoxy Accelerator; see separate product data sheet for cure information.

VOLATILE ORGANIC COMPOUNDS
Unthinned: 2.40 lbs/gallon (285 grams/litre)
Thinned 10% (No. 4 Thinner): 2.80 lbs/gallon (334 grams/litre)
Thinned 10% (No. 60 Thinner): 2.80 lbs/gallon (335 grams/litre)

HAPS
Unthinned: 2.40 lbs/gal solids
Thinned 10% (No. 4 Thinner): 3.25 lbs/gal solids
Thinned 10% (No. 60 Thinner): 2.40 lbs/gal solids

THEORETICAL COVERAGE 1,074 mil sq ft/gal (26.4 m²/L at 25 microns). See APPLICATION for coverage rates. †

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Published technical data and instructions are subject to change without notice. The online catalog at www.tnemec.com should be referenced for the most current technical data and instructions or you may contact your Tnemec representative for current technical data and instructions.

HI-BUILD EPOXOLINE® II | SERIES N69

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.

PACKAGING 5 gallon (18.9L) pails and 1 gallon (3.79L) cans — Order in multiples of 2.

NET WEIGHT PER GALLON 13.67 ± 0.25 lbs (6.10 ± .11 kg) (mixed) †

STORAGE TEMPERATURE Minimum 20°F (-7°C) Maximum 110°F (43°C)

TEMPERATURE RESISTANCE (Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)

SHELF LIFE Part A: 24 months; Part B: 12 months at recommended storage temperature.

FLASH POINT - SETA Part A: 82°F (28°C) Part B: 93°F (34°C)

HEALTH & SAFETY Paint products contain chemical ingredients which are considered hazardous. Read container label warning and Material Safety Data Sheet for important health and safety information prior to the use of this product.
Keep out of the reach of children.

APPLICATION

COVERAGE RATES

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested (1)	6.0 (150)	9.0 (230)	179 (16.6)
Minimum	2.0 (50)	3.0 (75)	537 (49.9)
Maximum	10.0 (250)	15.0 (375)	107 (10.0)

Dense Concrete & Masonry: From 100 to 150 sq ft (9.3 to 13.9 m²) per gallon.
CMU: From 75 to 100 sq ft (7.0 to 9.3 m²) per gallon.
(1) Note for Steel: Roller or brush application requires two or more coats to obtain recommended film thickness. Also, Series N69 can be spray applied to an optional high-build film thickness range of 8.0 to 10.0 dry mils (205 to 255 dry microns) or 11.5 to 14.5 wet mils (209 to 370 wet microns). Allow for overspray and surface irregularities. Film thickness is rounded to the nearest 0.5 mil or 5 microns. Application of coating below minimum or above maximum recommended dry film thicknesses may adversely affect coating performance. †

MIXING

1. Start with equal amounts of both Parts A & B.
2. Using a power mixer, separately stir Parts A & B.
3. (For accelerated version. If not using 44-700, skip to No. 4.)
Add four (4) fluid ounces of 44-700 per gallon of Part A while Part A is under agitation.
4. Add Part A to Part B under agitation, stir until thoroughly mixed.
5. Both components must be above 50°F (10°C) prior to mixing. For application of the unaccelerated version to surfaces between 50°F to 60°F (10°C to 16°C) or the accelerated version to surfaces between 35°F to 50°F (2°C to 10°C), allow mixed material to stand 30 minutes and restir before using.
6. For optimum application properties, the material temperature should be above 60°F (16°C).
Note: The use of more than the recommended amount of 44-700 will adversely affect performance.

THINNING Use No. 4 or No. 60 Thinner. For air spray, thin up to 10% or 3/4 pint (380 mL) per gallon. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon.

POT LIFE Without 44-700: 6 hours at 50°F (10°C) 4 hours at 75°F (24°C) 1 hour at 100°F (38°C)
With 44-700: 2 hours at 50°F (10°C) 1 hour at 75°F (24°C) 30 minutes at 100°F (38°C)

SPRAY LIFE Without 44-700: 1 hour at 75°F (24°C) With 44-700: 30 minutes at 75°F (24°C)
Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

APPLICATION EQUIPMENT

Air Spray ‡

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	75-100 psi (5.2-6.9 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray ‡

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.019" (380-485 microns)	3000-4800 psi (207-330 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
‡ Spray application of first coat on CMU should be followed by backrolling. **Note:** Application over inorganic zinc-rich primers: Apply a wet mist coat and allow tiny bubbles to form. When bubbles disappear in 1 to 2 minutes, apply a full wet coat at specified mil thickness.
Roller: Use 3/8" or 1/2" (9.5 mm or 12.7 mm) synthetic woven nap roller cover. Use longer nap to obtain penetration on rough or porous surfaces.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes.

SURFACE TEMPERATURE Minimum 50°F (10°C) Maximum 135°F (57°C) The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

CLEANUP Flush and clean all equipment immediately after use with the recommended thinner or MEK.
† Values may vary with color.

WARRANTY & LIMITATION OF SELLER'S LIABILITY: Tnemec Company, Inc. warrants only that its coatings represented herein meet the formulation standards of Tnemec Company, Inc. THE WARRANTY DESCRIBED IN THE ABOVE PARAGRAPH SHALL BE IN LIEU OF ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. The buyer's sole and exclusive remedy against Tnemec Company, Inc. shall be for replacement of the product in the event a defective condition of the product should be found to exist and the exclusive remedy shall not have failed its essential purpose as long as Tnemec is willing to provide comparable replacement product to the buyer. NO OTHER REMEDY (INCLUDING, BUT NOT LIMITED TO, INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, ENVIRONMENTAL INJURIES OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS) SHALL BE AVAILABLE TO THE BUYER. Technical and application information herein is provided for the purpose of establishing a general profile of the coating and proper coating application procedures. Test performance results were obtained in a controlled environment and Tnemec Company makes no claim that these tests or any other tests, accurately represent all environments. As application, environmental and design factors can vary significantly, due care should be exercised in the selection and use of the coating.

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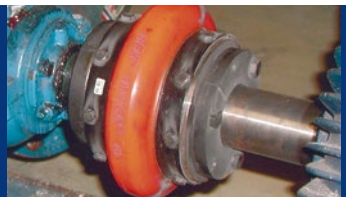
Elastomeric Coupling Catalog

Download the most up-to-date
versions at www.rexnord.com

Omega Elastomeric Couplings

(Inch)



Applications:
- Pumps
- Compressors
- Industrial Fans
- Mixers

Available Options:
- Hydrolytically Stable Urethane Element
- Heavy Duty Element
- Corrosion Resistant Element
- Stainless Steel Hubs and Hardware
- Spline Bore Hubs
- Keyless Hub/Internal Locking Device Designs
- Limited End Float
- Positive Drive Coupling

Worldwide Support:
www.rexnord.com/contact/worldwide-locations

ATEX II 2GD c T5

Rexnord Omega Elastomeric Couplings
The Benchmark for Over 40 Years

Rexnord Omega Elastomeric Couplings are non lubricated, material-flexing split-in-half tire couplings used in a variety of demanding applications in many industries. This all-purpose coupling has excellent vibration dampening capability, helping to provide extended life to connected equipment.

Omega couplings offer easy installation and replace-in-place design, while accommodating a wide range of shaft gaps.

Higher Material Strength
Omega's specially formulated polyurethane provides significantly higher peak torque capabilities than competitive rubber based solutions allowing for a smaller size coupling at a lighter weight and ultimately a lower Total Cost of Ownership (TCO).

Weight Balanced Elements
Omega half elements are tightly weight matched to ensure standard weight balance conforms with ISO G16 and AGMA Class 8, helping to prevent premature wearing of connected equipment due to an unbalanced coupling.

Variety of Sizes and Options
In addition to being available in 16 metric and imperial sizes, Omega is offered as a general-purpose Orange, in a Heavy Duty Yellow option that provides 25% more torque capacity, and a Hydrolytically Stable Green option that's ideal for hot and humid environments. Anti-corrosive coated steel shoes and stainless steel hardware or hubs are also available upon request.

Proven & Trusted Performance
Omega couplings have been used for over 40 years in a wide assortment of demanding applications and recognized in the industry as the benchmark for elastomeric split-in-half tire couplings.

Standard Orange

Heavy Duty Yellow (HDY)

Hydrolytically Stable Urethane Green (HSU)

Polyurethane-to-Metal Bond minimizes coupling components and eliminates potential slippage associated with mechanically clamped designs.

Radial Bolting provides easier access than axially bolted couplings in confined areas. Hardware available in carbon steel or stainless steel.

Interchangeable Hubs between close coupled and spacer elements allow for reduced inventory. Hubs are available in carbon steel, 303-304 stainless steel, or with electroless nickel plating.

Anti-corrosive coated steel shoes and stainless steel hardware available with Green (HSU-J).

Torsionally Soft Flex Element cushions shock loads and vibration to protect and extend connected equipment life.

Split-in-Half Design for easy assembly and replacement without having to remove the hubs. No need to move hubs, or realign equipment when replacing the coupling element.

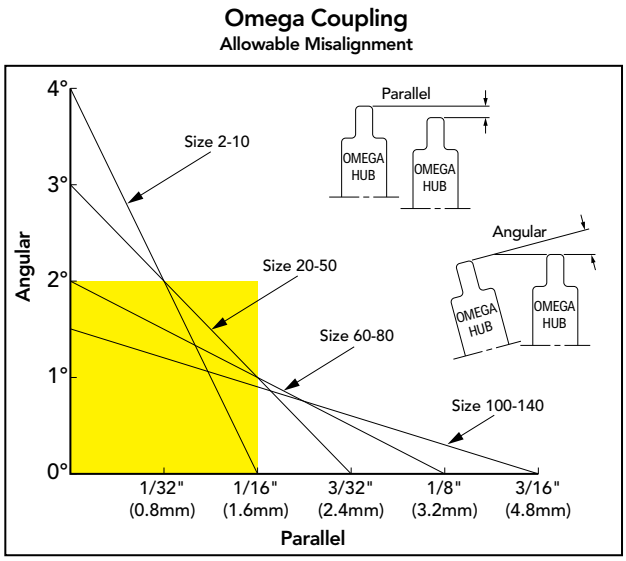
Weight Balanced Elements for higher speed ratings and prevention of premature wearing due to an unbalanced coupling.

High-misalignment Capacity accommodates unavoidable misalignment with reduced reactionary forces on connected equipment.

Allowable Misalignment

Orange & HSU — Any combination of parallel and angular misalignment which falls under the triangle will not cause a premature fatigue failure of the flexible element in normal use.

HDY — All sizes 2-140 have ratings of 2° angular and 1/16" (1.6mm) as represented in the ***yellow box*** below:



Torque Ratings

Size (E or ES)	Standard & HSU Omega Ratings (in-lbs / Nm)	HDY Omega Ratings (in-lbs / Nm)
2	190 / 22	238 / 28
3	365 / 41	456 / 51
4	550 / 62	687 / 78
5	925 / 105	1,156 / 131
10	1,450 / 164	1,812 / 205
15	1,800 / 204	2,249 / 255
20	2,300 / 260	2,875 / 325
30	3,650 / 412	4,563 / 515
40	5,500 / 622	6,875 / 778
50	7,650 / 864	9,563 / 1,080
60	12,500 / 1,412	15,625 / 1,765
70	22,125 / 2,486	27,656 / 3,108
80	39,500 / 4,463	49,375 / 5,579
100	85,050 / 9,605	106,312 / 12,006
120	170,100 / 19,221	212,625 / 24,026
140	340,200 / 38,442	425,250 / 48,053

© Rexnord Corporation. All Rights Reserved.

Rexnord Omega Elastomeric Couplings

OEM Performance and Coverage

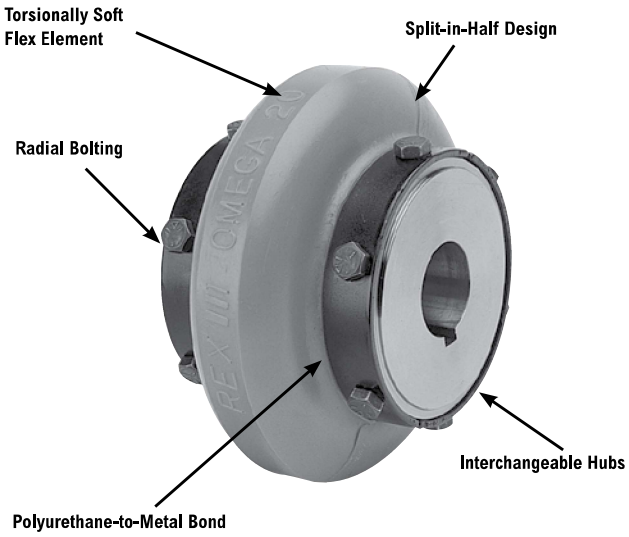
The unique split-in-half flex element and reversible hubs significantly decrease total costs by reducing inventory and assembly time.

Rexnord Omega couplings are non-lubricated, material-flexing couplings utilizing a specially formulated polyurethane material engineered for maximum durabilty, strength and fatigue resistance.

The Rex® Omega HSU coupling (green) is specifically designed for hot and humid conditions.

Rexnord is the leading coupling provider in the industry with a full-line of available solutions supported by trained customer service and application engineering professionals focused only on our coupling product line. For more information, contact your local Rexnord account executive.

Features and Benefits



- Split-in-half flex element design for simplified assembly and disassembly
- Interchangeable hubs allow for reduced inventory
- High-misalignment capacity accommodates unavoidable misalignment with low reactionary forces
- Torsionally soft flex element cushions shock loads and vibration, extending equipment life
- Polyurethane flex element does not require lubrication
- Polyurethane-to-metal bond eliminates assembly and slippage problems associated with mechanically clamped designs
- Our selection software makes choosing the right coupling a snap
- Rexnord field specialists are locally based experts available to support key end-users
- The Rexnord Omega HSU coupling (green) is specifically designed for hot and humid environments. In addition, the HSU material performs well in caustic and acidic environments. Consult Rexnord engineering for your application.

Rexnord Omega couplings operate in either horizontal or vertical applications without any additional components.

Ease of installation, ease of maintenance and visual inspection make these couplings a must for many applications such as this mash cooker in a brewery. Never operate a coupling without an OSHA approved guard.

Selection Procedures

1. **Determine HP/100 RPM:** $\text{HP/100 RPM} = \frac{\text{Horsepower} \times 100}{\text{RPM}}$
2. **Determine Service Factor:**

   Select the proper Service Factor from Table on **page 5**. If not listed, see Load Classification Table.

   Remember to consider both driver and driven equipment and temperature requirements.
3. **Multiply HP/100 by the service factor to get equivalent HP/100 RPM.**
4. **Select the Coupling Size:**

   From **Table 1**, with a rating equal to or greater than the equivalent HP/100 RPM determined in Step 3.
5. **Check Limiting Conditions:**

   Be sure that the operating speed of the coupling does not exceed maximum RPM listed on **pages 8-11**.
6. **Select Desired Hub Type:**

   Select desired hub type and check maximum allowable coupling bore on **page 17**.

OR

1. **Determine Operating Torque:** $\left(\frac{63{,}000 \times \text{HP}}{\text{RPM}}\right)$
2. **Multiply by Service Factor:**

   Select the proper Service Factor from Table on **page 5**.
3. **Select the Coupling Size:**

   Select coupling size from **Table 2** with a capacity equal to or greater than determined in Step 2.
4. **Follow Steps 5 & 6 Above**

Table 1

Size		Equivalent HP/100 RPM
Standard	Spacer	
E2	ES2	0.3
E3	ES3	0.58
E4	ES4	0.88
E5	ES5	1.48
E10	ES10	2.3
E20	ES20	3.65
E30	ES30	5.79
E40	ES40	8.85
E50	ES50	12.14
E60	ES60	19.84
E70	ES70	35.12
E80	ES80	62.7
E100	NA	135
E120	NA	270
E140	NA	540

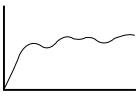
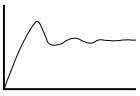
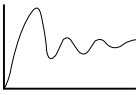
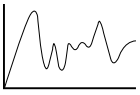
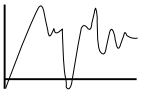
Table 2

Torque Capacity			
Size	Continuous Torque (lb-in)	Size	Continuous Torque (lb-in)
2	190	40	5,500
3	365	50	7,650
4	550	60	12,500
5	925	70	22,125
10	1,450	80	39,500
20	2,300	100	85,050
30	3,650	120	170,100
		140	340,200

Peak torque capacity of element is 250% of above continuous ratings.

Service Factors

Service Factors (S.F.) are a means of classifying different equipment and applications into various load classifications. Due to variations in application of equipment, service factors are used to adjust equipment ratings to accommodate for variable loading conditions. This is a general guide. More specific factors are given on **page 5**.

	Load Classifications	Service Factors
	Continuous service and running loads vary only slightly.	1.0
	Torque loading varies during operation of the equipment.	1.5
	Torque loading varies during operation, frequent stop/start cycles are encountered.	2.0
	For shock loading and substantial torque variations.	2.5
	For heavy shock loading or light reversing drives.	3.0
	Reversing torque loads do not necessarily mean reversal of rotation. Depending upon severity of torque reversal, such loads must be classified between "medium" and "extreme."	Consult Rexnord

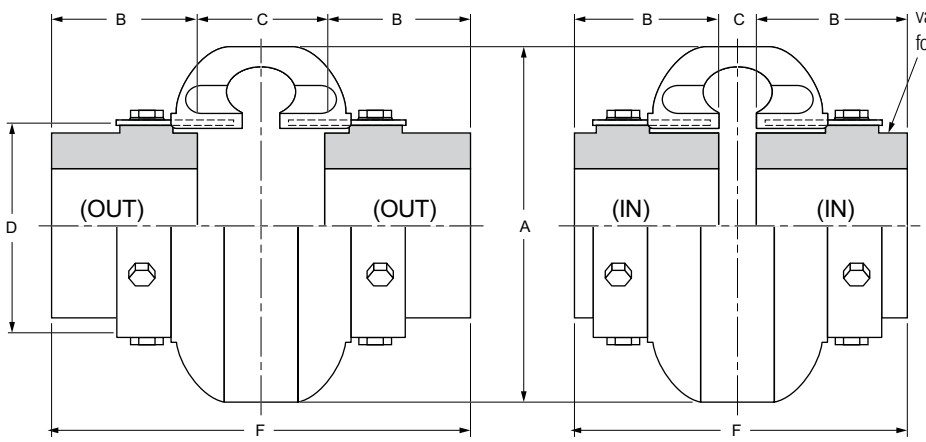
Omega Element Temperature Range (Ambient) ①	
-40°F	-40°C
to	
+200°F	+93°C

High Temperature Service Factor Adjustment ①	
Ambient Temp.	S.F. Adjust.
+150°F (66°C)	0.25
+165°F (74°C)	0.50
+180°F (82°C)	0.75
+200°F (93°C)	1

① Added to application service factor.

The service factor adjustment for high temperature is in addition to the service factor consideration for the driver and driven equipment. However, if high temperatures are typical for a specific application, maximum temperature consideration is incorporated into the "typical" service factor listing on **page 5**, i.e., steel mill runout tables.

Omega Close-Coupled Design with Straight Bore Hubs



NOTE: Hub/shoulder design varies per coupling size. Consult Rexnord for specific size assembly drawings.

(HUBS OUTBOARD) **(HUBS INBOARD)**

Coupling Size	Recom. Max. Bore (in) ①	Continuous HP/100 RPM	Continuous Torque (lb-in)	Max. RPM	Dimensions (in)							Weight ② (lb)
					A	B	C		D	F		
							(In)	(Out)		(In)	(Out)	
E2	1.13	0.30	190	7500	3.50	0.94	1.34	1.90	1.85	3.22	3.78	1.2
E3	1.38	0.58	365	7500	4.00	1.50	0.81	1.31	2.32	3.81	4.31	2.4
E4	1.63	0.88	550	7500	4.56	1.69	0.44	1.31	2.69	3.81	4.69	3.9
E5	1.88	1.48	925	7500	5.38	1.75	0.81	1.81	3.13	4.31	5.31	5.4
E10	2.13	2.30	1450	7500	6.38	1.88	0.56	1.84	3.65	4.31	5.56	8.2
E20	2.38	3.65	2300	6600	7.25	2.06	0.50	2.38	4.48	4.62	6.50	13.0
E30	2.88	5.79	3650	5800	8.25	2.31	0.56	2.44	5.42	5.19	7.06	21
E40	3.38	8.85	5500	5000	9.50	2.50	0.56	2.68	6.63	5.56	7.68	35
E50	3.63	12.14	7650	4200	11.00	2.75	0.63	3.38	8.13	6.13	8.88	54
E60	4	19.84	12,500	3800	12.50	3.25	0.69	3.44	8.75	7.19	9.94	72
E70	4.5	35.12	22,125	3600	14.00	3.62	0.75	3.75	9.25	8.00	11.00	86
E80	6	62.7	39,500	2000	16.00	4.87	0.75	5.00	11.25	10.50	14.75	170
E100	6.75	135	85,050	1900	21.00	5.50	1.75	3.75	14.13	12.75	14.75	244
E120	7.5	270	170,100	1800	25.00	6.00	2.25	4.88	17.63	14.24	16.88	425
E140	9.00	540	340,200	1500	30.00	7.00	3.00	5.00	20.88	17.00	19.00	746

① See **page 17** for larger bore capacities with shallow keyways.
② With maximum bore hubs.

Split-in-Half Flex Element

Allows disassembly and replacement without disturbing hubs or connected equipment.

Reversible Hubs

Accommodates different shaft spacing requirements, and allows compression bushings to be installed from either side of the hub.

Straight Bore Hubs

QD Hubs and Bushings

Taper-Lock Hubs and Bushings

NOTE: Dimensions subject to change. Certified dimensions of ordered material furnished on request.

NEMA Premium® Motors

The Energy Efficient Choice

It pays to replace your motors with U.S. MOTORS® brand NEMA Premium Standard Motors.

NEMA Premium® standard motors…the right thing for your business and the environment.

This brochure includes detailed information on what NEMA Premium standard motors can do for you and your company. But the environmental impact of these more efficient motors should not be overlooked. Considering that more than 40 million commercial and industrial motors are in use in the United States* today, it's easy to see how even small increases in motor efficiency can add up to significant reductions in overall energy usage.

Thanks to premium efficient motors, the potential reduction in energy usage is truly staggering. The implementation of EPAct electric motors is estimated to provide savings of 5,800 gigawatts of electricity over 10 years, and a reduction of carbon emissions by 80 million tons…the equivalent of keeping 16 million cars off the road.*

And now, with the introduction of EISA and the move toward using NEMA Premium motors, the reduction in energy usage can be even greater. An impact study by the American Council for an Energy Efficient Economy estimated that if all motors in the United States were upgraded to NEMA Premium, the annual energy savings could reach nearly 10,000 gigawatts of electricity every year. That's equal to the power generated by three coal burning power plants!

*According to The U.S. Department of Energy.

The new EISA regulation went into effect in 2010.

The Energy Independence and Security Act of 2007 (EISA) took effect on December 19, 2010, changing mandatory efficiency levels for 3-phase electric motors up to 600 volts, which are manufactured or imported into the USA. Under the EISA regulation, electric motors previously required to meet EPAct efficiency levels must move up to NEMA Premium standards. These include general purpose motors from 1 to 200 horsepower. In addition, products not previously covered by EPAct are required to meet EPAct levels. These include U-frame, design C, close coupled pump, footless, vertical solid shaft normal thrust, 8-pole motors, and 201 to 400 horsepower design B motors.

Cut your energy usage and start saving money right now!

NEMA Premium standard motors can significantly reduce your energy usage and costs — offering fast payback and long-term operating cost savings. Just take a look at this typical example:

50 HP Motor

Repair cost: $1,114
Replacement cost (NEMA Premium): $2,080
Cost vs. repair: $966
Energy savings: $1,184 per year*
Payback: 10 months
10-year savings: $11,840*
Return on investment: Over 1,000%

*This is based on 0.10 cents a kilowatt hour (kwh), so if your energy costs are higher per kwh in your area, your savings can be even greater.

HOSTILE DUTY™ TEFC

UNIMOUNT® TEFC

Three Phase ODP

U.S. MOTORS® brand motors keep you EISA compliant.

U.S. MOTORS® brand NEMA Premium electric motors meet the EISA regulation requirements, including: Open Drip-Proof (ODP) motors, UNIMOUNT® Totally Enclosed Fan Cooled (TEFC) motors, TEFC HOSTILE DUTY™ motors, CORRO-DUTY® TEFC motors, 841 PLUS® TEFC motors, and TEFC Cooling Tower Duty motors. With U.S. MOTORS® brand NEMA Premium standard motors, you will meet EISA requirements and cut your monthly energy costs.

Want to learn more about motor efficiency?

Our online MotorPro® training tool features a new module on electric motor energy efficiency. Just visit **www.usmotors.com/motorpro**, and choose Module 3 for complete details on energy laws and efficiency — and on how you can reduce your energy usage and operating costs.

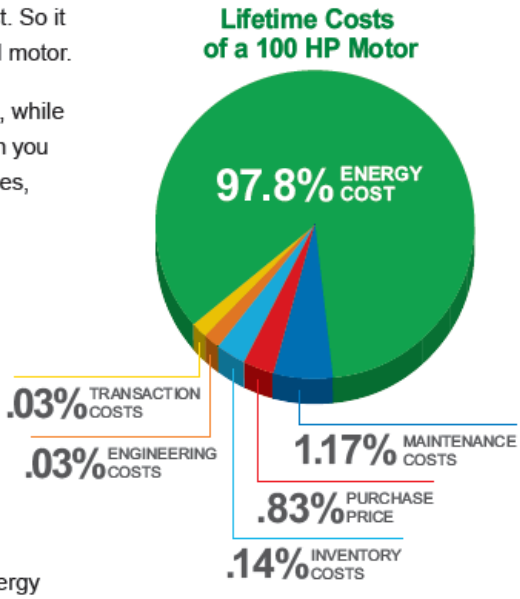
Small increases in efficiency can turn into big savings!

Over the life of a motor, the energy it uses adds up to more than 97% of its total cost. So it makes sense to consider this "lifetime" cost when deciding what to do about a failed motor.

Motors as small as one horsepower can remain in operation for more than 15 years, while motors above 50 horsepower can remain in operation for more than 25 years. When you consider that a more efficient motor will save energy costs every single day for decades, it's easy to see that small increases in efficiency can turn into big savings!

With such a large percentage of a motor's lifetime cost being the energy it uses, seemingly small increases in efficiency add up to significant savings over time. That is why NEMA Premium standard motors can be such a valuable investment. While they do come with a slightly higher price, that initial investment is typically paid back quickly through lower energy bills.

Just look at the examples below to see your potential savings. These are based on a 100 HP, fully-loaded, continuous-duty motor operating at 8,700 hours per year. In both examples, the NEMA Premium standard motors would pay for their higher purchase price in less than two years — and then continue to deliver the annual energy savings over their entire lifetimes! And remember, this is based upon 0.10 cents per kwh, so if your energy costs are higher in your area, your savings can be even greater.



Standard Efficiency vs. NEMA Premium

	Standard	NEMA Premium
Efficiency	92.5%	95.4%
Operating Cost	$49,115 per yr	$47,622 per yr
Annual Savings*		$1,493
10-Year Savings*		$14,930

EPAct vs. NEMA Premium

	Standard	NEMA Premium
Efficiency	94.5%	95.4%
Operating Cost	$48,076 per yr	$47,622 per yr
Annual Savings*		$454
10-Year Savings*		$4,540

*This is based on 0.10 cents a kilowatt hour (kwh), so if your energy costs are higher per kwh in your area, your savings can be even greater.

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

CERTIFIED MOTOR PERFORMANCE DATA

MOTOR MANUFACTURER: NIDEC MOTOR CORPORATION **DATE:** 8/6/2020

PENTAIR PURCHASE ORDER #: GA51 PENTAIR TAG #: _____

PERFORMANCE DATA BASED ON STANDARD RULES OF: X **IEEE** X **ASA** X **NEMA**

HP	SYNCHRONOUS SPEED (RPM)	FULL LOAD * SPEED (RPM)	FRAME NUMBER	TYPE	ENCLOSURE
25	1800	1775	284T	CTI	TEFC-IP54

*Full Load Speed Tolerance Per NEMA MG1-12.46 is+/- 20% of slip (Slip=Synchronous RPM-Full Load RPM)

PHASE	HERTZ	VOLTS	AMPHERES		INSULATION CLASS	MAX. TEMP. RISE X _____RESIS. _____THERM.	SERVICE FACTOR	NEMA KVA/HP CODE	NEMA DESIGN
			FULL LOAD	LOCKED ROTOR					
3	60	460/230	29.2/58	188/377	F	105 DEG C AT 1.00 SF	1.15	G	B

GUARANTEED EFFICIENCY			POWER FACTOR			TORQUE AT FULL VOLTAGE		
						FULL LOAD TORQUE AT FULL LOAD SPEED (LB.FT)	LOCKED STARTING	PULLOUT BREAKDOWN
FULL LOAD	3/4 LOAD	1/2 LOAD	FULL LOAD	3/4 LOAD	1/2 LOAD		PERCENT OF FULL LOAD	
92.4	93.0	92.4	85.5	82.5	74.7	73.9	210	280

VSS ☐ **VHS** ☐ **NRR** ☐ **SRC** ☐ **HORIZ** ☒

BEARINGS:

Drive End Lubrication:
☐ Oil ☒ Grease

Opposite End Lubrication:
☐ Oil ☒ Grease

PAINT: (Attach Technical Data Sheets)
☒ Factory Standard
☐ Other _____

MOTOR NO.: GA51

MOTOR WEIGHT: 330 LBS

ROTATION: ☐ **BI-DIRECTIONAL** ☐ **CW** ☒ **CCW**

Certified by: *Krista Thomas* Date: 8/6/2020 Revision # _____

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 8/6/2020

Pentair Purchase Order #: GA51 Pentair Tag #: _____

	Required	Not Required	Description
Space Heaters:	☐	☒	Watts: _____ Voltage: _____
Thermostats:	☒	☐	Type: ☐ N.O. ☒ N.C.
Thermistors:	☐	☒	Make & Model: _____ Trip Range: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
	Quantity Per Motor: _____		
Winding RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
	Quantity Per Motor: _____		
Bearing RTD's:	☐	☒	Make & Model: _____ Construction/OHM Rating: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
	Quantity _____		
Vibration Sensor:	☐	☒	Make & Model: _____ ☐ relay not Supplied ☐ relay supplied: Type: ☐ factory set ☐ field adjustable ☐ wiring diagram/cut sheet attached. Ref.: _____
Tests:	☒	☐	☒ Short commercial, unwitnessed ☐ Short commercial, witnessed ☐ Calibration Test, unwitnessed ☐ Complete initial, unwitnessed ☐ Complete initial, witnessed ☐ Sound test, unwitnessed ☐ Bump Test, unwitnessed ☐ Vibration Test, unwitnessed ☐ Polarization Index, unwitnessed ☐ Reed Critical Test, unwitnessed ☐ IEEE841

Certified by: *Krista Thomas* Date: 8/6/2020 Revision #: _____

PENTAIR FLOW TECHNOLOGIES

3601 Fairbanks Avenue
Kansas City, Kansas 66106
913-371-5000 FAX 913-371-2272

Accessory Data

Motor Manufacturer: NIDEC MOTOR CORPORATION Date: 8/6/2020

Pentair Purchase Order #: GA51 Pentair Tag #:

Features:

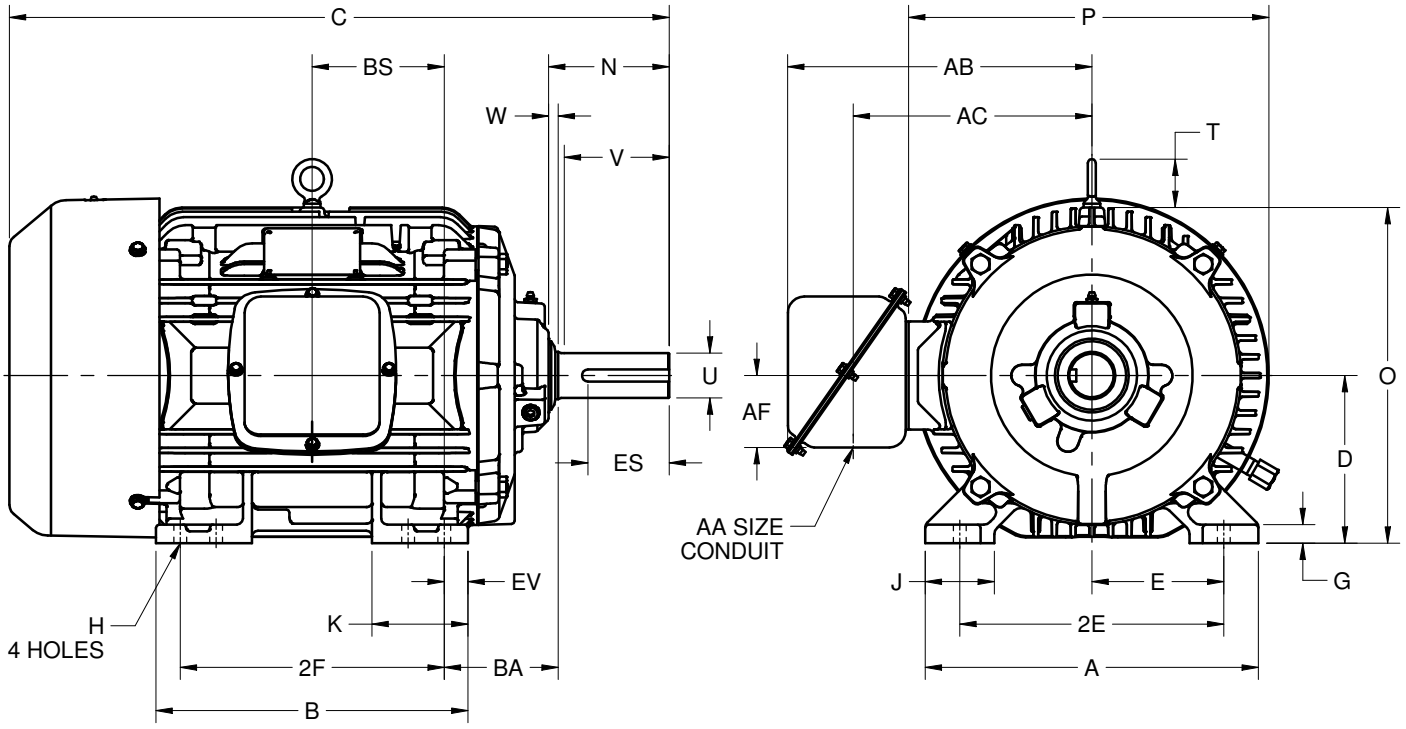
Enclosure ..... TEFC
Winding Type ..... Random Wound
Service Factor 1.15
Insulation Class ..... Class "F" ~ Insulife 2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M)
Ambient In Degree C (Max) +40 C
Assembly Position ..... "F-1" Assembly Position
Efficiency Class ..... Premium Efficiency
Application ..... Unknown
Inverter Duty NEMA MG1 Part 31
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 20:1
VFD Service Factor 1.00
Temperature Rise (Sine Wave): "F" Rise @ SF
(Resist)
Starting Method ..... Direct-On-Line Start
Duty Cycle ..... Continuous Duty
Efficiency Value ..... 93.6 % ~ Typical

Accessories:

AEGIS Grounding Ring (SGR)
Special Balance
Thermostats - Normally Closed

Certified by: *Krista Thomas* Date: 8/6/2020 Revision #:

EFFECTIVE: 09-JAN-17	DIMENSION PRINT WORLD MOTOR INVERTER DUTY FRAME: 284T, 286T BASIC TYPE: CTI	PRINT: 08-1009
SUPERSEDES: NEW		SHEET: 1 OF 1



ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS

UNITS		A	B	C	D -.06	E	2E ±.03	G	H +.05	J	K	N	O	P [2]
	IN	13.88	13.00	27.50	7.00	5.50	11.00	.78	.53	2.88	4.00	5.03	14.00	15.00
	MM	353	330	699	178	140	279	20	13	73	102	128	356	381

UNITS		T	U -.001	V MIN	W	AA	AB	AC	AF	BA	BS	EV	ES MIN	SQ KEY
	IN	2.03	1.875	4.38	.41	1.50	12.69	9.94	3.00	4.75	5.50	1.00	3.28	.500
	MM	52	47.63	111	10		322	252	76	121	140	25	83	12.70

FRAME	UNITS	2F ±.03
284T	IN	9.50
	MM	241
286T	IN	11.00
	MM	279

1. DIMENSIONS MAY VARY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS
2. LARGEST MOTOR WIDTH
3. STANDARD ASSEMBLY POSITION F-1 IS SHOWN. F-2 IS PROVIDED WHEN SPECIFIED. CONDUIT OPENING MAY BE LOCATED IN STEPS OF 90° REGARDLESS OF THE LOCATION
4. TOLERANCES ARE SHOWN IN INCHES ONLY

Nidec Motor Corporation
St. Louis, Missouri

INFORMATION DISCLOSED ON THIS DOCUMENT IS CONSIDERED PROPRIETARY AND SHALL NOT BE REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OF NIDEC MOTOR CORPORATION

ISSUED BY	R. TIMMERMANN
APPROVED BY	M. CULLEN

IHP_DP_NMCA (MAR-2011) SOLIDEDGE

NAMEPLATE DATA

CATALOG NUMBER:	HD25V2B		NAMEPLATE PART #:	422699-007	
MODEL	GA51	FR 284T	TYPE	CTI	ENCL TEFC-IP54
SHAFT END BRG	6310-2Z-J/C3 - QTY 1		OPP END BRG	6210-2Z-J/C3 - QTY 1	
PH	3	MAX AMB 40 C	ID#		
INSUL CLASS	F	Asm. Pos. F1	DUTY	CONT	

HP	25		RPM	1775		HP		RPM	
VOLTS	460	230				VOLTS			
FL AMPS	29.2	58.0				FL AMPS			
SF AMPS	33.0	67.0				SF AMPS			
SF	1.15	DESIGN B	CODE	G		SF		DESIGN	CODE
NEMA NOM EFFICIENCY	93.6	NOM PF	85.5	KiloWatt	18.65	NEMA NOM EFFICIENCY		NOM PF	
GUARANTEED EFFICIENCY	92.4	MAX KVAR		HZ	60	GUARANTEED EFFICIENCY		MAX KVAR	HZ

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS	460	230
AMPS	30.7	60.9

TORQUE 1	73.90LB-FT	TORQUE 2	
VFD LOAD TYPE 1	VT/PWM	VFD LOAD TYPE 2	
VFD HERTZ RANGE 1	3-60	VFD HERTZ RANGE 2	
VFD SPEED RANGE 1	90-1800	VFD SPEED RANGE 2	
SERVICE FACTOR	1.00	FL SLIP	
NO. POLES		MAGNETIZING AMPS	
VECTOR MAX RPM		Encoder PPR	
Radians / Seconds		Encoder Volts	

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=109145	Customer PN	
Notes		Non Rev Ratchet	
Max Temp Rise		OPP/Upper Oil Cap	GREASE
Thermal (WDG)	OVER TEMP PROT 2	SHAFT/Lower Oil Cap	GREASE
Altitude		Usable At	
Regulatory Notes		Regulatory Compliance	CC 030A
COS		Marine Duty	
Balance	0.08 IN/SEC	Arctic Duty	
3/4 Load Eff.	94.3	Inrush Limit	
Motor Weight (LBS)	330	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)		Special Note 2	
Thrust Percentage		Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	
380V 50 Hz Max Amps		SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4		Special Accessory Note 19	
Special Accessory Note 5		Special Accessory Note 20	
Special Accessory Note 6		Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3		Note 4	
Note 5		Note 6	
Note 7		Note 8	

NIDEC MOTOR CORPORATION

ST. LOUIS, MO

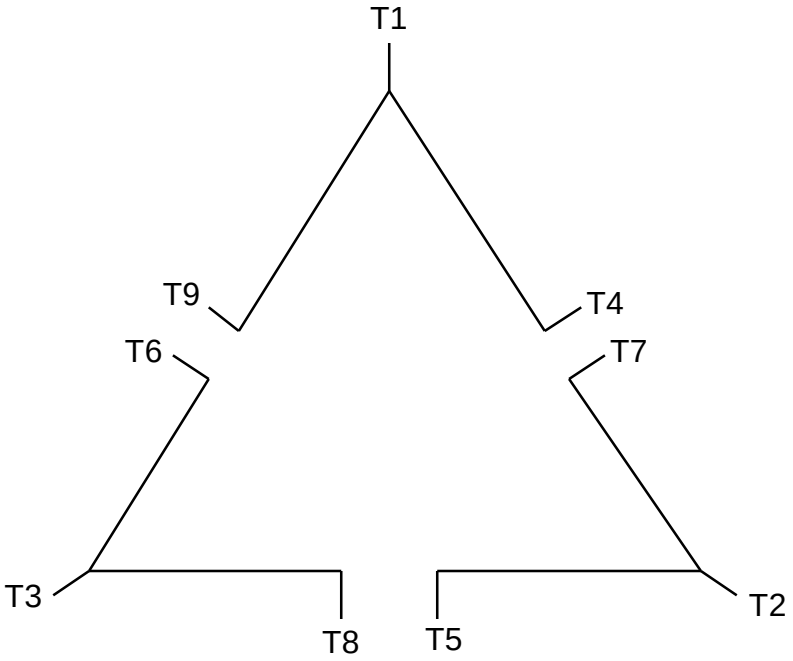
TYPICAL NAMEPLATE DATA
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
SOME FIELDS MAY BE OMITTED

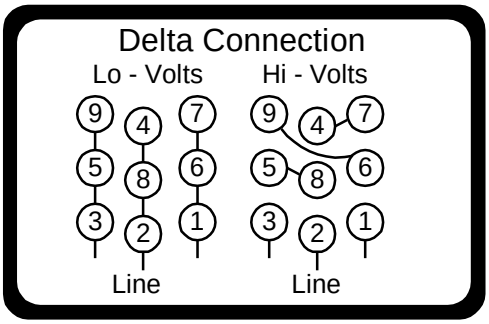
Nidec trademarks followed by the ® symbol are registered with the U.S. Patent and Trademark Office.

A109145

Motor Wiring Diagram

9 Lead, Dual Voltage (DELTA Conn.)





To reverse direction of rotation interchange connections L1 and L2.

Each lead may have one or more cables comprising that lead.
In such case each cable will be marked with the appropriate lead number.

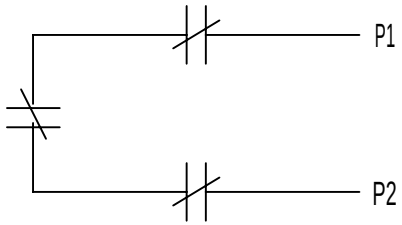
Connection Plate: A109145
Connection Decal: 344122

THERMOSTATS

1. MOTOR IS EQUIPPED WITH QTY-3 (1 PER PHASE) NORMALLY CLOSED THERMOSTATS. THERMOSTATS ARE SET TO OPEN AT HIGH TEMPERATURE.

2. CONTACT RATINGS FOR THERMOSTATS: 120-600 VAC, 720 VA

N. C. THERMOSTATS



NOTE: THERMOSTATS LEADS MAY BE LOCATED IN EITHER THE MAIN OUTLET BOX OR IF SO EQUIPPED, AN AUXILIARY BOX.

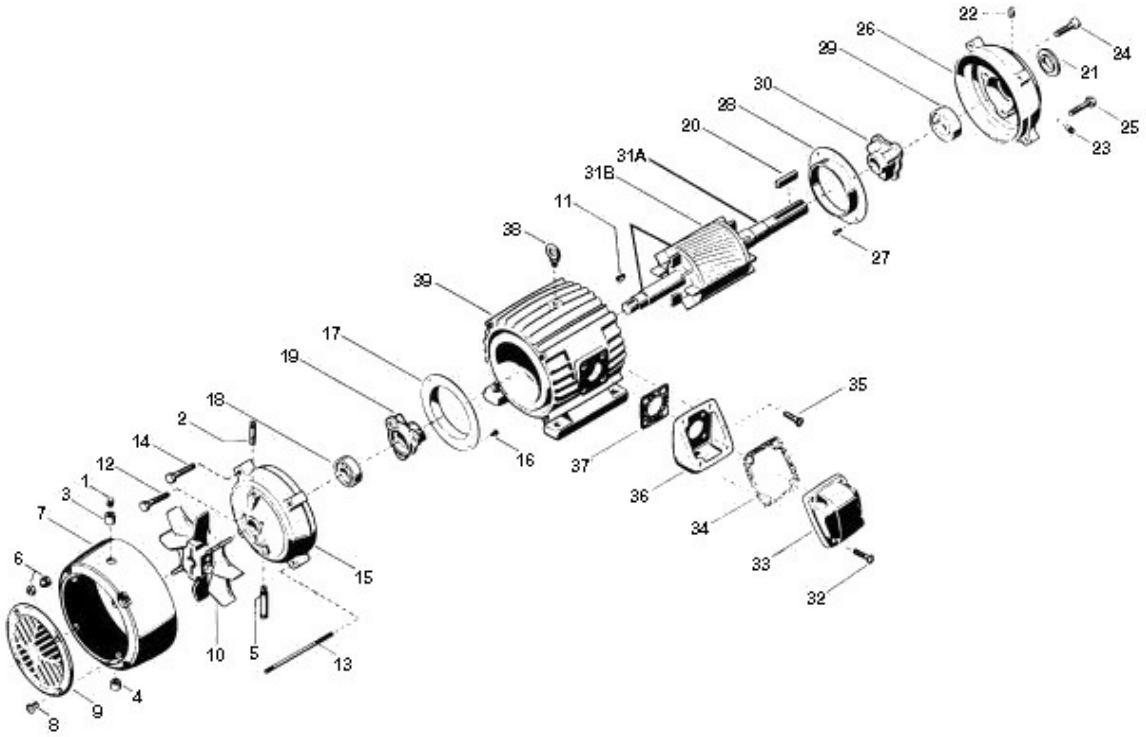
ACCESSORY LISTING
QTY-3 N.C. THERMOSTATS

REVISION DESCRIPTION FOR: MISC STL0211 - UPDATED FORMAT .	SCALE: NONE UNITS: IN TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED) INCHES / mm ANGLES X°= ±1°	TITLE: CUSTOMER CONNECTION DIAGRAM ISSUED BY: R. KING APPROVED BY: C. CADE CODE DWG NO.: 0834066	NIDEC MOTOR CORPORATION REVISION DATE: 24-FEB-11 REV: G SHEET NUMBER: 1 OF 1 DWG SIZE: A
MATERIAL: --- MUST BE COMPLIANT TO RoHS DIRECTIVE EU 2002/95/IEC AND REGULATION EC 1907/2006 (REACH) AS AMENDED			

NIDEC CONFIDENTIAL
NIDEC MOTOR CORPORATION 24-Feb-11

RENEWAL PARTS

FRAMES 254T THRU 447T - TOTALLY ENCLOSED AND EXPLOSIONPROOF MOTORS
TYPES: CE, CE1, CE4, CEF, CT, CT1, CT4, CTC, CTE, CTE1, CTE4, CTEF, CTEF1, CTEF4, CTEI, CTEN, CTF, CTF1, CTF4, CTFI, CTFI1, CTFI4, CTFN, CTI, CTI4, CTN, CTNI, EC, ECEI, FCT, FCTF, FCTF1, FCTN, FD, FDF, FDF1, FL, FLC, FLCA, FLCF, FLF, FN, FNC, FTC, FTCF, JAD, JDE, L, L1, L4, LC, LC1, LCA, LCAE, LCE, LCEF, LCEI, LCE1, , LCF, LCFI, LCI, LE, LE1, LE4, LEF, LF, LF1, LF4, LFC, LFI, LI, LN, N, NC, NCE, NCEF, NCF, NCFI, NCI, NE, NF, NN, T, T1, T4, TC, TC1, TC4, TCA, TCE, TCE1, TCE4, TCEF, TCEF4, TCEI, TCEN, TCEP, TCF, TCF1, TCFI, TCI, TCI1, TCN, TE, TEF, TEN, TF, TFC, TFN, TN



ITEM NO.	QTY	NAME OF PART
1	1	Slotted Headless Pipe Plug
2	1	Pipe Coupling
3	1	Pipe Nipple
4	1	Pipe Cap
5	1	Pipe Nipple
6	2	Cap and Jam Nut
7	1	Fan Cover Guard
8	3	Screw & Lockwasher
9	1	Grill
10	1	Vent Fan Assembly
11	1	Woodruff Key (Not used on frames 254T &256T
12	2	Screw
13	2	Stud & Nut
14	2	Screw (Qty 6 on frames 254T & 256T)
15	1	Bracket
16	4	Screw (Used only on frame 286T & 326T)
17	1	Air Deflector (Used only on frame 286T & 326T)
18	1	Ball Bearing
19	1	Bearing Cap
20	1	Key
21	1	Water Deflector

ITEM NO.	QTY	NAME OF PART
22	1	Slotted Headless Pipe Plug
23	1	Pipe Plug
24	2	Screw
25	4	Screw (Qty 8 on frames 286T & 326T)
26	1	Bracket (Not used on types TF)
27	4	Screw (Used only on frame 286T & 326T)
28	1	Air Deflector ((Used only on frame 286T & 326T)
29	1	Ball Bearing
30	1	Bearing Cap
31	1	Rotor Assembly (Includes items 31A & 31B)
31A	1	Motor Shaft
31B	1	Rotor Core
32	4	Screw
33	1	Outlet Box Cover
34	1	Gasket
35	4	Screw (Qty 2 on frames 254T & 256T)
36	1	Outlet Box Base
37	1	Gasket (Outlet Box Base)
38	1	Eyebolt
39	1	Wound Stator Assembly

WARNING:
Any disassembly or repair work on explosionproof motors will void the Underwriters Laboratories, Inc. label unless done by the manufacturer, or a facility approved by the Underwriters Laboratories, Inc. Refer to your nearest sales office for assistance.

BEARINGS:
Refer to motor nameplate for the bearing numbers.

PRICES:
Parts stocking distributors: refer to renewal parts numerical index. All Others: refer to your nearest parts distributor.

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AEGIS® BEARING PROTECTION RINGS

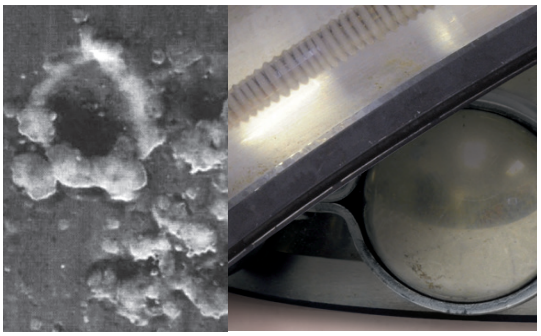
Protecting VFD-Driven Motors:

Bearing Protection Best Practices

VFD-Driven Motors Can Fail From Destructive Bearing Currents - Costing Downtime and Lost Production

Motors operated by variable frequency drives (VFD) are vulnerable to premature bearing failure from VFD induced shaft voltages and bearing currents – sometimes within only weeks or months – and the result is costly down time and production interruptions.

VFDs induce destructive shaft voltages and high frequency currents which will cause electrical discharge machining (EDM) pitting, fusion craters, and fluting damage to the motor's bearings and deteriorate the bearing lubrication by allowing electrical arcing to burn the grease.

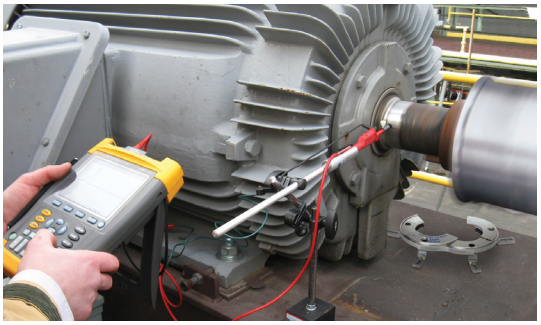


EDM Pitting and Fluting

Cost Avoidance - Follow Best Practices to Ensure Uptime and Reliability

Motor repair best practices will provide bearing protection from these destructive bearing currents by adding AEGIS® Shaft Grounding Ring Technology and when needed insulating a bearing to prevent high frequency circulating currents.

- Motors up to 100 HP - Add AEGIS® Shaft Grounding Ring to discharge shaft voltages to ground.
- Motors over 100 HP - Add AEGIS® Rings by one bearing and insulate the opposite bearing.

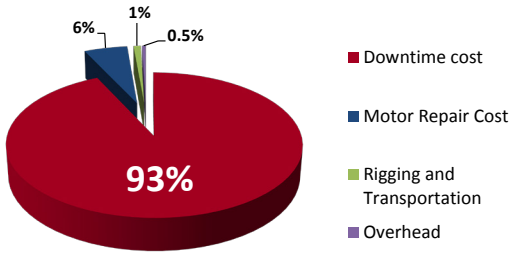


AEGIS® Shaft Voltage Testing

Detailed recommendations are contained in the AEGIS® Shaft Grounding Ring Motor Repair Handbook - an essential reference available upon request at www.est-aegis.com/bearing

Solution: AEGIS® Bearing Protection Rings

Motor Bearings are the Most Vulnerable Parts- Cost of a Failed Motor Adds Up Quickly



The return on investment in repairing motors and following the AEGIS® Shaft Grounding Ring Motor Repair Handbook's best practices recommendations will pay dividends day after day and ensure the most reliable repair to the motor.

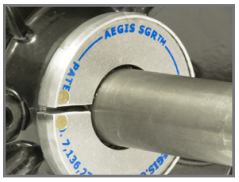
AEGIS® uKIT

Mounting Options

AEGIS® BEARING PROTECTION RINGS

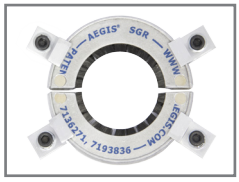
Patented Technology

uKIT - SGR with Universal Mounting Brackets
Sized for NEMA and IEC Frame motors
Solid and Split Ring
Install with screws or conductive epoxy
4 different bracket sizes



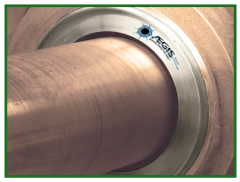
Conductive Epoxy Mounting (-0AW, -0A4W)
Shaft diameters: 0.311" to 6.02"
Solid and Split Ring
Conductive Epoxy Included

Standard Mounting Brackets (-1)
Shaft diameters: 0.311" to 6.02"
Mounting clips, 6-32 x 1/4" cap screws and washers

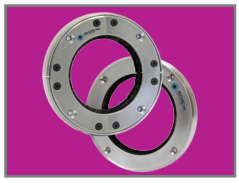


Split Ring (-1A4)
Shaft diameter: 0.311" to 6.02"
4 to 6 mounting brackets, 6-32 x 1/4" cap screws and washers
Installs without decoupling motor

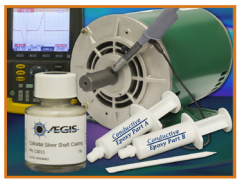
Bolt Through Mounting (-3FH)
Shaft diameters: 0.311" to 6.02"
6-32 x 1/2" flat head screws
2 mounting holes up to shaft size 3.395"
4 mounting holes for larger sizes



Press Fit Mounting
Shaft diameters: 0.311" to 6.02"
Clean dry 0.004" press fit
Press into motor end bracket or bearing cap

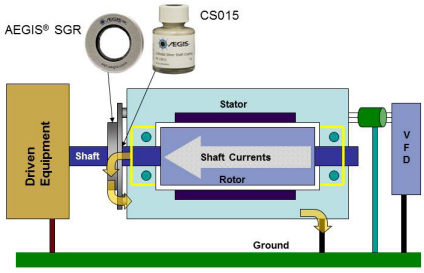


Large SGR, iPRO, WTG
Large Rings over 6.02"
iPRO for Medium Voltage Motors
WTG for Wind Turbine Generators



Accessories
SVP - AEGIS® Shaft Voltage Probe
CS015 - AEGIS® Colloidal Silver Shaft Coating
EP2400 - AEGIS® Conductive Epoxy

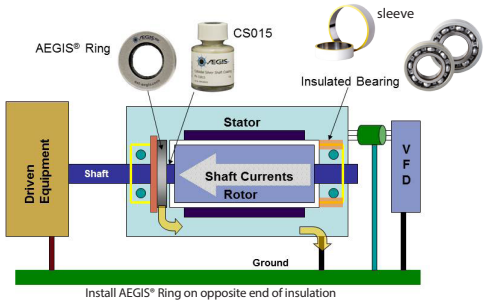
Motors up to and including 100 HP (75 kW) Low Voltage



- Install one AEGIS® SGR Bearing Protection Ring on either the drive end or the non-drive end of the motor.
- AEGIS® SGR may be installed either internally or externally.
- Use AEGIS® Colloidal Silver Shaft Coating (PN# CS015) on motor shaft where fibers touch.

***Product recommendation:* AEGIS® SGR**

Motors Greater than 100 HP (75 kW)



Install AEGIS® Ring on opposite end of insulation

- Non-Drive end: Bearing housing must be isolated with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.
- Drive end: Install one AEGIS® Bearing Protection Ring.
- AEGIS® Ring can be installed internally on the back of the bearing cap or externally on the motor end bracket.
- Use AEGIS® Colloidal Silver Shaft Coating (PN# CS015) on motor shaft where fibers touch.

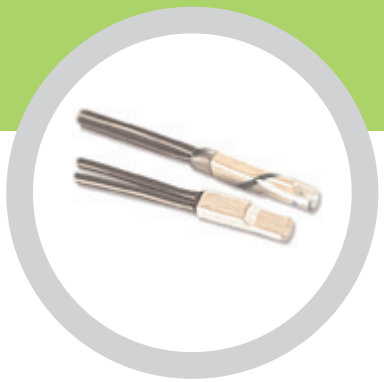
Product recommendation:

- **Low Voltage Motors up to 500HP: AEGIS® SGR**
- **Low Voltage Motors over 500HP: AEGIS®iPRO**
- **Medium Voltage Motors: AEGIS® iPRO**

For more recommendations, download the AEGIS® Handbook from our website.
www.est-aegis.com/bearing

© 2015 Form 105-7

Sensata Technologies



9700

Thermal Protector for Motor/Fluorescent ballasts and Temperature Sensing Controls

KEY BENEFITS

Miniature size-compact design assures ease of installation

Precision Calibration-temperature calibrated and inspected in controlled ambients for dependable consistent performace

Snapaction-positive make and break assured with proven Klixon® strip disc...contact pressure at open temperature eliminates nuisance trips due to vibration

Sealed steel case-withstands impregnation and baking...maybe varnish dipped...prevents changes in calibration during installation

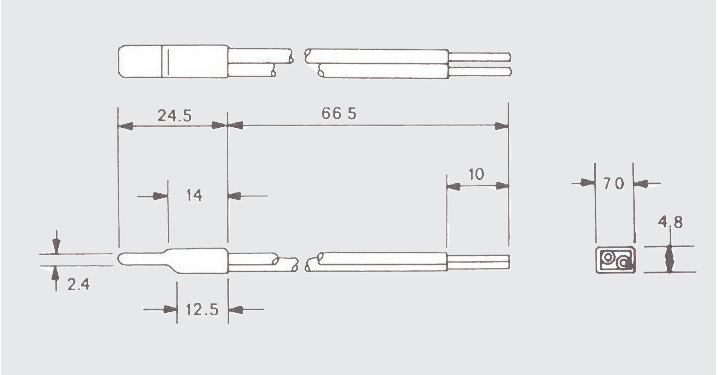
The Klixon® 9700 protector is a field proven miniature protector developed to protect shaded pole and permanent split capacitor motors, fluorescent ballasts, solenoids, transformers and other electrical equipment against overheating.

In addition to being small and lightweight, the unit is both temperature and current sensitive. Since the 9700 is sealed to withstand varnish dipping, it can be mounted directly in windings where it can best sense the true temperature of the electrical equipment. As a result, over-temperature protection is assured.

Since the case is not electrically insulated, the protector is furnished with a durable Mylar insulating sleeve. Shrinkable and non-shrinkable sleeves are available.

Technical Characteristics

Purpose of control:	thermal motor protector (TMP) thermal ballast protector (TBP) thermal cut-out (TCO)
Contact capacity:	250VAC 13A for TCO 250VAC 2A for TBP
Temperature range:	60°C to 150°C for TCO and TMP 60°C to 135°C for TBP
Tolerance on Open temp:	+/- 5K or +/- 8K
Automatic action:	Type 3C for TMP Type 2C for TBP and TCO
Operating time:	Continuous
Pollution situation:	Normal
Extent of sensing element:	Whole control
PTI of the insulation:	175
Enclosure protection degree:	IP00



Sensata Technologies

9700 X X YY - ZZZZ

Z : Wire Lead and sleeve
Serial number is assigned for each lead and sleeve configuration, i.e. wire type, length, AWG#, stripped length, sleeve type, and length.

Y : Operating temperature and actuation disc material
Serial number is assigned for each desired temperature and resistance rating.

Nominal operating temperature	Resistance of actuation disc (ohms/cmf)				
	30	250	850	100	475
	Temperature code				
60	56	57	58	59	60
80	91	92	93	94	95
90	21	22	23	24	25
100	26	27	28	29	30
110	36	37	38	39	40
120	1	2	3	4	5
130	11	12	13	14	15
140	66	67	68	69	70
150	46	47	48	49	50

This is a typical temperature code. There is a temperature code at each 5℃ in a step from 60 to 150℃.

X : Open Temperature tolerance
: +/- 5K
2: +/- 8K

X : Contact material combination

Code	Stationaly contact	Movable contact
L	Steel + Fine silver	Steel + copper + Silver Cadmium oxide
K	Ag-Ni + Silver Cadmium oxide	Steel + copper + Silver Cadmium oxide
H	Brass + Fine silver	Steel + copper + Silver Cadmium oxide
P	Ag-Ni + Fine silver	Steel + Fine silver
S	Brass + Fine silver	Steel + Copper + Ag-Ni

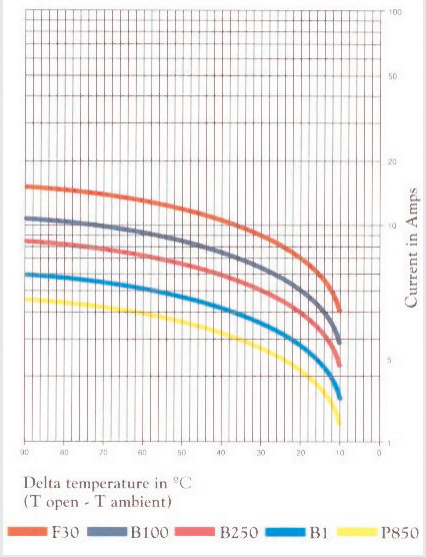
Type "S" is set up for Cadmium-free contact

9700 : Device Identification

Example :
9700K01-215
Bimetal of 30ohms/cmf,
120°C operating temperature,
+/-5K tolerance with
AWG#18(UL3343 125℃-600V)
66.7mm length leads,
thick 0.15mm, dia. 6.9mm,
length 34mm, Mylar sleeve.

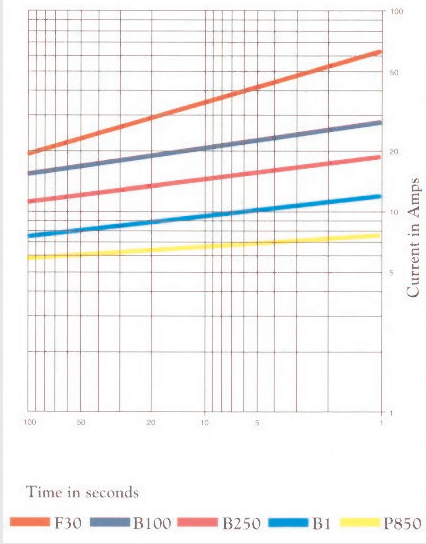
Ultimate trip current vs ambient temperature

Approx., to be used only for selecting samples for verification tests



Average first cycle tripping time vs current 25°C. ambient

Approx., to be used only for selecting samples for verification tests



Certifications

Agency	File number	Standard	Note
UL	E 15962	UL2111	Motor protector
ENEC	2014531.10	EN60730-2-9	Thermal cut-out
ENEC	2014531.10	EN60730-2-2	Thermal motor protector
ENEC	2014531.10	EN60730-2-3	Thermal ballast protector
CQC	CQC0200	2001344	

Sensata Technologies

TECHNICAL / SALES SUPPORT

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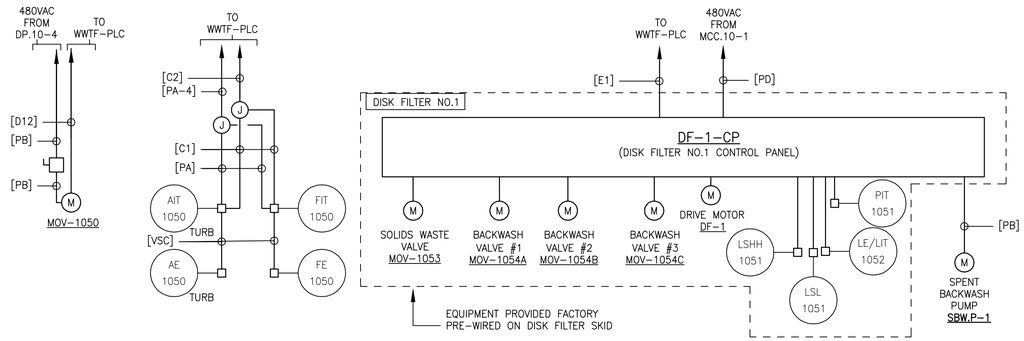
Instrumentation & Control

PROJECT:	Orleans, MA Downtown Area WWTF and Effluent Disposal	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-01	DATE:	4/7/2021
SUBMITTAL NO:	169 (11377-001-1)	REVIEWER:	A. Gates
SUBJECT:	Rotary Positive Displacement Blowers and Appurtenances Resubmittal	SPECIFICATION:	11377 – Rotary Positive Displacement Blowers and Appurtenances

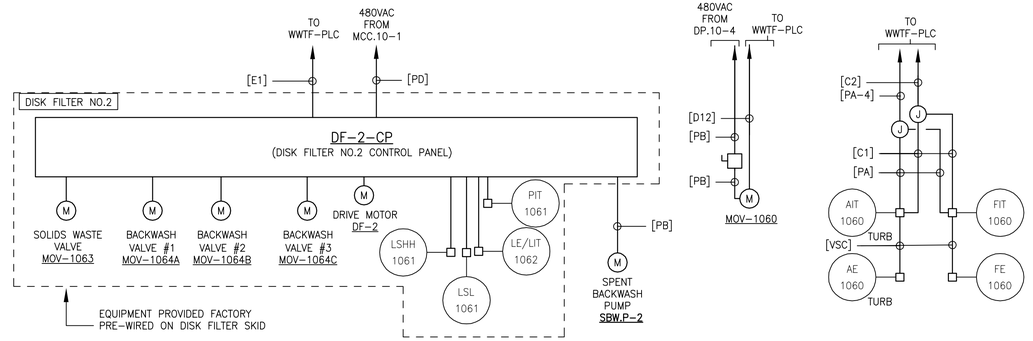
(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only
(6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.		1	No exceptions taken.
2.			
3.			
4.			
5.			
REVIEWER SIGNATURE	Gates, Austin Digitally signed by Gates, Austin DN: cn=Gates, Austin, ou=USCHL1, email=Austin.Gates@aecom.com Date: 2021.04.07 11:04:16 -04'00'		
APPROVER SIGNATURE			



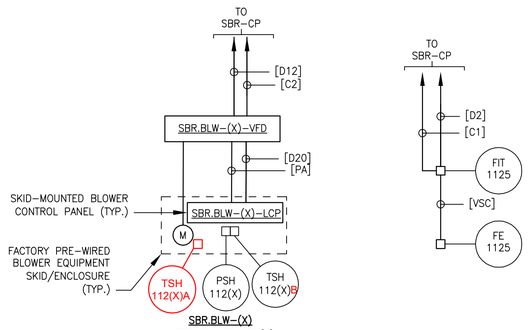
DISK FILTER NO.1 - RISER DIAGRAM



DISK FILTER NO.2 - RISER DIAGRAM

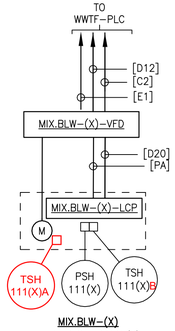
DISK FILTERS - RISER DIAGRAMS

NTS



SBR.BLW–(X)
SBR BLOWER NO.(X)

SBR BLOWER SBR.BLW–(X)	SBR BLOWER VFD SBR.BLW–(X)–VFD	LOCAL CONTROL PANEL SBR.BLW–(X)–LCP	TSH–112(X), PSH–112(X)	ESTOP HS–112(X)
SBR.BLW–1	SBR.BLW–1–VFD	SBR.BLW–1–LCP	1121	1121
SBR.BLW–2	SBR.BLW–2–VFD	SBR.BLW–2–LCP	1122	1122
SBR.BLW–3	SBR.BLW–3–VFD	SBR.BLW–3–LCP	1123	1123
SBR.BLW–4 (FUTURE)	SBR.BLW–4–VFD	SBR.BLW–4–LCP	1124	1124

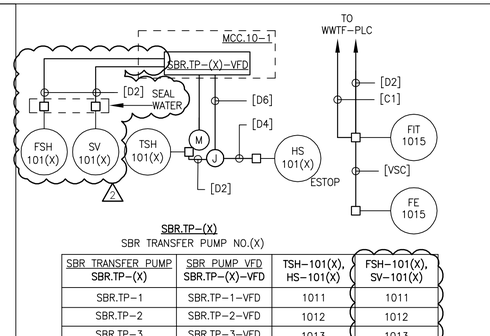


MIX.BLW–(X)
MIX BLOWER NO.(X)

MIX BLOWER MIX.BLW–(X)	MIX BLOWER VFD MIX.BLW–(X)	LOCAL CONTROL PANEL MIX.BLW–(X)–LCP	TSH–111(X), PSH–111(X)	ESTOP HS–111(X)
MIX.BLW–1	MIX.BLW–1–VFD	MIX.BLW–1–LCP	1111	1111
MIX.BLW–2	MIX.BLW–2–VFD	MIX.BLW–2–LCP	1112	1112
MIX.BLW–3	MIX.BLW–3–VFD	MIX.BLW–3–LCP	1113	1113
MIX.BLW–4	MIX.BLW–4–VFD	MIX.BLW–4–LCP	1114	1114

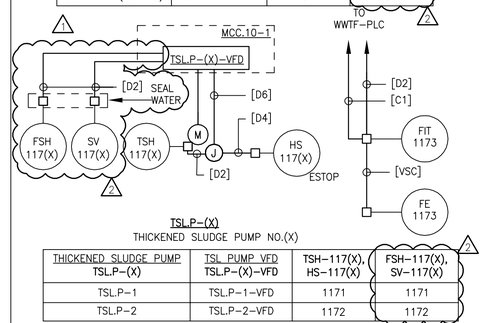
WWTF BLOWERS - RISER DIAGRAMS

NTS



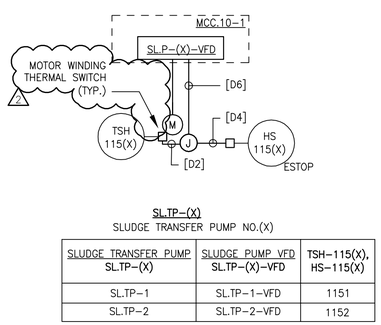
SBR.TP–(X)
SBR TRANSFER PUMP NO.(X)

SBR TRANSFER PUMP SBR.TP–(X)	SBR PUMP VFD SBR.TP–(X)–VFD	TSH–101(X), HS–101(X)	FSH–101(X), SV–101(X)
SBR.TP–1	SBR.TP–1–VFD	1011	1011
SBR.TP–2	SBR.TP–2–VFD	1012	1012
SBR.TP–3	SBR.TP–3–VFD	1013	1013
SBR.TP–4 (FUTURE)	SBR.TP–4–VFD	1014	1014



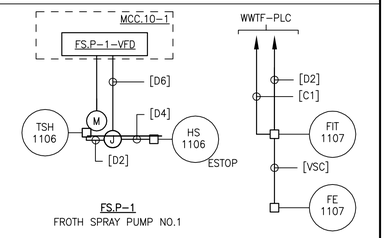
TSL.P–(X)
THICKENED SLUDGE PUMP NO.(X)

THICKENED SLUDGE PUMP TSL.P–(X)	TSL PUMP VFD TSL.P–(X)–VFD	TSH–117(X), HS–117(X)	FSH–117(X), SV–117(X)
TSL.P–1	TSL.P–1–VFD	1171	1171
TSL.P–2	TSL.P–2–VFD	1172	1172

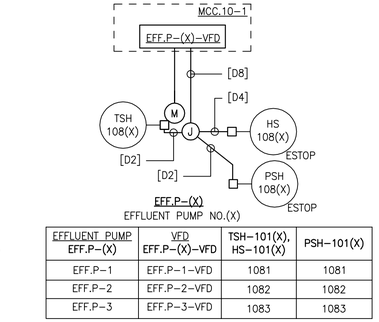


SL.TP–(X)
SLUDGE TRANSFER PUMP NO.(X)

SLUDGE TRANSFER PUMP SL.TP–(X)	SLUDGE PUMP VFD SL.TP–(X)–VFD	TSH–115(X), HS–115(X)
SL.TP–1	SL.TP–1–VFD	1151
SL.TP–2	SL.TP–2–VFD	1152

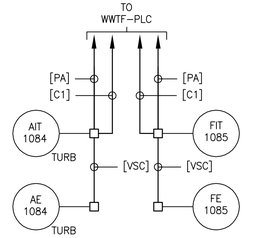


FS.P–1
FROTH SPRAY PUMP NO.1



EFF.P–(X)
EFFLUENT PUMP NO.(X)

EFFLUENT PUMP EFF.P–(X)	VFD EFF.P–(X)–VFD	TSH–101(X), HS–101(X)	PSH–101(X)
EFF.P–1	EFF.P–1–VFD	1081	1081
EFF.P–2	EFF.P–2–VFD	1082	1082
EFF.P–3	EFF.P–3–VFD	1083	1083



WWTF PUMPS - RISER DIAGRAMS

NTS

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

OWNER

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION
2	04-30-2020	ADDENDUM 9
1	03-24-2020	ADDENDUM 7

PROJECT NUMBER

60587515

Designed By:	A. ABRAHAM
Drawn By:	A. ABRAHAM
Dept Check:	Y. RIZK
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

ELECTRICAL

SHEET TITLE

WWTF - ELECTRICAL RISER DIAGRAMS IV

SHEET NUMBER

10 E-607

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\E10 E-607.DWG
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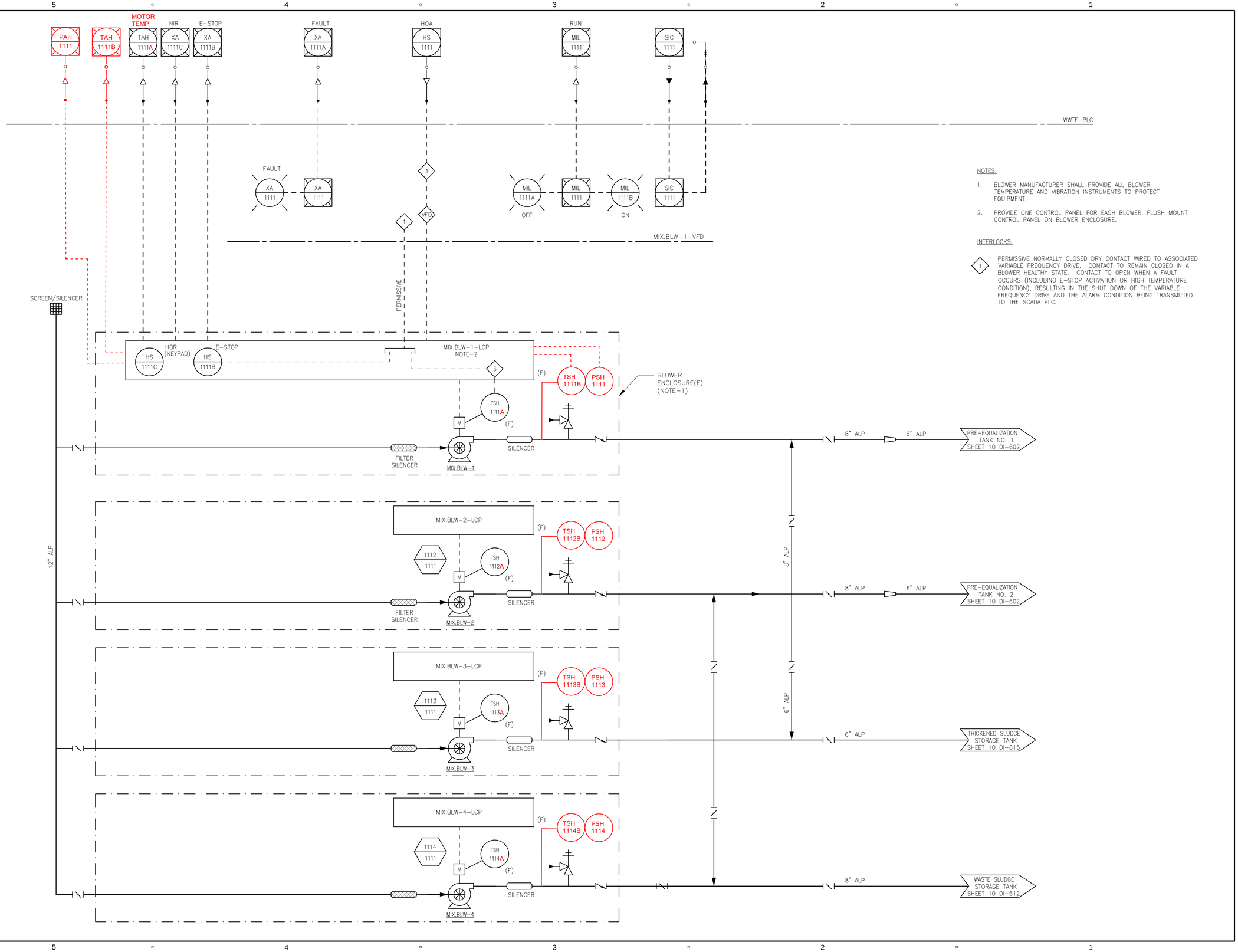
PLOT DATE: Thursday, April 30, 2020 12:08:06 PM



NOTES:

1. BLOWER MANUFACTURER SHALL PROVIDE ALL BLOWER TEMPERATURE AND VIBRATION INSTRUMENTS TO PROTECT EQUIPMENT.
2. PROVIDE ONE CONTROL PANEL FOR EACH BLOWER. FLUSH MOUNT CONTROL PANEL ON BLOWER ENCLOSURE.

INTERLOCKS:

1 PERMISSIVE NORMALLY CLOSED DRY CONTACT WIRED TO ASSOCIATED VARIABLE FREQUENCY DRIVE. CONTACT TO REMAIN CLOSED IN A BLOWER HEALTHY STATE. CONTACT TO OPEN WHEN A FAULT OCCURS (INCLUDING E-STOP ACTIVATION OR HIGH TEMPERATURE CONDITION), RESULTING IN THE SHUT DOWN OF THE VARIABLE FREQUENCY DRIVE AND THE ALARM CONDITION BEING TRANSMITTED TO THE SCADA PLC.

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

OWNER

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www.aecom.com

REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60587515

Designed By:	S. PAPAZIAN
Drawn By:	S. PAPAZIAN
Dept Check:	Y. RIZK
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

INSTRUMENTATION

SHEET TITLE

MIXING BLOWERS P&ID

SHEET NUMBER

10 DI-609

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTP\SHEETS\DI\10 DI-609.DWG
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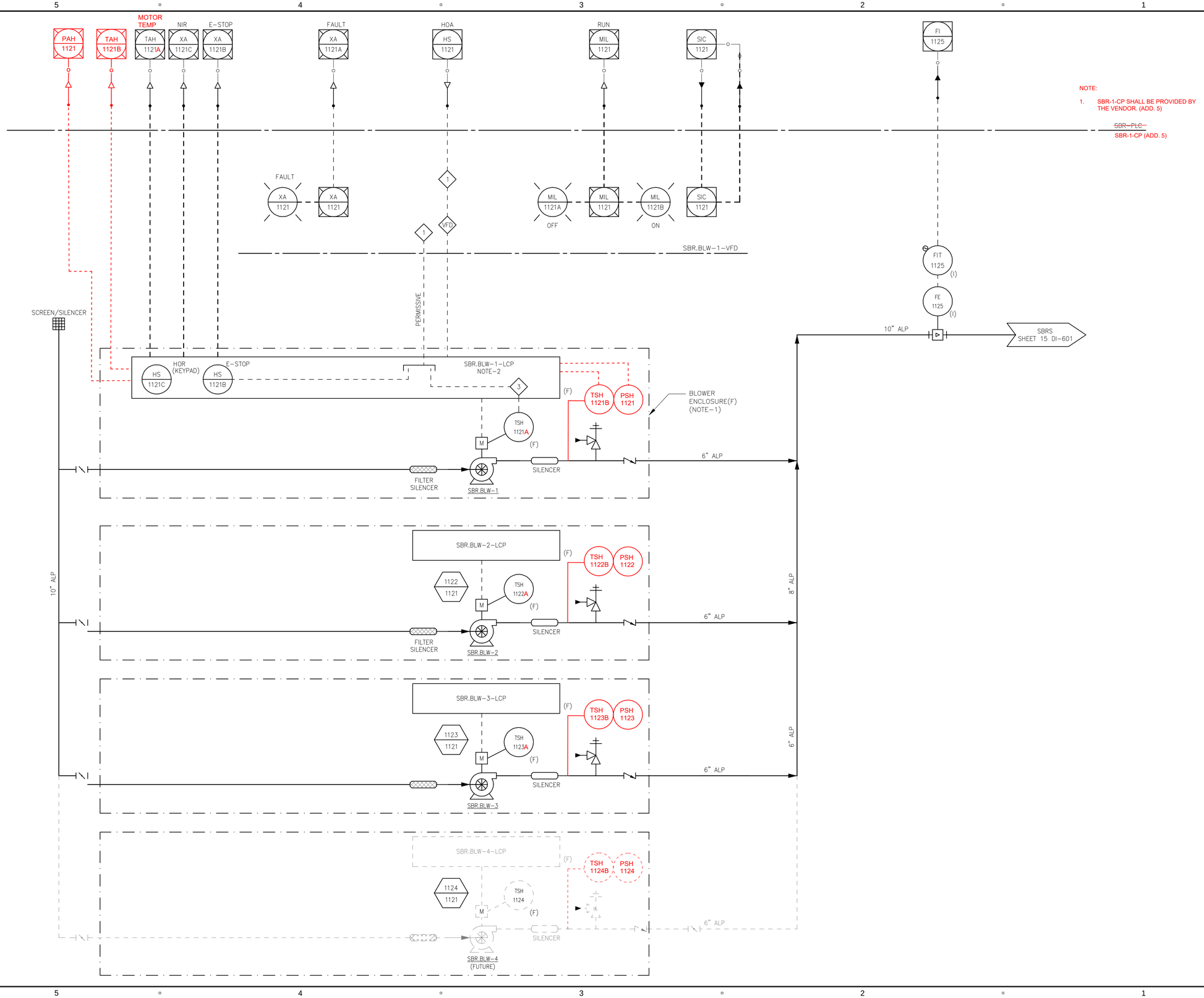
PLOT DATE: Monday, January 27, 2020 2:58:09 PM



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LAST UPDATE: Monday, January 13, 2020 10:49:53 AM
PLOT DATE: Monday, January 27, 2020 2:58:16 PM

AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

OWNER

TOWN OF ORLEANS, MA
19 SCHOOL ROAD
ORLEANS, MA 02653
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ENGINEER

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REGISTRATION

COMMONWEALTH OF MASSACHUSETTS
SARAH PAPAZIAN
INSTRUMENTATION
No.52296
REGISTERED
PROFESSIONAL ENGINEER

Jan 24 2020

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A	03-10-20	ADDENDUM 5

PROJECT NUMBER

60587515

Designed By:	S. PAPAZIAN
Drawn By:	S. PAPAZIAN
Dept Check:	Y. RIZK
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

INSTRUMENTATION

SHEET TITLE

SBR BLOWERS P&ID

SHEET NUMBER

10 DI-610

Electrical Department

PROJECT:	Orleans, MA Downtown Area WWTF and Effluent Disposal	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-01	DATE:	04/02/2021
SUBMITTAL NO:	169 (11377-001-1)	REVIEWER:	A.Abraham
SUBJECT:	Rotary Positive Displacement Blowers and Appurtenances	SPECIFICATION:	11377, 01171

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only (6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	11377 1.04.C	1	~~Submit a copy of the contract mechanical process, electrical and instrumentation drawings applicable to equipment in this section, marked to show all changes necessary for the equipment proposed specification section 11377. If no changes are required, mark all drawings with "No changes required" in accordance with specification requirements.~~ Response: P&ID pages, with comments are attached. AECOM Response: No exceptions taken.
2.	ESTOP	1	~~Provide blower control panels with Estop pushbuttons as shown on P&IDs 10 DI-609 and 10 DI-610.~~ Response: See updated E-stop drawing in Section 4. AECOM Response: No exceptions taken.
REVIEWER SIGNATURE			
APPROVER SIGNATURE	Andrea Abraham		

Mechanical Process Group

PROJECT:	Orleans, MA Downtown Area WWTF and Effluent Disposal	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-01	DATE:	3/25/2021
SUBMITTAL NO:	169 (11377-001-1)	REVIEWER:	CM/CG
SUBJECT:	Rotary Positive Displacement Blowers and Appurtenances Resubmittal	SPECIFICATION:	11377 – Rotary Positive Displacement Blowers and Appurtenances

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only
(6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.		1	No exceptions taken.
REVIEWER SIGNATURE	Mini, Christopher — Mini, Christopher cn=Mini, Christopher, ou=USCHL1, email=Christopher.Mini@aecom.com		
APPROVER SIGNATURE	Galligan, Chris — Digitally signed by Galligan, Chris DN: cn=Galligan, Chris, ou=USCHL1, email=Chris.Galligan@aecom.com Date: 2021.03.24 14:07:06 -04'00'		

Town of Orleans, MA
Downtown Area WWTF and Effluent Disposal
Contract No. 2019-01 SRF No. 4486

Contractor Certification Stamp

Submittal No. 11377-001-1 Submittal Title: Rotary Positive Displacement Blowers

Drawing No N/A Spec. Paragraph: _____

Deviations: N/A

Contractor – Daniel O'Connell's Sons
Subcontractor/Supplier – Total Mechanical
Date of Submission – 3/18/21

Daniel O'Connell's Sons

Representation is made to Owner and Engineer that Contractor has reviewed this submittal in accordance with Section 1300, Par. 3.01 and that the Contractor herby approves this submittal.

MAC — Initials

3/18/21 — Date

Engineer's Review:

- [ ] NO EXCEPTION TAKEN
- [ ] MAKE CORRECTIONS NOTED
- [ ] AMEND AND RESUBMIT
- [ ] REJECTED; SEE REMARKS
- [ ] FOR INFORMATION ONLY
- [ ] NOT REQUIRED FOR REVIEW

_____ Reviewed by

_____ Firm

_____ Date

AERZEN USA CORPORATION
108 Independence Way * Coatesville, PA 19320
Main Phone: 610-380-0244 * Fax: 610-380-0278

Letter of Transmittal

Company: **Total Mechanical Service Corporation**	**Transmittal #: 02**
	Date: 3/18/2021
Attn: **info@totalmech.net**	**PO #:** **2020-19**
Subject: **Town of Orleans**	**Job #:** **SO-20-00311**

WE ARE SENDNG YOU

☐ Letter ☐ Purchase Order ☒ Submittal ☐ O&M Manual ☐ Other

 # OF COPIES:

TRANSMITTED as checked below:

☒ For Approval
☐ For Your Use
☐ As Requested
☐ As Built
☐ Action Specified Below

Remarks:

Copy To:
Aerzen's responses to the comment are in the AECOM review page following each comment.

PROJECT MANAGER:

NAME: Karri Taggart
Tel: 484-718-3815
Email: karri.taggart@aerzenusa.com

Signed: *Karri Taggart*

AECOM

SHOP DRAWING REVIEW COMMENTS

Project Group

PROJECT:	Orleans, MA Downtown Area WWTF and Effluent Disposal	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-01	DATE:	2/8/2021
SUBMITTAL NO:	86 (11377-001)	REVIEWER:	C. Galligan
SUBJECT:	Rotary Positive Displacement Blowers and Appurtenances	SPECIFICATION:	11377 – Rotary Positive Displacement Blowers and Appurtenances

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only
(6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	Seismic Design	2	Provide seismic design documentation and Certificate of Unit Responsibility as specified in Section 2.03. AERZEN RESPONSE: Certificate of Unit Responsibility statement will be provided on the Seismic Calculations documentation.
2.	Piping Connections	5	Contractor please note the inlet and discharge piping connections of the proposed blowers are different than as drawn on the contract drawings (inlet near top, outlet near bottom), and in some cases different type (flange in lieu of sleeve) and size (5” discharge on SBR Blowers). Contractor to coordinate connections to proposed blowers. AERZEN RESPONSE: Aerzen can provide a flex sleeve vs. ANSI connection on any blowers we are supplying for this project. Additionally, Mixing Blower 3 & SBR Blower 1-3 (GM25S size) can be provided with 5” connections, if required. Changes will not be made, unless specified.
3.	Spare Parts	2	Provide 2 spare filters per blower as specified in section 3.07.B.b. AERZEN RESPONSE: 2 filters, per machine, will be provided
4.	VFD’s	5	It’s noted that the blower VFD’s are not included in this submittal.
5.	Field Performance testing	2	Contractor to provide field testing as specified in 3.08. AERZEN RESPONSE: Comment appears to apply to the Contractor. Aerzen is providing its standard field testing, as submitted
6.	Painting	2	Provide details of the proposed painting confirming that it’s equal to or better than as specified in Section 2.17. AERZEN RESPONSE: Per Section 6 of the submittal: The machine castings are fettled, cleaned and primed; the primer used is specially developed for machinery parts and is particularly notable for its excellent bonding characteristic and elasticity. Its base is a quick drying synthetic resin binder possessing a high degree of water resistance. The proportion of pigment to binder is such to ensure the best protection for the machines. Surface Preparation: Sand blasting, mechanical cleaning to near white surfaces per SA 2,5 acc. to DIN ISO 8501 or SSPC10

			Primer: Alkyd Resin: RAL 6006, Manufacturer: Relius Coatings Final Coat: Alkyd Resin: RAL 5001 (Blue), Manufacturer: Relius Coatings (BASF) or Dr. Demuth GmbH
REVIEWER SIGNATURE	Galligan, Chris	Digitally signed by Galligan, Chris N: cn=Galligan, Chris, ou=USCHL1, email=Chris.Galligan@aecom.com Date: 2021.02.19 13:30:02 -05'00'	
APPROVER SIGNATURE			

SHOP DRAWING REVIEW COMMENTS

Electrical Department

PROJECT:	Orleans, MA Downtown Area WWTF and Effluent Disposal	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-01	DATE:	02/19/2021
SUBMITTAL NO:	86 (11377-001)	REVIEWER:	A.Abraham
SUBJECT:	Rotary Positive Displacement Blowers and Appurtenances	SPECIFICATION:	11377, 01171

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only (6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	11377 1.04.C	2	Submit a copy of the contract mechanical process, electrical and instrumentation drawings applicable to equipment in this section, marked to show all changes necessary for the equipment proposed specification section 11377. If no changes are required, mark all drawings with “No changes required” in accordance with specification requirements. AERZEN RESPONSE: P&ID pages, with comments, are attached.
2.	ESTOP	2	Provide blower control panels with Estop pushbuttons as shown on P&IDs 10 DI-609 and 10 DI-610. AERZEN RESPONSE: See updated E-stop drawing in Section 4.
REVIEWER SIGNATURE			
APPROVER SIGNATURE	Abraham, Andrea		

SHOP DRAWING REVIEW COMMENTS

AECOM

Instrumentation & Control

PROJECT:	Orleans, MA Downtown Area WWTF and Effluent Disposal	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-01	DATE:	2/18/2021
SUBMITTAL NO:	86 (11377-001)	REVIEWER:	A. Gates
SUBJECT:	Rotary Positive Displacement Blowers and Appurtenances	SPECIFICATION:	11377 – Rotary Positive Displacement Blowers and Appurtenances

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only (6)-Not Required for Review

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ITEM NUMBER	REFERENCE	CODE	COMMENT
1.		1	No exceptions taken.
REVIEWER SIGNATURE	Gates, Austin	Digitally signed by Gates, Austin DN: cn=Gates, Austin, ou=USCHL1, email=Austin.Gates@aecom.com Date: 2021.02.18 19:40:49 -05'00'	
APPROVER SIGNATURE			

Town of Orleans, MA
Downtown Area WWTF and Effluent Disposal Contract
No. 2019-01 SRF No. 4486

Contractor Certification Stamp

Submittal No. Submittal Title: Rotary PD Blowers and Appurtenances 11377-001__

Drawing No 10-D-103 Spec. Paragraph: _ 1.04

Deviations: As listed in submittal

Contractor – Daniel O'Connell's Sons
Subcontractor/Supplier – Aerzen / Total Mechanical
Date of Submission – 1/6/21

Daniel O'Connell's Sons

Representation is made to Owner and Engineer that Contractor has reviewed this submittal in accordance with Section 1300, Par. 3.01 and that the Contractor herby approves this submittal.

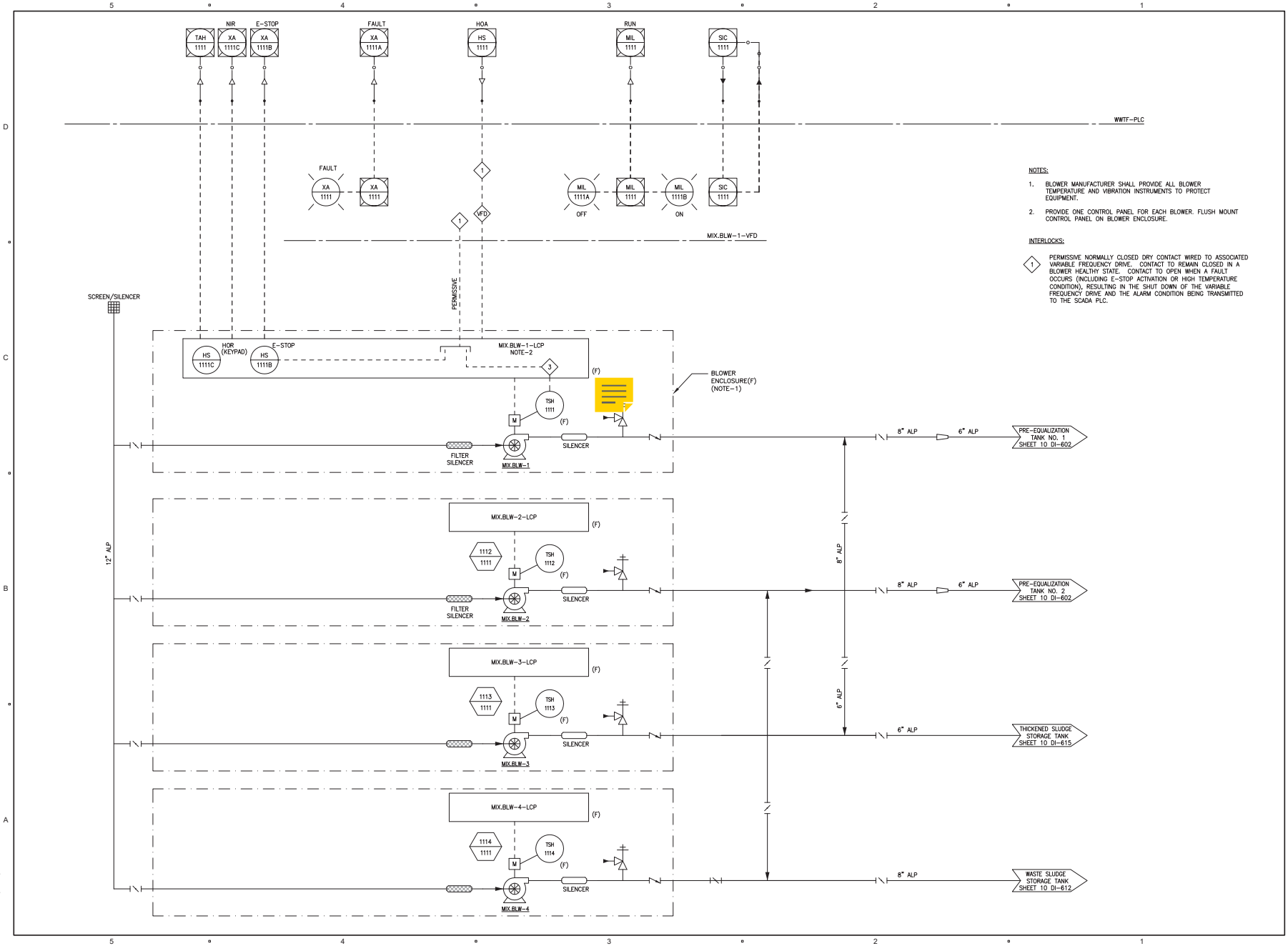
RJB 1/6/2021

Initials Date

Engineer's Review:

	NO EXCEPTION TAKEN
	MAKE CORRECTIONS NOTED
	AMEND AND RESUBMIT
	REJECTED; SEE REMARKS
	FOR INFORMATION ONLY
	NOT REQUIRED FOR REVIEW

Reviewed by Firm Date



NOTES:

1. BLOWER MANUFACTURER SHALL PROVIDE ALL BLOWER TEMPERATURE AND VIBRATION INSTRUMENTS TO PROTECT EQUIPMENT.
2. PROVIDE ONE CONTROL PANEL FOR EACH BLOWER. FLUSH MOUNT CONTROL PANEL ON BLOWER ENCLOSURE.

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AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

OWNER

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19 SCHOOL ROAD
ORLEANS, MA 02653
(508) 240-3700

ENGINEER

AECOM TECHNICAL SERVICES, INC.
9 JONATHAN BOURNE DRIVE
POCASSET, MA 02559
PHONE: (508) 833-6950
www.aecom.com

REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60587515

Designed By:	S. PAPAZIAN
Drawn By:	S. PAPAZIAN
Dept Check:	Y. RIZK
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

INSTRUMENTATION

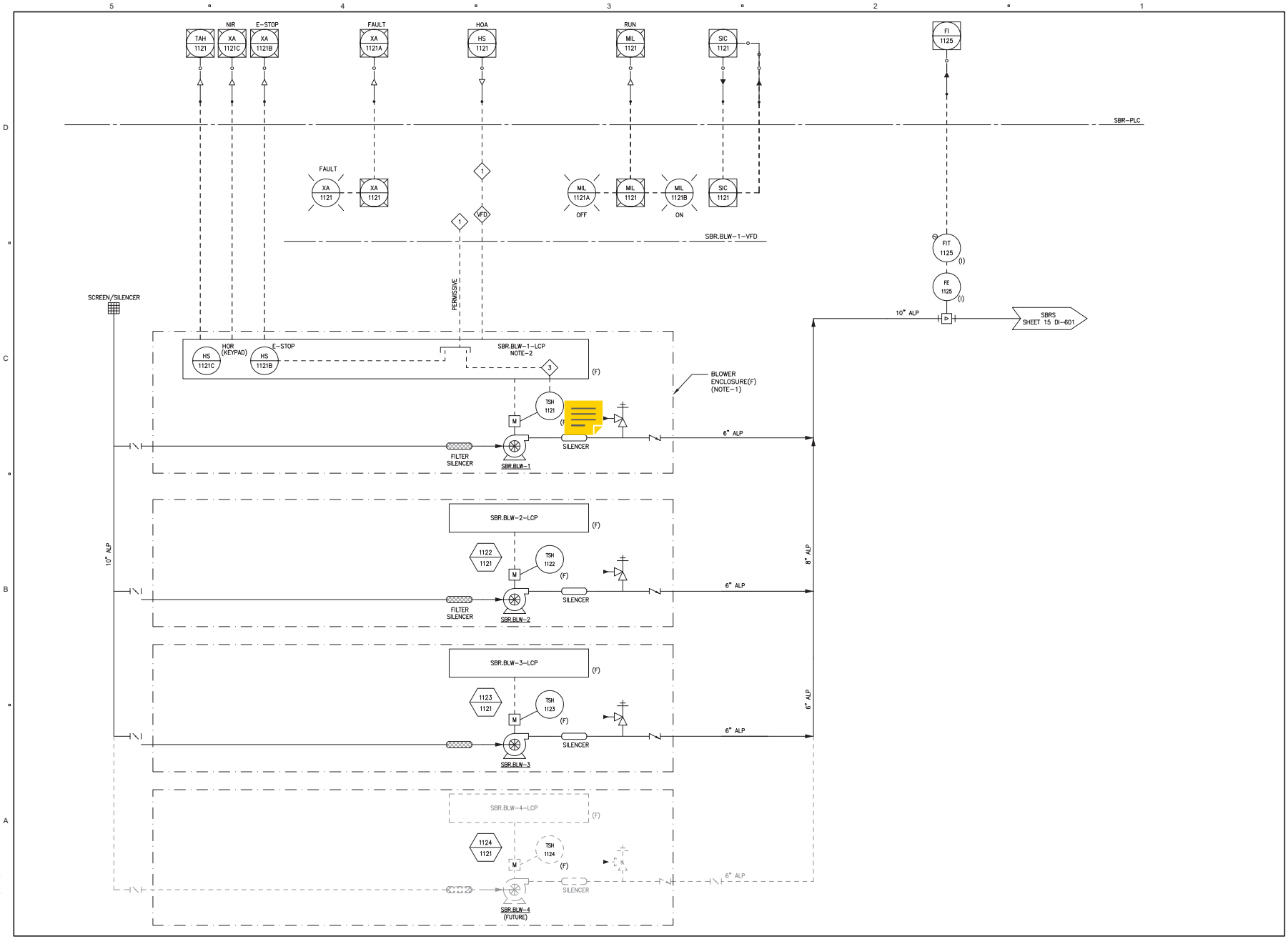
SHEET TITLE

MIXING BLOWERS P&ID

SHEET NUMBER

10 DI-609

PATH/FILENAME: P:\60587515 - ORLEANS\DOWNTOWN AREA WWTF\SHEETS\2020\10 DI-609.DWG
LAST UPDATE: Friday, January 24, 2020 4:37:13 PM
PLOT DATE: Monday, January 27, 2020 2:58:09 PM



AECOM

PROJECT

DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL

CONTRACT No. 2019-1
SRF No. 4486

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TOWN OF ORLEANS, MA

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www.aecom.com

REGISTRATION

SARAH PAPAZIAN
INSTRUMENTATION
No.52296
REGISTERED
PROFESSIONAL ENGINEER
COMMONWEALTH OF MASSACHUSETTS

Jan 24 2020

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER

60587515

Designed By:	S. PAPAZIAN
Drawn By:	S. PAPAZIAN
Dept Check:	Y. RIZK
Proj Check:	T. PARECE
Date:	JANUARY 2020
Scale:	AS NOTED

DISCIPLINE

INSTRUMENTATION

SHEET TITLE

SBR BLOWERS P&ID

SHEET NUMBER

10 DI-610

PATH/FILENAME: P:\60587515 - ORLEANS DOWNTOWN AREA WWTF\SHEETS\DI\10 DI-610.DWG
LAST UPDATE: Monday, January 13, 2020 10:49:53 AM
PLOT DATE: Monday, January 27, 2020 2:58:16 PM

Letter of Clarification/Exception

Project: Downtown Area WWTF and Effluent Disposal
Town of Orleans

January 5, 2021

Compressed air, gas
and vacuum solutions

Aerzen USA
108 Independence Way
Coatesville, PA 19320 USA

Telephone: (610) 380-0244
Fax: (610) 380-0278
USA-Inquiries@aerzen.com
www.aerzen.com/en-us

Section 01171 – Electric Motors

2.03.E.3 Motors shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.
This is typically not a requirement for low voltage, small HP motors and would be a more applicable requirement of medium voltage motors. The motors will also be located indoors which further decreases the need for this type of insulation. Aerzen is supplying their standard motor with insulation per Section 11377 part 2.16.K.

Section 01900 – Seismic and Wind Requirements

1.08.B Wind design shall conform to the International Building Code and ASCE/SEI 7.
Considering the blower packages will be located inside, Aerzen is providing its standard package/sound enclosure that is rated for a wind load of 40 mph.

Section 11377 – Rotary Positive Displacement Blowers

1.04.B.10 Bearing temperature operating range for the service conditions specified.
Aerzen does not collect bearing temperature operating range data. Aerzen has provided the blower discharge temperature for the service conditions, specified. Refer to Section 1 of your blower submittal package.

1.07.F.1.a Variable frequency motor controllers can be supplied by the Contractor or the blower manufacturer at the Contractor's option.
Supplied by Contractor.

1.07.K For variable speed blowers systems the blower manufacturer must perform an analysis of the combined motor and blower assembly for resonant frequency or their harmonics independent of a structure.
Aerzen cannot provide this service, nor will Aerzen be liable for harmonic analysis/mitigation because the VFD is not supplied by Aerzen.

1.07.H.4 Field performance testing
See comment pertaining to part 3.08.C regarding performance testing.

2.01.D.1 Upper noise levels with intake and discharge silencers not to exceed the chart in spec.
Aerzen is providing its standard inlet/discharge silencers which are integral to the blower package. Combined with the sound enclosure, the package's sound is reduced to 75 dBA 3' away, in free field conditions.

2.01.D.2 Noise level in the room with three blowers running at maximum conditions not to exceed 97 dBA.
Aerzen is guaranteeing a noise level of 75 dBA, 3' away, in free field conditions. Installed noise levels cannot be guaranteed, as there are factors in the field (i.e. external piping configuration, facility layout, other machinery running…etc) that will contribute to increased sound levels that are out of Aerzen's scope of supply.

2.04.F.4 Provide bearings with minimum L-10 or B-10 life rating of 100,000 hours at specified operating conditions.
For SBR blowers, Aerzen is providing a blower with a theoretical bearing life of 10 years. This will likely be much more than 100,000 hours because the blower will not be running at the design conditions 100% of the time.

2.06.B Provide Solberg external intake filter/silencer.
For 8" and larger external intake filter/silencers, Aerzen recommends a filter/silencer by Endustra. Therefore Aerzen is providing an Endustra external intake filter silencer.

2.08.B The discharge silencer shall be designed to reduce the noise emitted by the piping leaving the blower package to 85 dBA.
See comment 2.01.D.1.

2.10.C Provide type 316L SS flap.
Aerzen is providing a steel check valve flap embedded in EPDM.

2.13.D.3 & 4 Provide inlet/discharge manometer and inlet/discharge temperature gauge.
Aerzen is providing its standard set of 4" inlet pressure gauge, discharge pressure gauge and discharge temperature gauge integrated into the sound enclosure.

2.16.E Provide bearings with a minimum B-10 life of 50,000 hours.
Aerzen is providing its standard motor that has a B-10 life of 20,000 hours. However, with proper routine maintenance these motors with last up to 135,000 hours.

2.16.F Overall sound pressure level of each motor shall not exceed 88 dBA when measured on flat network using an octave band frequency analyzer conforming to ANSI S1.11.
The motor is contained within the package's sound enclosure, Aerzen is guaranteeing a free field sound level of 75 dBA of the overall blower package, including the motor. Aerzen cannot provide a sound pressure level reading of the motor with an octave band frequency analyzer.

2.17.A Provide shop painting in accordance with Section 09940, Shop Painting.
Aerzen is providing its standard paint system on the blower package which is in line with industry best practice.

2.18.B Blower testing

Aerzen is providing ISO-1217, Annex B testing on the blower stage only, to verify flow and brake horsepower at blower max conditions. Should any deficiencies be found during this test, corrections will be made prior to releasing each blower stage for shipment. The blower stage test results will be provided. A fully assembled package 60 minute run test will not be provided as there is little value added by this test. All blowers will be run tested in the field during startup to ensure that the packages are operating within their allowable tolerances. Aerzen will also provide noise test results in accordance with ISO-2151.

3.08.C After installation of blower assemblies, and after inspection, operation, testing and adjustment have been completed by the manufacturer's field service technician, conduct running test for each blower in presence of the Engineer to determine its ability to operate within the vibration and temperature limits specified, and to deliver its rated capacity under specified conditions.

It is Aerzen's interpretation of the spec that Aerzen's standard field test procedures are acceptable and that the contractor is responsible for performing the additional testing procedures as outlined in the sub-sections of this part (3.08.C.1 thru 5). Field performance test results should not be compared to the ISO-1217 factory test results, as site conditions will yield inaccurate test results.

Drawings

Drawing 00 D-004

The motor sizes for MIX.BLW-1, 2/MIX.BLW-3/MIX.BLW-4 appear to be sized for the blower design conditions in the 90% design spec. The design parameters for the blowers stated in this drawing have a higher bHP requirement than the motors called out by this drawing. Therefore, Aerzen has sized the motors according to the bHP requirement.

Submittal

Positive Displacement Blowers
Town of Orleans
Spec Section

Contractor
Total Mechanical Service Corporation
One Park Place
Plymouth, MA 02360
508-746-1183 (tel)

Local Representative
Aqua Solutions
59 Locke Street
Watertown, MA 02472
617-923-3900 (tel)
617/249-0634 (fax)

Manufacturer/Service/ Parts
Aerzen USA Corp.
108 Independence Way
Coatesville, PA 19320
800-444-1692 (tel)
610-380-0278 (fax)
www.aerzen.com/en-us

Aerzen USA Project:
SO-20-00311

Customer:
Total Mechanical Service Corporation

Purchase Order No.
2020-19

Project:
Town of Orleans

SECTION 1
Section 1a – MIX.BLW-1, 2
- Performance Data
- Bill of Material
- General Arrangement Drawing

Section 1b – MIX.BLW-3
- Performance Data
- Bill of Material
- General Arrangement Drawing

Section 1c – MIX.BLW-4
- Performance Data
- Bill of Material
- General Arrangement Drawing

Section 1d – SBR.BLW-1 to 3
- Performance Data
- Bill of Material
- General Arrangement Drawing

Performance Data
Bill of Material
General Arrangement Drawing
Performance Curves
Test Reports
Declaration of Conformity

SECTION 2
Blower Literature

SECTION 3
Blower Package Accessories

SECTION 4
Instrumentation and/or Controls

SECTION 5
Motor Data

SECTION 6
Corrosion Protection / Paint Spec

SECTION 7
Startup Report

SECTION 8
Seismic Calcs

SECTION 1

SECTION 1a

MIX.BLW-1, 2

AERZEN	**Aerzen USA Corporation** 108 Independence Way, Coatesville, PA 19320 Tel: (610) 380-0244 Fax: (610) 380-0278 website www.USA-Inquiries@aerzen.com	**Job Specific Data Package**		
		DATE	**Aerzen Job #**	**Page**
		9-Nov-20	SO-20-00311	1 of 3
		Revision Letter		-

CUSTOMER INFORMATION

CUSTOMER	Total Mechanical Services
CUSTOMER PO #	2020-19
PROJECT NAME	Downtown Area WWTF

PACKAGE DESCRIPTION

EQUIPMENT IDENTIFICATION	MIX.BLW-1, 2		**SERIAL NUMBERS**
BLOWER MODEL #	GM 035S-00	QTY. (2)	
PACKAGE DESCRIPTION	Pressure Unit w/ Enclosure		
DISCHARGE CONNECTION TYPE	150# ANSI Discharge Connection		
INLET CONNECTION TYPE	Sleeve Inlet Connection		
MOTOR CONDUIT LOCATION	F3 Conduit Box		
TOTAL PACKAGE WEIGHT	3239 lbs		

DOCUMENTATION

GENERAL ARRANGEMENT DRAWING	GB-006954-20-00311_MIX.BLW1.2.4
MOTOR CABLE ROUTING	IA-004545
OPERATIONS & MAINTENANCE MANUAL	G4-006
WARRANTY TERMS & CONDITIONS	A2-001-USA

PERFORMANCE DATA

MEDIUM		AIR	
INLET CAPACITY	*ICFM*	1146	287
INLET CAPACITY	*SCFM*	1019	255
INLET PRESSURE	*PSIA*	14.5	14.5
DISCHARGE PRESSURE	*PSIG*	8	8
INLET TEMPERATURE	*°F*	100	100
DISCHARGE TEMPERATURE	*°F*	199	231
NOMINAL BLOWER SPEED	*RPM*	3230	1077
POWER @ BLOWER SHAFT	*BHP*	52.3	15.7
MOTOR RATING	*HP*	60	60
MOTOR SPEED	*RPM*	1780	594
SOUND PRESSURE LEVEL *	*dB(A)*	69	0
MOTOR/VFD SPEED	*Hz*	60	20

* measured in free field at 3 foot distance from the outline of the unit (tol. +/- 2 dB(A))

Tolerance on Power & Flow is +/- 5%

CRITICAL INFORMATION / NOTES

1 PRIOR TO SHIPMENT - AERZEN DOES THE FOLLOWING
Removes V-Belts from the motor sheave and wraps them around the blower sheave
Locks the motor hinge plate
Always refer to the operations manual for determining the most suitable lubricant.
Operating and ambient conditions may impact which lubricant to use.

2 UPON ARRIVAL
Immediately remove stretch wrap from package when storred outdoors

3 LIFTING PACKAGE
Without Sound Enclosure: lifting eye holes in the corner of the base frame
With Sound Enclosure: lifting through slots in base with fork lift

4 READ OPERATION MANUAL FOR INSTALLATION INSTRUCTIONS
Call Aerzen After-Sales / Service if you have any questions

5 AT COMMISSIONING - CUSTOMER / CONTRACTOR IS TO
Check oil level (refer to operations manual) - and adjust if necessary
Anchor the base or sound enclosure
Make grounding connections
Connect motor cable per Aerzen Drawing IA-004545
Verify correct rotation of motor (counter-clockwise, looking at drive shaft)
Remove locking device from motor pivot plate
Reinstall V-belts

6 **ALL CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED**

7 Recommended MINIMUM clearance at front and rear of package for "normal"
(i.e. inspect machine, change oil, replace belts, etc.) maintenance is 32 inches.

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Job Specific Data Package

Date	Aerzen Job #	Page
2021-01-04	SO-20-00311	

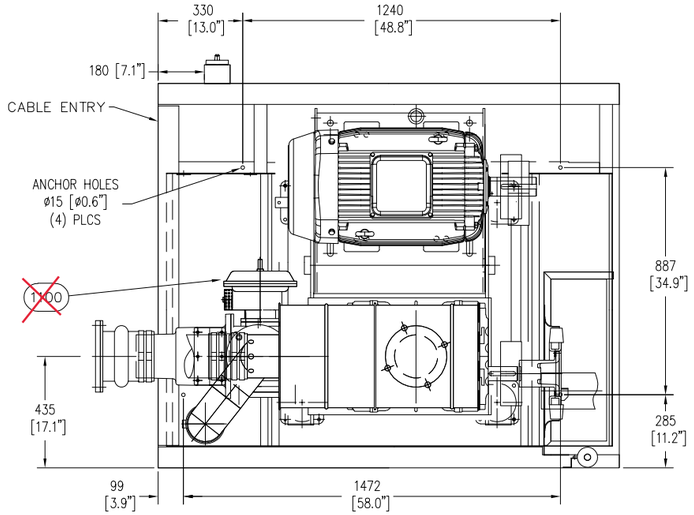
BILL OF MATERIAL FOR

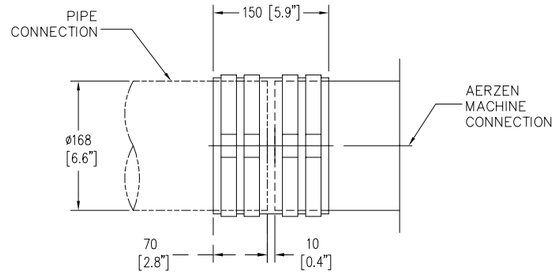
ITEM #	QTY	DESCRIPTION	PART #
100	1	Base Torso, Delta Blower GM35S, DN150 Over-pressure applications	21-G5-A035150P
110	1	Safety Relief Valve for DN150, set at 750 mbar	21-G5-PRV150
200	1	Sound Enclosure DN150, Pressure for F3 Electric Motors	21-G5-SE3150
310	1	Motor Mounting, DN150 for Motor Sizes 324/6 thru 364	21-G5-MM150
320	1	Belt Drive Set for DN150	21-G5-BELTDRIVE
400	1	Belt Guard DN150 with F3 Sound Encl.	21-G5-BGS3150
500	1	Cooling Fan, 3000-4000 rpm for DN150 Shaft-Driven Max Speed (VFD) 3800 - 4600 rpm	21-G5-SCF150-035
600	1	Process Connection, Discharge Sleeve to Flange, 6" ANSI 150# for DN150	21-G5-CD150-01
700	1	Process Connection, Inlet Rubber Sleeve for 6" Pipe for DN150	21-G5-CI150-00
800	1	Instrumentation Package Package No. 07 for Delta Blower 4.0" Dial Gauges, for units with Sound Encl.	21-G5-IM-PS07-4001
1000	1	Control Panel Mounted to Sound Encl.	21-004503
300	1	Electric Motor 60 HP, 4 Pole (1800 RPM), 364T 208-230/460V, 3ph, 60 Hz, F3 Conduit Mods: Klixons, Aegis, & Insulated Bearings WEG W22 (ARZ-180074000)	21-MTR-WG4-060BD305

Ship Loose & Spares		
1	Endustra P09, 12" w/ SS wire mesh element	21-008039
4	Air filters (2 per unit)	175241000
2	Gaskets & seal sets (1 per unit)	180687000
2	Bearing sets (1 per unit)	180690001

ITEM	QTY	DESCRIPTION	DESCRIPTION 2
100	1	BLOWER TORSO	GM35S, DN150
110	1	PRESSURE RELIEF VALVE	
200	1	SOUND ENCLOSURE	
300	1	ELECTRIC MOTOR	SHOWN WITH A 400 NEMA MOTOR
310	1	MOTOR MOUNTING	
320	1	BELT DRIVE	
400	1	BELT GUARD	
500	1	COOLING FAN	
600	1	DISCHARGE CONNECTION	6"-150# ANSI
800	1	INSTRUMENTATION	
900	1	LOCAL CONTROL PANEL	
~~1100~~	~~1~~	~~UNLOADING VALVE~~	~~(OPTIONAL)~~

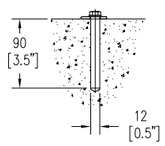
PLAN VIEW





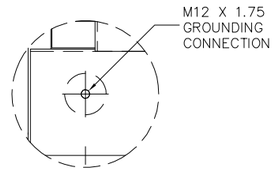
DETAIL Z

SLEEVE CONNECTION
CUSTOMER PIPE ENGAGEMENT
LEAVES 10 [0.4"] GAP
3X SCALE



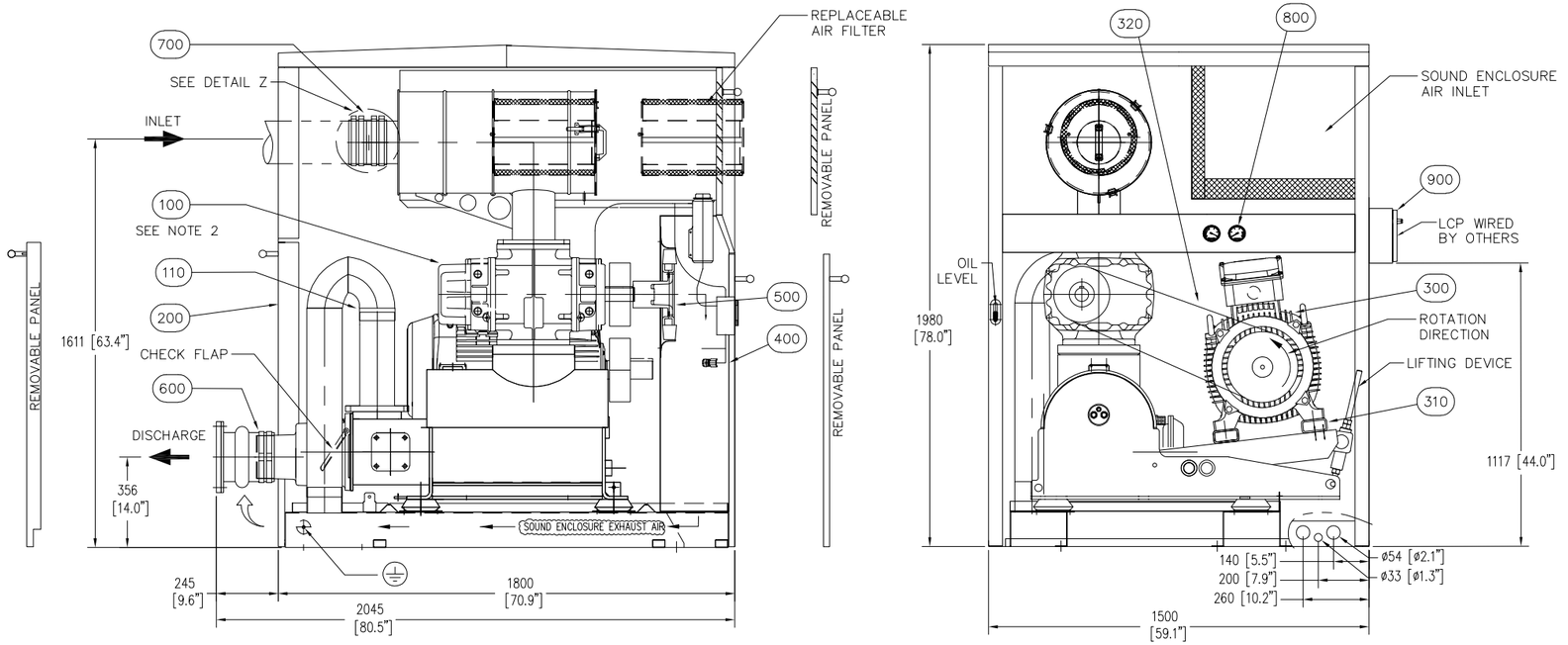
SOUND ENCLOSURE ANCHOR

RECOMMENDATION
SHOW WITH OPTIONAL ANCHOR
AERZEN PART NO. 2000053552
3X SCALE



EARTH GROUND

MAT'L: 304 SS
3X SCALE



FRONT VIEW

NOTES:

1. TOLERANCE ON DIMENSIONS = ±12mm [0.5"]
2. ITEM 100 (BLOWER TORSO) INCLUDES BLOWER STAGE, INLET SILENCER, BASE FRAME/DISCHARGE SILENCER, VIBRATION ISOLATORS, & CONNECTION HOUSING WITH CHECK FLAP
3. CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED
4. LIFT PACKAGE FROM FRONT SIDE THROUGH FORK LIFT POCKETS IN BASE OR LIFTING HOLES IN CORNER OF BASE USING SPREADER BAR
5. SEE JOB DATA SHEETS FOR PERFORMANCE DATA, PART NUMBERS, TOTAL PACKAGE WEIGHT, INSTRUMENTATION, ANY OTHER OPTIONAL EQUIPMENT & OWNERS MANUAL

WEIGHT

BLOWER PACKAGE (LESS MOTOR)	1075 kg	2370 lbs
ELECTRIC MOTOR (ITEM 300)	-	869 lbs
TOTAL (WET WEIGHT)		3239 lbs

AERZEN

AERZEN USA *CORPORATION*
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WWW.AERZEN.COM/EN-US

CLASS I

SCALE:- SHEET:1/ 1

	NAME	DATE
DRAWN BY	DFT	03.09.2021
CHECKED BY	MAJ	03.09.2021
APPROVED BY	-	-

DRAWING NO.
GB-006954-20-00311
NAVISION PN.
-

TITLE
GA DRAWING
GM35S, DN150, G5
F3 SOUND ENCL.
6" SLEEVE (IN) / 6"-150# ANSI (OUT)
MIX.BLW 1,2, & 4

REV.	NAME	DATE
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

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SECTION 1b

MIX.BLW-3

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Job Specific Data Package		
DATE	**Aerzen Job #**	**Page**
9-Nov-20	SO-20-00311	1 of 3
Revision Letter		-

CUSTOMER INFORMATION

CUSTOMER	Total Mechanical Services
CUSTOMER PO #	2020-19
PROJECT NAME	Downtown Area WWTF

PACKAGE DESCRIPTION

EQUIPMENT IDENTIFICATION	MIX.BLW-3		**SERIAL NUMBERS**
BLOWER MODEL #	GM 025S-00	QTY. (1)	
PACKAGE DESCRIPTION	Pressure Unit w/ Enclosure		
DISCHARGE CONNECTION TYPE	150# ANSI Discharge Connection		
INLET CONNECTION TYPE	150# ANSI Inlet Connection		
MOTOR CONDUIT LOCATION	F3 Conduit Box		
TOTAL PACKAGE WEIGHT	1804 lbs		

DOCUMENTATION

GENERAL ARRANGEMENT DRAWING	GB-006952-20-00311_MIX.BLW3
MOTOR CABLE ROUTING	IA-004545
OPERATIONS & MAINTENANCE MANUAL	G4-006
WARRANTY TERMS & CONDITIONS	A2-001-USA

PERFORMANCE DATA

MEDIUM		AIR	
INLET CAPACITY	*ICFM*	683	168
INLET CAPACITY	*SCFM*	607	149
INLET PRESSURE	*PSIA*	14.5	14.5
DISCHARGE PRESSURE	*PSIG*	7	7
INLET TEMPERATURE	*°F*	100	100
DISCHARGE TEMPERATURE	*°F*	187	218
NOMINAL BLOWER SPEED	*RPM*	3907	1303
POWER @ BLOWER SHAFT	*BHP*	27.4	8.3
MOTOR RATING	*HP*	40	40
MOTOR SPEED	*RPM*	1775	592
SOUND PRESSURE LEVEL *	*dB(A)*	72	0
MOTOR/VFD SPEED	*Hz*	60	20

* measured in free field at 3 foot distance from the outline of the unit (tol. +/- 2 dB(A))

Tolerance on Power & Flow is +/- 5%

CRITICAL INFORMATION / NOTES

1 PRIOR TO SHIPMENT - AERZEN DOES THE FOLLOWING
Removes V-Belts from the motor sheave and wraps them around the blower sheave
Locks the motor hinge plate
Always refer to the operations manual for determining the most suitable lubricant.
Operating and ambient conditions may impact which lubricant to use.

2 UPON ARRIVAL
Immediately remove stretch wrap from package when storred outdoors

3 LIFTING PACKAGE
Without Sound Enclosure: lifting eye holes in the corner of the base frame
With Sound Enclosure: lifting through slots in base with fork lift

4 READ OPERATION MANUAL FOR INSTALLATION INSTRUCTIONS
Call Aerzen After-Sales / Service if you have any questions

5 AT COMMISSIONING - CUSTOMER / CONTRACTOR IS TO
Check oil level (refer to operations manual) - and adjust if necessary
Anchor the base or sound enclosure
Make grounding connections
Connect motor cable per Aerzen Drawing IA-004545
Verify correct rotation of motor (counter-clockwise, looking at drive shaft)
Remove locking device from motor pivot plate
Reinstall V-belts

6 **ALL CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED**

7 Recommended MINIMUM clearance at front and rear of package for "normal"
(i.e. inspect machine, change oil, replace belts, etc.) maintenance is 32 inches.

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Job Specific Data Package

Date	Aerzen Job #	Page
2021-01-04	SO-20-00311	

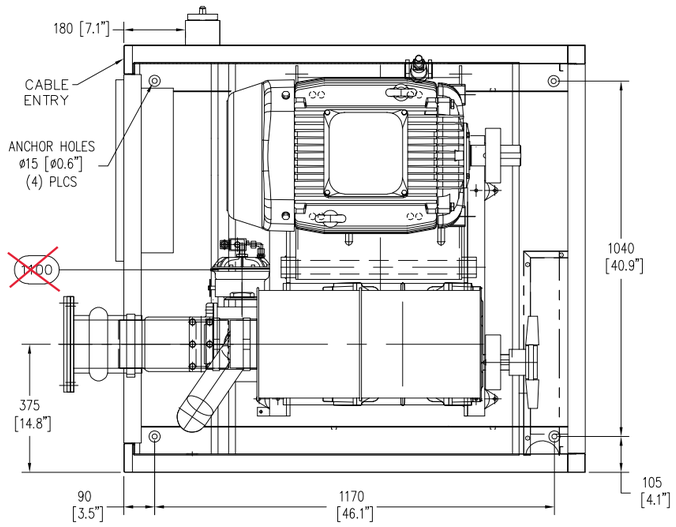
BILL OF MATERIAL FOR

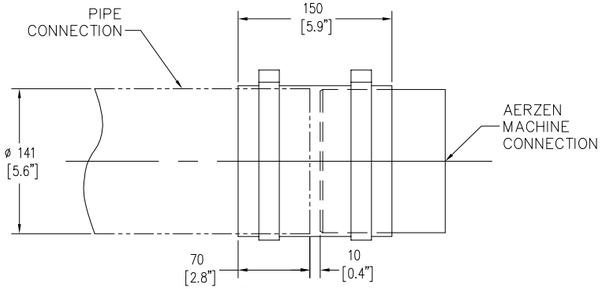
ITEM #	QTY	DESCRIPTION	PART #
100	1	Base Torso, Delta Blower GM25S, DN125 (Motors > 400lbs) Over-pressure applications	21-G5-A025125P
110	1	Safety Relief Valve for DN125, set at 750 mbar	21-G5-PRV125
200	1	Sound Enclosure DN125, Pressure for F3 Electric Motors	21-G5-SE3100
310	1	Motor Mounting, DN125 for Motor Sizes 324/6 thru 364	21-G5-MM100
320	1	Belt Drive Set for DN125	21-G5-BELTDRIVE
400	1	Belt Guard DN125 with F3 Sound Encl.	21-G5-BGS3100
500	1	Cooling Fan, 3000-4000 rpm for DN125 Shaft-Driven Max Speed (VFD) 4400 - 4800 rpm	21-G5-SCF125
600	1	Process Connection, Discharge Sleeve to Flange, 6" ANSI 150# for DN125	21-G5-CD125-01
700	1	Process Connection, Inlet Stub Pipe, 6" ANSI 150# for DN125	21-G5-CI125-03
800	1	Instrumentation Package Package No. 07 for Delta Blower 4.0" Dial Gauges, for units with Sound Encl.	21-G5-IM-PS07-4001
1000	1	Control Panel Mounted to Sound Encl.	21-004503
300	1	Electric Motor 40 HP, 4 Pole (1800 RPM), 324T 208-230/460V, 3ph, 60 Hz, F3 Conduit Mods: Klixons, Aegis, & Insulated Bearings WEG W22 (ARZ-180066000)	21-MTR-WG4-040BD305

Spares		
2	Air filters	175240000
1	Gaskets & seal set	180682000
1	Bearing set	180685001

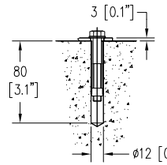
ITEM	QTY	DESCRIPTION	DESCRIPTION 2
100	1	BLOWER TORSO	GM25S, DN125
110	1	PRESSURE RELIEF VALVE	
200	1	SOUND ENCLOSURE	
300	1	ELECTRIC MOTOR	SHOWN WITH A 360 NEMA MOTOR
310	1	MOTOR MOUNTING	
320	1	BELT DRIVE	
400	1	BELT GUARD	
500	1	COOLING FAN	
600	1	DISCHARGE CONNECTION	6"-150# ANSI
700	1	INLET CONNECTION	6"-150# ANSI
800	1	INSTRUMENTATION	
900	1	LOCAL CONTROL PANEL	
~~1100~~	~~1~~	~~UNLOADING VALVE~~	~~(OPTIONAL)~~

PLAN VIEW

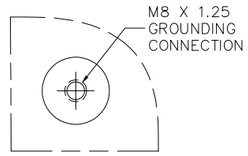




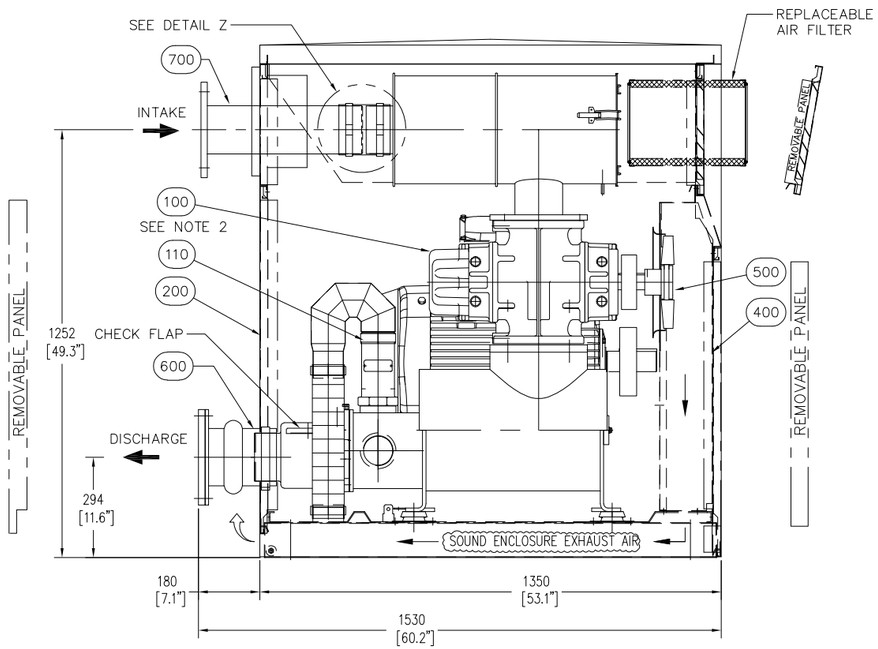
DETAIL Z
SLEEVE CONNECTION
CUSTOMER PIPE ENGAGEMENT
LEAVES 10 [0.4"] GAP
3X SCALE

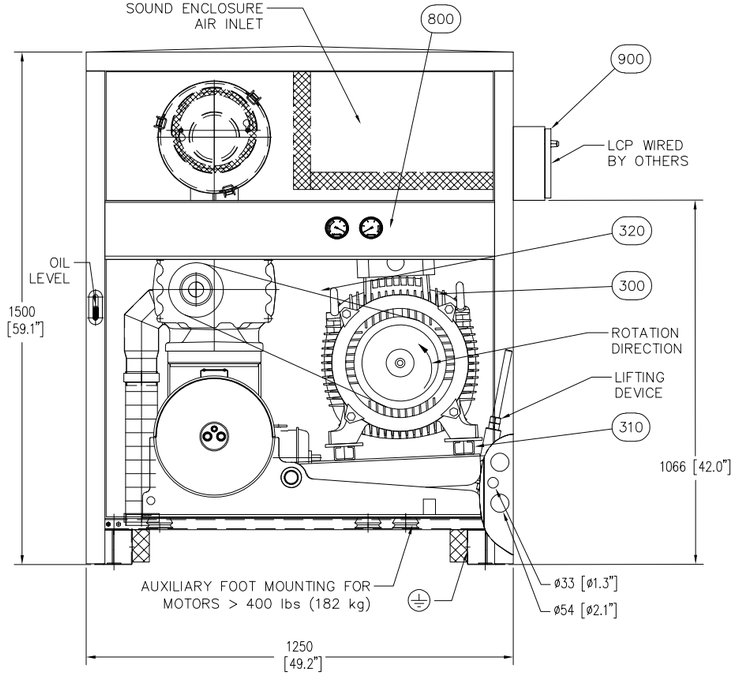


SOUND ENCLOSURE ANCHOR
RECOMMENDATION
SHOW WITH OPTIONAL ANCHOR
AERZEN PART NO. 2000053552
3X SCALE



EARTH GROUND
MAT'L: 304 SS
8X SCALE





FRONT VIEW

NOTES:

1. TOLERANCE ON DIMENSIONS = ±12mm [0.5"]
2. ITEM 100 (BLOWER TORSO) INCLUDES BLOWER STAGE, INLET SILENCER, BASE FRAME/DISCHARGE SILENCER, VIBRATION ISOLATORS, & CONNECTION HOUSING WITH CHECK FLAP
3. CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED
4. LIFT PACKAGE FROM FRONT SIDE THROUGH FORK LIFT POCKETS IN BASE OR LIFTING HOLES IN CORNER OF BASE USING SPREADER BAR
5. SEE JOB DATA SHEETS FOR PERFORMANCE DATA, PART NUMBERS, TOTAL PACKAGE WEIGHT, INSTRUMENTATION, ANY OTHER OPTIONAL EQUIPMENT & OWNERS MANUAL

WEIGHT

BLOWER PACKAGE (LESS MOTOR)	595 kg	1312 lbs
ELECTRIC MOTOR (ITEM 300)	-	492 lbs
TOTAL (WET WEIGHT)	-	3239 lbs

AERZEN USA *CORPORATION*
108 INDEPENDENCE WAY, COATESVILLE, PA.
PH: (610) 380-0244 FX: (610) 380-0278
WWW.AERZEN.COM/EN-US

CLASS I

SCALE:- SHEET:1/ 1

	NAME	DATE
DRAWN BY	DFT	03.09.2021
CHECKED BY	MAJ	03.09.2021
APPROVED BY	-	-

DRAWING NO.
GB-006952-20-00311
NAVISION PN.
-

TITLE
GA DRAWING
GM25S, DN125, G5
F3 SOUND ENCL.
6"-150# ANSI (IN) / 6"-150# ANSI (OUT)
MIX.BLW 3

REV.	NAME	DATE
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

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SECTION 1c

MIX.BLW-4

AERZEN	**Aerzen USA Corporation** 108 Independence Way, Coatesville, PA 19320 Tel: (610) 380-0244 Fax: (610) 380-0278 website www.USA-Inquiries@aerzen.com	**Job Specific Data Package**		
		DATE	**Aerzen Job #**	**Page**
		9-Nov-20	SO-20-00311	1 of 3
		Revision Letter		-

CUSTOMER INFORMATION

CUSTOMER	Total Mechanical Services
CUSTOMER PO #	2020-19
PROJECT NAME	Downtown Area WWTF

PACKAGE DESCRIPTION

EQUIPMENT IDENTIFICATION	MIX.BLW-4		**SERIAL NUMBERS**
BLOWER MODEL #	GM 035S-00	QTY. (1)	
PACKAGE DESCRIPTION	Pressure Unit w/ Enclosure		
DISCHARGE CONNECTION TYPE	150# ANSI Discharge Connection		
INLET CONNECTION TYPE	Sleeve Inlet Connection		
MOTOR CONDUIT LOCATION	F3 Conduit Box		
TOTAL PACKAGE WEIGHT	2906 lbs		

DOCUMENTATION

GENERAL ARRANGEMENT DRAWING	GB-006954-20-00311_MIX.BLW1.2.4
MOTOR CABLE ROUTING	IA-004545
OPERATIONS & MAINTENANCE MANUAL	G4-006
WARRANTY TERMS & CONDITIONS	A2-001-USA

PERFORMANCE DATA

MEDIUM		AIR	
INLET CAPACITY	*ICFM*	907	278
INLET CAPACITY	*SCFM*	806	247
INLET PRESSURE	*PSIA*	14.5	14.5
DISCHARGE PRESSURE	*PSIG*	8	8
INLET TEMPERATURE	*°F*	100	100
DISCHARGE TEMPERATURE	*°F*	202	233
NOMINAL BLOWER SPEED	*RPM*	2628	1055
POWER @ BLOWER SHAFT	*BHP*	40.9	15.4
MOTOR RATING	*HP*	50	50
MOTOR SPEED	*RPM*	1770	711
SOUND PRESSURE LEVEL *	*dB(A)*	74	0
MOTOR/VFD SPEED	*Hz*	60	24

* measured in free field at 3 foot distance from the outline of the unit (tol. +/- 2 dB(A))

Tolerance on Power & Flow is +/- 5%

CRITICAL INFORMATION / NOTES

1 PRIOR TO SHIPMENT - AERZEN DOES THE FOLLOWING
Removes V-Belts from the motor sheave and wraps them around the blower sheave
Locks the motor hinge plate
Always refer to the operations manual for determining the most suitable lubricant.
Operating and ambient conditions may impact which lubricant to use.

2 UPON ARRIVAL
Immediately remove stretch wrap from package when storred outdoors

3 LIFTING PACKAGE
Without Sound Enclosure: lifting eye holes in the corner of the base frame
With Sound Enclosure: lifting through slots in base with fork lift

4 READ OPERATION MANUAL FOR INSTALLATION INSTRUCTIONS
Call Aerzen After-Sales / Service if you have any questions

5 AT COMMISSIONING - CUSTOMER / CONTRACTOR IS TO
Check oil level (refer to operations manual) - and adjust if necessary
Anchor the base or sound enclosure
Make grounding connections
Connect motor cable per Aerzen Drawing IA-004545
Verify correct rotation of motor (counter-clockwise, looking at drive shaft)
Remove locking device from motor pivot plate
Reinstall V-belts

6 **ALL CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED**

7 Recommended MINIMUM clearance at front and rear of package for "normal"
(i.e. inspect machine, change oil, replace belts, etc.) maintenance is 32 inches.

Aerzen USA Corporation
108 Independence Way, Coatesville, PA 19320
Tel: (610) 380-0244 Fax: (610) 380-0278
website www.aerzenusa.com

Job Specific Data Package

Date	Aerzen Job #	Page
2021-01-04	SO-20-00311	

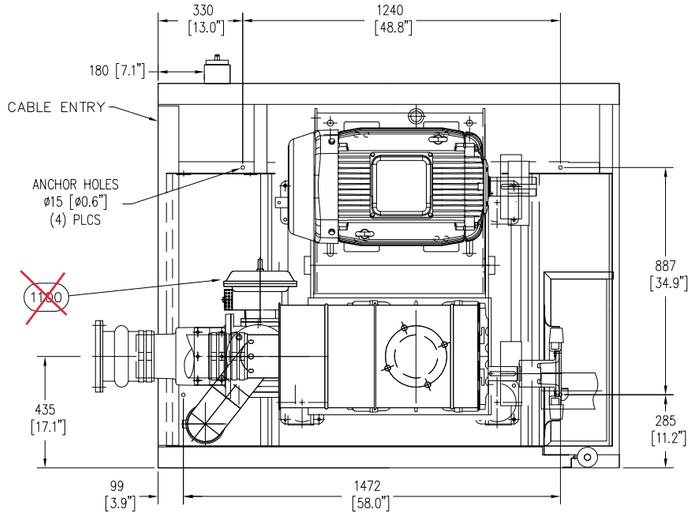
BILL OF MATERIAL FOR

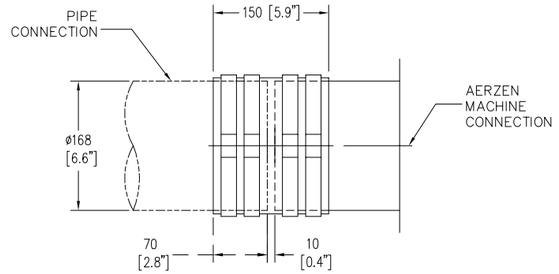
ITEM #	QTY	DESCRIPTION	PART #
100	1	Base Torso, Delta Blower GM35S, DN150 Over-pressure applications	21-G5-A035150P
110	1	Safety Relief Valve for DN150, set at 750 mbar	21-G5-PRV150
200	1	Sound Enclosure DN150, Pressure for F3 Electric Motors	21-G5-SE3150
310	1	Motor Mounting, DN150 for Motor Sizes 324/6 thru 364	21-G5-MM150
320	1	Belt Drive Set for DN150	21-G5-BELTDRIVE
400	1	Belt Guard DN150 with F3 Sound Encl.	21-G5-BGS3150
500	1	Cooling Fan, 2000-3000 rpm for DN150 Shaft-Driven Max Speed (VFD) 3150 - 3800 rpm	21-G5-SCF150-035
600	1	Process Connection, Discharge Sleeve to Flange, 6" ANSI 150# for DN150	21-G5-CD150-01
700	1	Process Connection, Inlet Rubber Sleeve for 6" Pipe for DN150	21-G5-CI150-00
800	1	Instrumentation Package Package No. 07 for Delta Blower 4.0" Dial Gauges, for units with Sound Encl.	21-G5-IM-PS07-4001
1000	1	Control Panel Mounted to Sound Encl.	21-004503
300	1	Electric Motor 50 HP, 4 Pole (1800 RPM), 326T 208-230/460V, 3ph, 60 Hz, F3 Conduit Mods: Klixons, Aegis, & Insulated Bearings WEG W22 (ARZ-180070000)	21-MTR-WG4-050BD305

Spares		
2	Air filters (2 per unit)	175241000
1	Gaskets & seal set 1	180687000
	Bearing set	180690001

ITEM	QTY	DESCRIPTION	DESCRIPTION 2
100	1	BLOWER TORSO	GM35S, DN150
110	1	PRESSURE RELIEF VALVE	
200	1	SOUND ENCLOSURE	
300	1	ELECTRIC MOTOR	SHOWN WITH A 400 NEMA MOTOR
310	1	MOTOR MOUNTING	
320	1	BELT DRIVE	
400	1	BELT GUARD	
500	1	COOLING FAN	
600	1	DISCHARGE CONNECTION	6"-150# ANSI
800	1	INSTRUMENTATION	
900	1	LOCAL CONTROL PANEL	
~~1100~~	~~1~~	~~UNLOADING VALVE~~	~~(OPTIONAL)~~

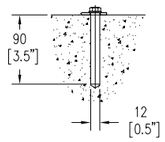
PLAN VIEW





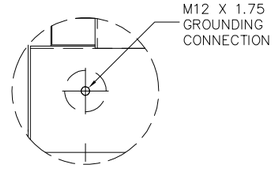
DETAIL Z

SLEEVE CONNECTION
CUSTOMER PIPE ENGAGEMENT
LEAVES 10 [0.4"] GAP
3X SCALE



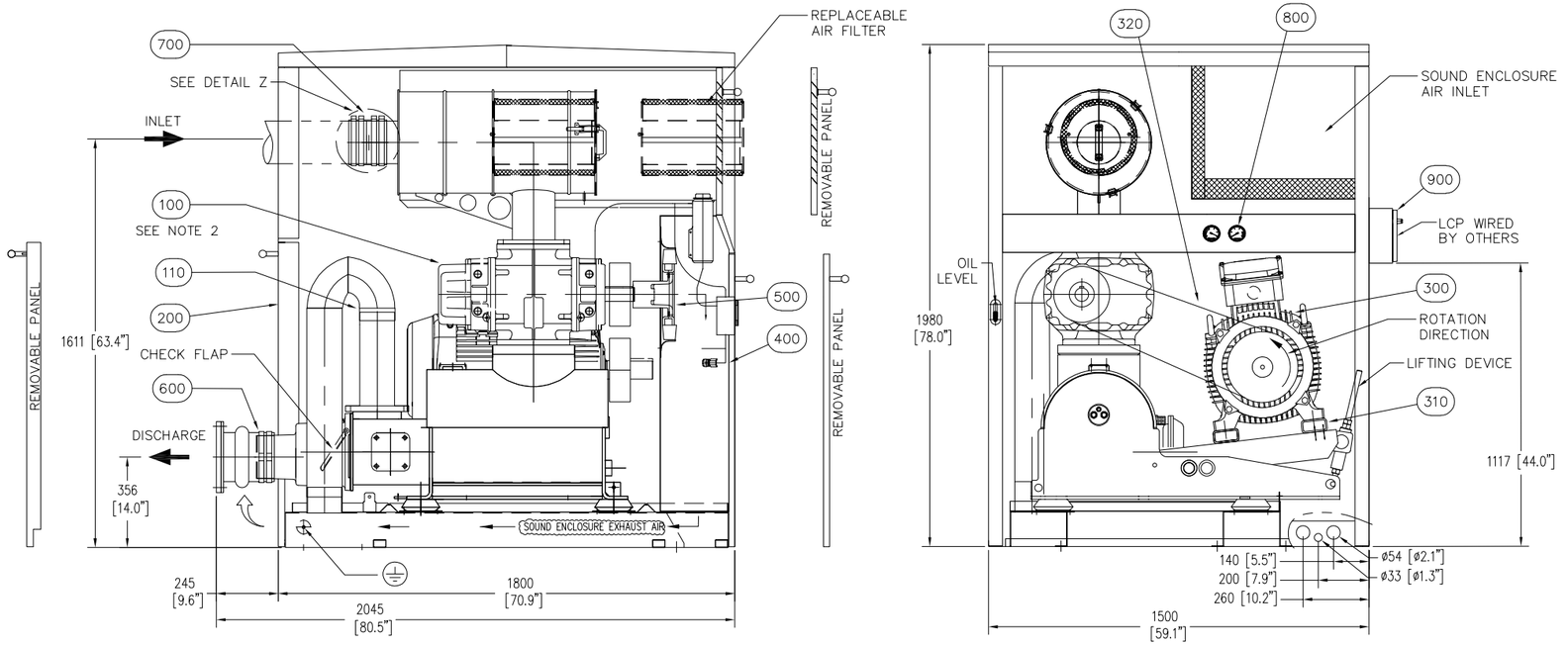
SOUND ENCLOSURE ANCHOR

RECOMMENDATION
SHOW WITH OPTIONAL ANCHOR
AERZEN PART NO. 2000053552
3X SCALE



EARTH GROUND

MAT'L: 304 SS
3X SCALE



FRONT VIEW

NOTES:

1. TOLERANCE ON DIMENSIONS = ±12mm [0.5"]
2. ITEM 100 (BLOWER TORSO) INCLUDES BLOWER STAGE, INLET SILENCER, BASE FRAME/DISCHARGE SILENCER, VIBRATION ISOLATORS, & CONNECTION HOUSING WITH CHECK FLAP
3. CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED
4. LIFT PACKAGE FROM FRONT SIDE THROUGH FORK LIFT POCKETS IN BASE OR LIFTING HOLES IN CORNER OF BASE USING SPREADER BAR
5. SEE JOB DATA SHEETS FOR PERFORMANCE DATA, PART NUMBERS, TOTAL PACKAGE WEIGHT, INSTRUMENTATION, ANY OTHER OPTIONAL EQUIPMENT & OWNERS MANUAL

WEIGHT

BLOWER PACKAGE (LESS MOTOR)	1075 kg	2370 lbs
ELECTRIC MOTOR (ITEM 300)	-	536 lbs
TOTAL (WET WEIGHT)		2906 lbs

AERZEN

AERZEN USA *CORPORATION*
108 INDEPENDENCE WAY, COATESVILLE, PA.
PH: (610) 380-0244 FX: (610) 380-0278
WWW.AERZEN.COM/EN-US

CLASS I

SCALE:- SHEET:1/ 1

	NAME	DATE
DRAWN BY	DFT	03.09.2021
CHECKED BY	MAJ	03.09.2021
APPROVED BY	-	-

DRAWING NO.
GB-006954-20-00311
NAVISION PN.
-

TITLE
GA DRAWING
GM35S, DN150, G5
F3 SOUND ENCL.
6" SLEEVE (IN) / 6"-150# ANSI (OUT)
MIX.BLW 1,2, & 4

REV.	NAME	DATE
-	-	-
-	-	-
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-	-	-

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SECTION 1d

SBR.BLW-1 to 3

Aerzen USA Corporation
108 Independence Way, Coatesville, PA 19320
Tel: (610) 380-0244 Fax: (610) 380-0278
website www.USA-Inquiries@aerzen.com

Job Specific Data Package		
DATE	**Aerzen Job #**	**Page**
9-Nov-20	SO-20-00311	1 of 3
Revision Letter		-

CUSTOMER INFORMATION

CUSTOMER	Total Mechanical Services
CUSTOMER PO #	2020-19
PROJECT NAME	Downtown Area WWTF

PACKAGE DESCRIPTION

EQUIPMENT IDENTIFICATION	SBR.BLW-1 to 3		**SERIAL NUMBERS**
BLOWER MODEL #	GM 025S-00	QTY. (3)	
PACKAGE DESCRIPTION	Pressure Unit w/ Enclosure		
DISCHARGE CONNECTION TYPE	150# ANSI Discharge Connection		
INLET CONNECTION TYPE	150# ANSI Inlet Connection		
MOTOR CONDUIT LOCATION	F3 Conduit Box		
TOTAL PACKAGE WEIGHT	1804 lbs		

DOCUMENTATION

GENERAL ARRANGEMENT DRAWING	GB-006952-20-00311_SBR.BLW1-3
MOTOR CABLE ROUTING	IA-004545
OPERATIONS & MAINTENANCE MANUAL	G4-006
WARRANTY TERMS & CONDITIONS	A2-001-USA

PERFORMANCE DATA

MEDIUM		AIR	
INLET CAPACITY	*ICFM*	596	350
INLET CAPACITY	*SCFM*	530	311
INLET PRESSURE	*PSIA*	14.5	14.5
DISCHARGE PRESSURE	*PSIG*	10.5	10.5
INLET TEMPERATURE	*°F*	100	100
DISCHARGE TEMPERATURE	*°F*	237	252
NOMINAL BLOWER SPEED	*RPM*	3569	2324
POWER @ BLOWER SHAFT	*BHP*	35.3	22.1
MOTOR RATING	*HP*	40	40
MOTOR SPEED	*RPM*	1775	1156
SOUND PRESSURE LEVEL *	*dB(A)*	75	0
MOTOR/VFD SPEED	*Hz*	60	39

* measured in free field at 3 foot distance from the outline of the unit (tol. +/- 2 dB(A))

Tolerance on Power & Flow is +/- 5%

CRITICAL INFORMATION / NOTES

1 PRIOR TO SHIPMENT - AERZEN DOES THE FOLLOWING
Removes V-Belts from the motor sheave and wraps them around the blower sheave
Locks the motor hinge plate
Always refer to the operations manual for determining the most suitable lubricant.
Operating and ambient conditions may impact which lubricant to use.

2 UPON ARRIVAL
Immediately remove stretch wrap from package when storred outdoors

3 LIFTING PACKAGE
Without Sound Enclosure: lifting eye holes in the corner of the base frame
With Sound Enclosure: lifting through slots in base with fork lift

4 READ OPERATION MANUAL FOR INSTALLATION INSTRUCTIONS
Call Aerzen After-Sales / Service if you have any questions

5 AT COMMISSIONING - CUSTOMER / CONTRACTOR IS TO
Check oil level (refer to operations manual) - and adjust if necessary
Anchor the base or sound enclosure
Make grounding connections
Connect motor cable per Aerzen Drawing IA-004545
Verify correct rotation of motor (counter-clockwise, looking at drive shaft)
Remove locking device from motor pivot plate
Reinstall V-belts

6 **ALL CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED**

7 Recommended MINIMUM clearance at front and rear of package for "normal"
(i.e. inspect machine, change oil, replace belts, etc.) maintenance is 32 inches.

Aerzen USA Corporation
108 Independence Way, Coatesville, PA 19320
Tel: (610) 380-0244 Fax: (610) 380-0278
website www.aerzenusa.com

Job Specific Data Package

Date	Aerzen Job #	Page
2021-01-04	SO-20-00311	

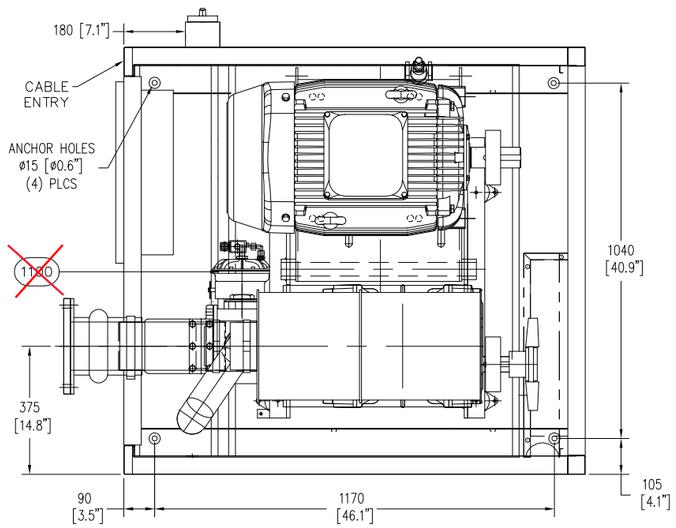
BILL OF MATERIAL FOR

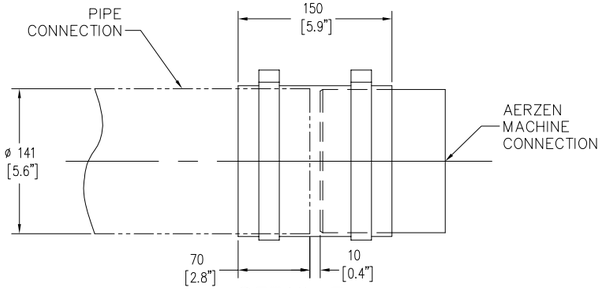
ITEM #	QTY	DESCRIPTION	PART #
100	1	Base Torso, Delta Blower GM25S, DN125 (Motors > 400lbs) Over-pressure applications	21-G5-A025125P
110	1	Safety Relief Valve for DN125, set at 1050 mbar	21-G5-PRV125
200	1	Sound Enclosure DN125, Pressure for F3 Electric Motors	21-G5-SE3100
310	1	Motor Mounting, DN125 for Motor Sizes 324/6 thru 364	21-G5-MM100
320	1	Belt Drive Set for DN125	21-G5-BELTDRIVE
400	1	Belt Guard DN125 with F3 Sound Encl.	21-G5-BGS3100
500	1	Cooling Fan, 3000-4000 rpm for DN125 Shaft-Driven Max Speed (VFD) 4400 - 4800 rpm	21-G5-SCF125
600	1	Process Connection, Discharge Sleeve to Flange, 6" ANSI 150# for DN125	21-G5-CD125-01
700	1	Process Connection, Inlet Stub Pipe, 5" ANSI 150# for DN125	21-G5-CI125-03
800	1	Instrumentation Package Package No. 07 for Delta Blowe 4.0" Dial Gauges, for units with Sound Encl.	21-G5-IM-PS07-4001
1000	1	Control Panel Mounted to Sound Encl.	21-004503
300	1	Electric Motor 40 HP, 4 Pole (1800 RPM), 324T 208-230/460V, 3ph, 60 Hz, F3 Conduit Mods: Klixons, Aegis, & Insulated Bearings WEG W22 (ARZ-180066000)	21-MTR-WG4-040BD305

Ship Loose & Spares		
1	Endustra P09, 10" w/ SS wire mesh element	21-008038
6	Air filters (2 per unit)	175240000
3	Gaskets & seal sets (1 per unit)	180682000
3	Bearing sets (1 per unit)	180685001

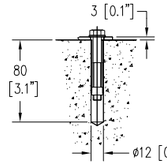
ITEM	QTY	DESCRIPTION	DESCRIPTION 2
100	1	BLOWER TORSO	GM25S, DN125
110	1	PRESSURE RELIEF VALVE	
200	1	SOUND ENCLOSURE	
300	1	ELECTRIC MOTOR	SHOWN WITH A 360 NEMA MOTOR
310	1	MOTOR MOUNTING	
320	1	BELT DRIVE	
400	1	BELT GUARD	
500	1	COOLING FAN	
600	1	DISCHARGE CONNECTION	5"-150# ANSI
700	1	INLET CONNECTION	6"-150# ANSI
800	1	INSTRUMENTATION	
900	1	LOCAL CONTROL PANEL	
~~1100~~	1	UNLOADING VALVE	(OPTIONAL)

PLAN VIEW

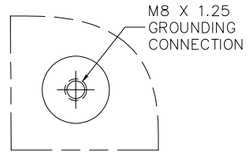




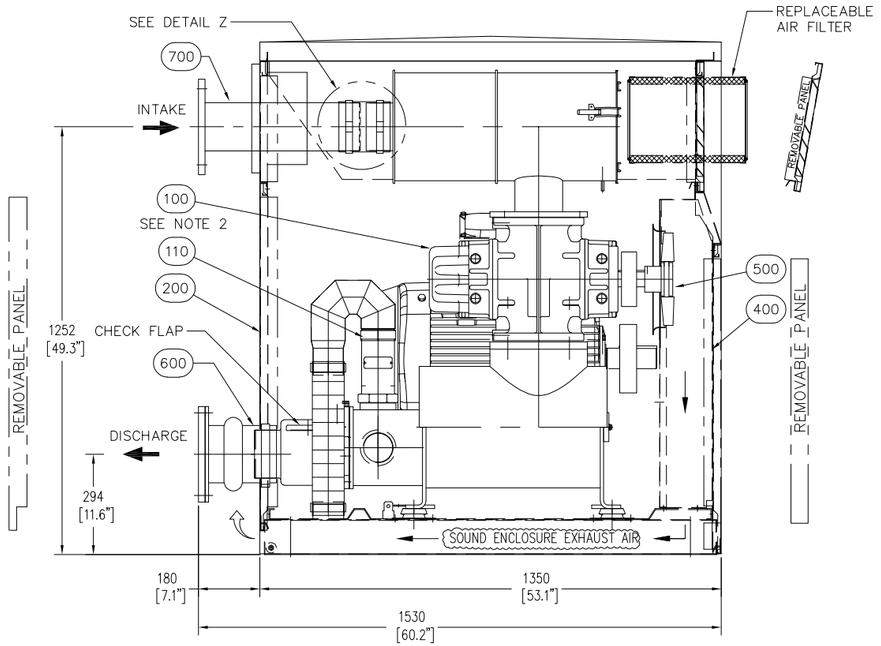
DETAIL Z
SLEEVE CONNECTION
CUSTOMER PIPE ENGAGEMENT
LEAVES 10 [0.4"] GAP
3X SCALE

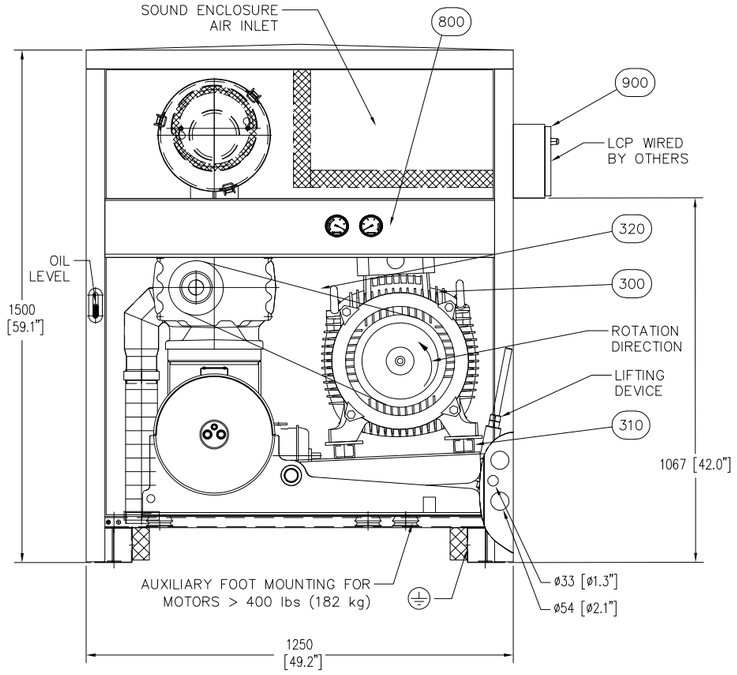


SOUND ENCLOSURE ANCHOR
RECOMMENDATION
SHOW WITH OPTIONAL ANCHOR
AERZEN PART NO. 2000053552
3X SCALE



EARTH GROUND
MAT'L: 304 SS
8X SCALE





FRONT VIEW

NOTES:

1. TOLERANCE ON DIMENSIONS = ±12mm [0.5"]
2. ITEM 100 (BLOWER TORSO) INCLUDES BLOWER STAGE, INLET SILENCER, BASE FRAME/DISCHARGE SILENCER, VIBRATION ISOLATORS, & CONNECTION HOUSING WITH CHECK FLAP
3. CUSTOMER PIPING TO BE INDEPENDENTLY SUPPORTED
4. LIFT PACKAGE FROM FRONT SIDE THROUGH FORK LIFT POCKETS IN BASE OR LIFTING HOLES IN CORNER OF BASE USING SPREADER BAR
5. SEE JOB DATA SHEETS FOR PERFORMANCE DATA, PART NUMBERS, TOTAL PACKAGE WEIGHT, INSTRUMENTATION, ANY OTHER OPTIONAL EQUIPMENT & OWNERS MANUAL

WEIGHT

BLOWER PACKAGE (LESS MOTOR)	595 kg	1312 lbs
ELECTRIC MOTOR (ITEM 300)	-	492 lbs
TOTAL (WET WEIGHT)	-	1804 lbs

AERZEN USA *CORPORATION*
108 INDEPENDENCE WAY, COATESVILLE, PA.
PH: (610) 380-0244 FX: (610) 380-0278
WWW.AERZEN.COM/EN-US

CLASS I

SCALE: - SHEET:1/ 1

	NAME	DATE
DRAWN BY	DFT	03.09.2021
CHECKED BY	MAJ	03.09.2021
APPROVED BY	-	-

DRAWING NO.
GB-006952-20-00311
NAVISION P/N.
-

TITLE
GA DRAWING
GM25S, DN125, G5
F3 SOUND ENCL.
5"-150# ANSI (IN) / 6"-150# ANSI (OUT)
SBR.BLW 1-3

REV.	NAME	DATE
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-

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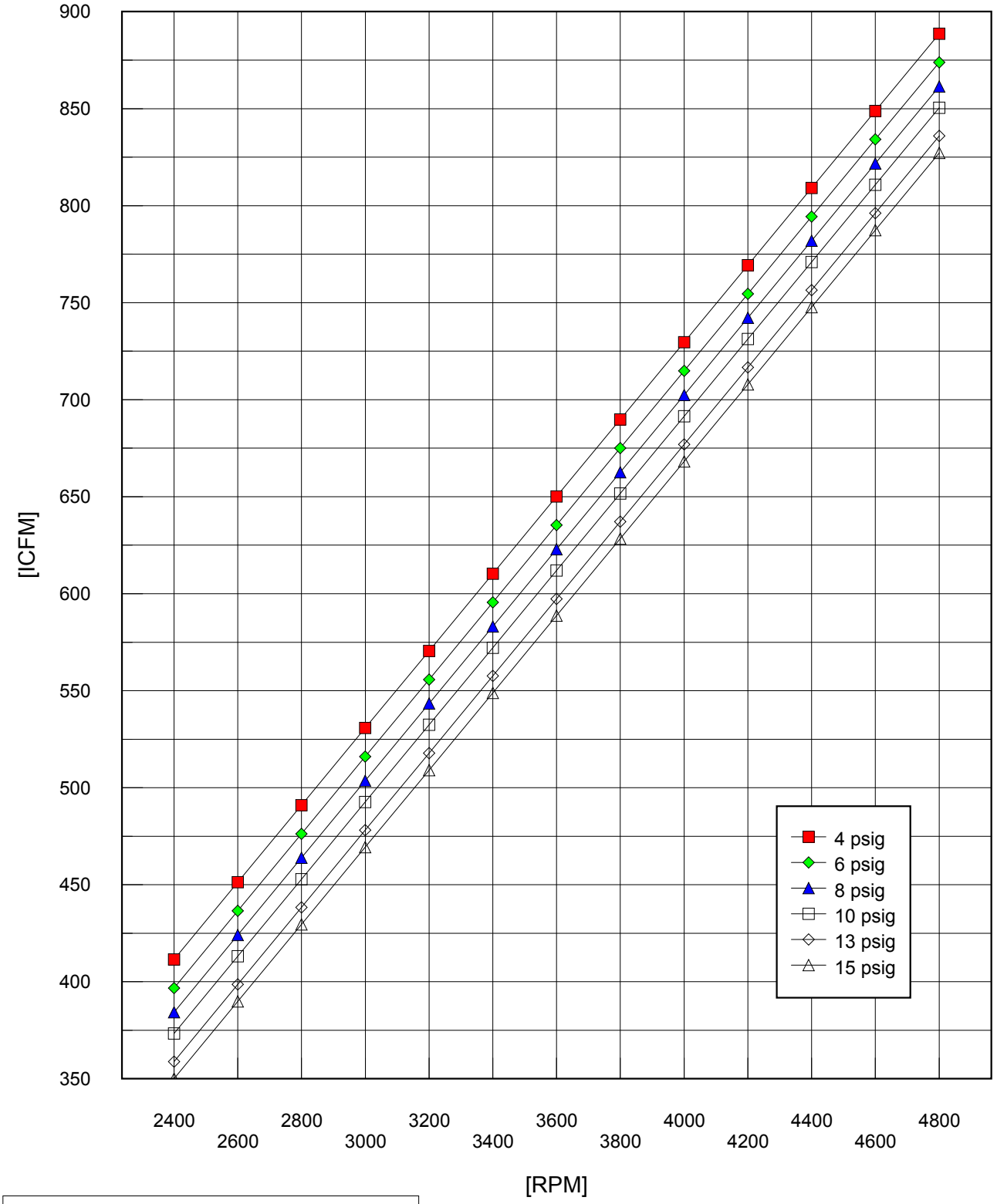
AERZEN GM 25S DELTA PACKAGE, PRESSURE

INLET FLOW

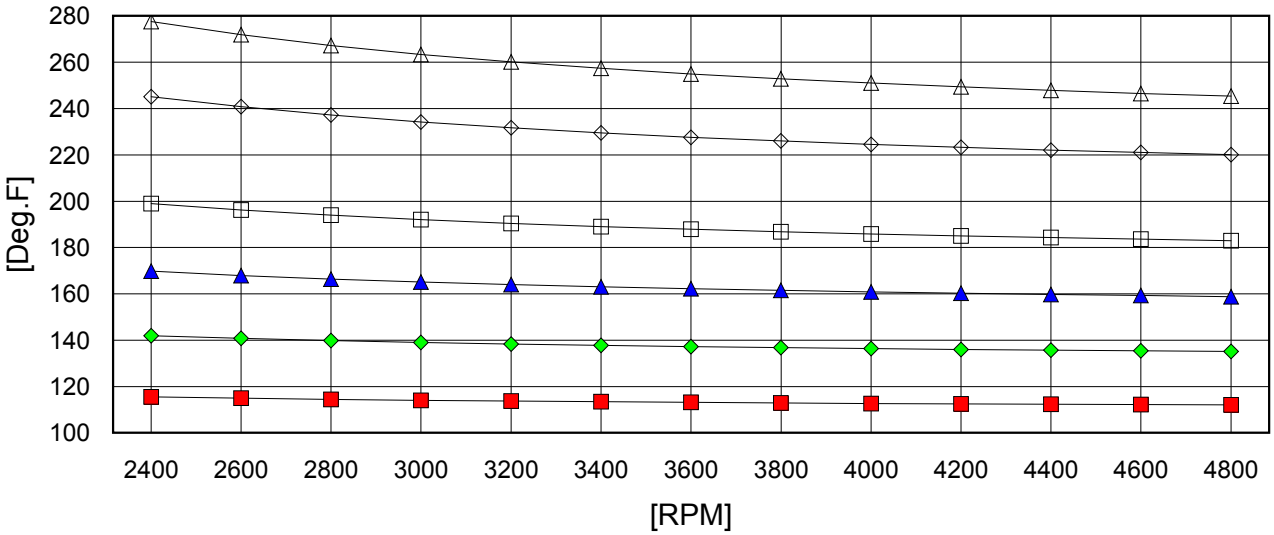


Performance data based on air @ 68 deg.F/ 14.7 psia inlet.

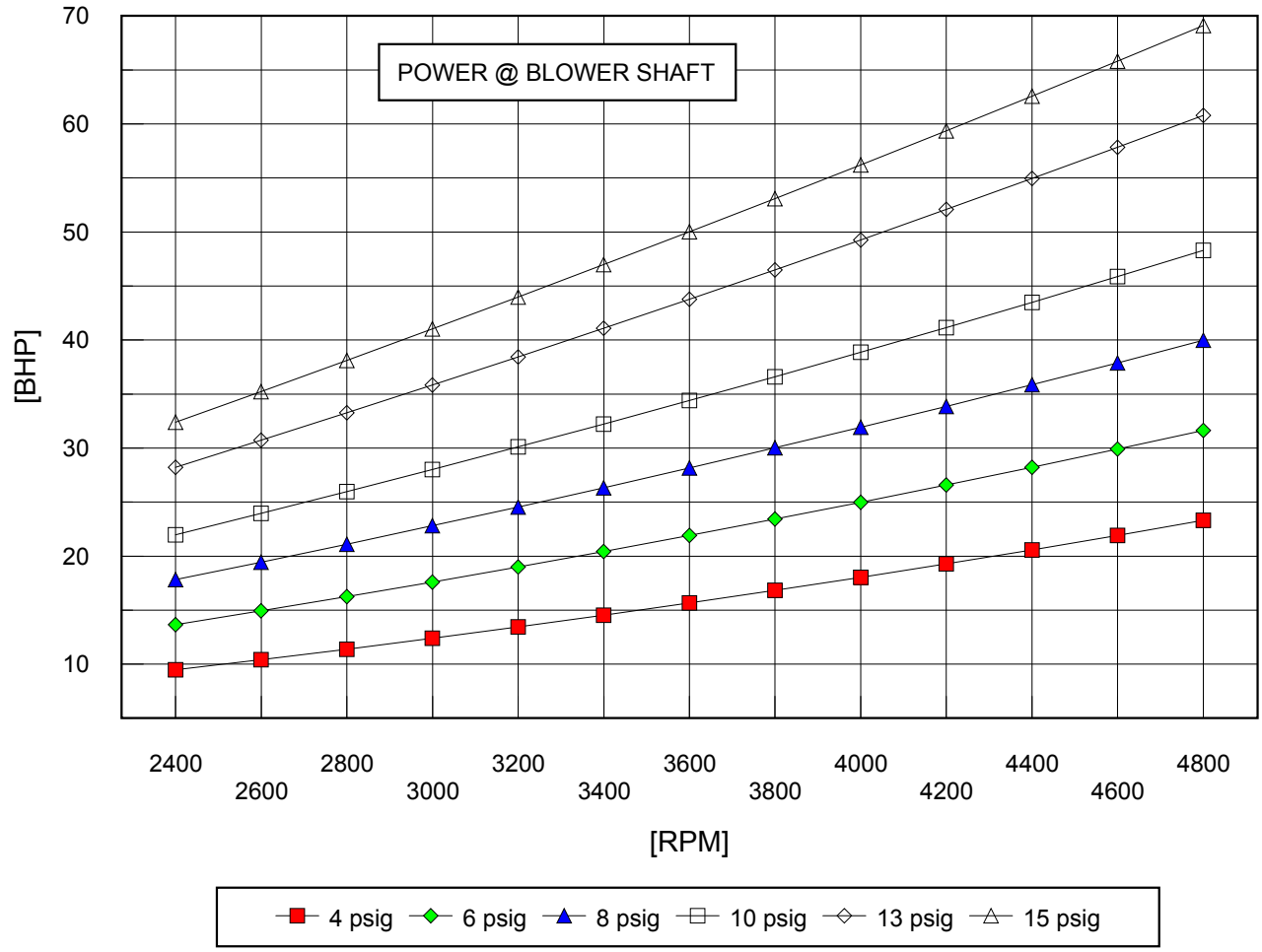
See temperature chart on second sheet for allowable operating range.

AERZEN GM 25S DELTA PACKAGE, PRESSURE

DISCHARGE TEMPERATURE

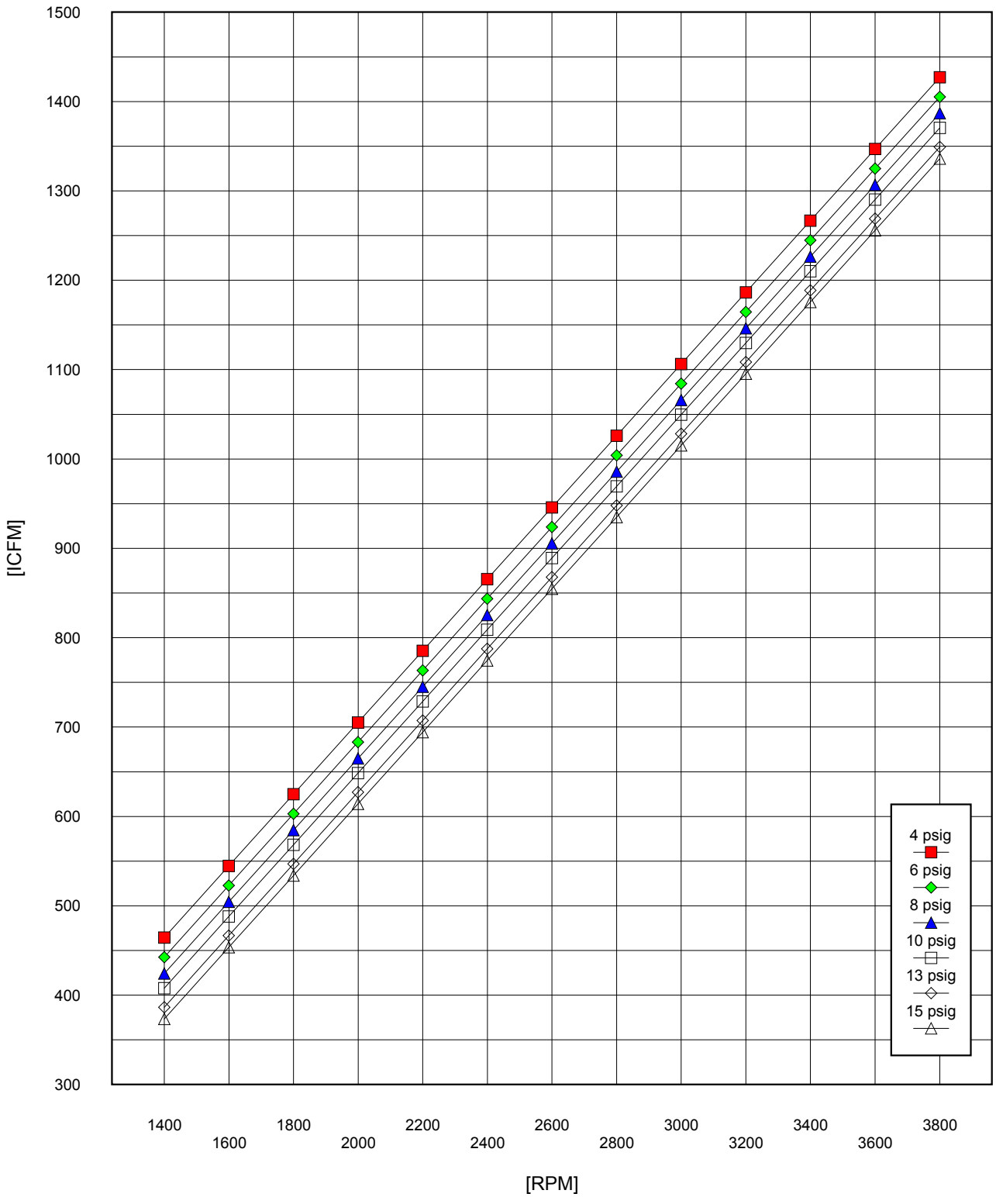


MAXIMUM ALLOWABLE DISCHARGE TEMPERATURE: 285 deg.F
Performance data based on air @ 68 deg.F/ 14.7 psia inlet.



AERZEN GM 35S DELTA PACKAGE, PRESSURE

INLET FLOW

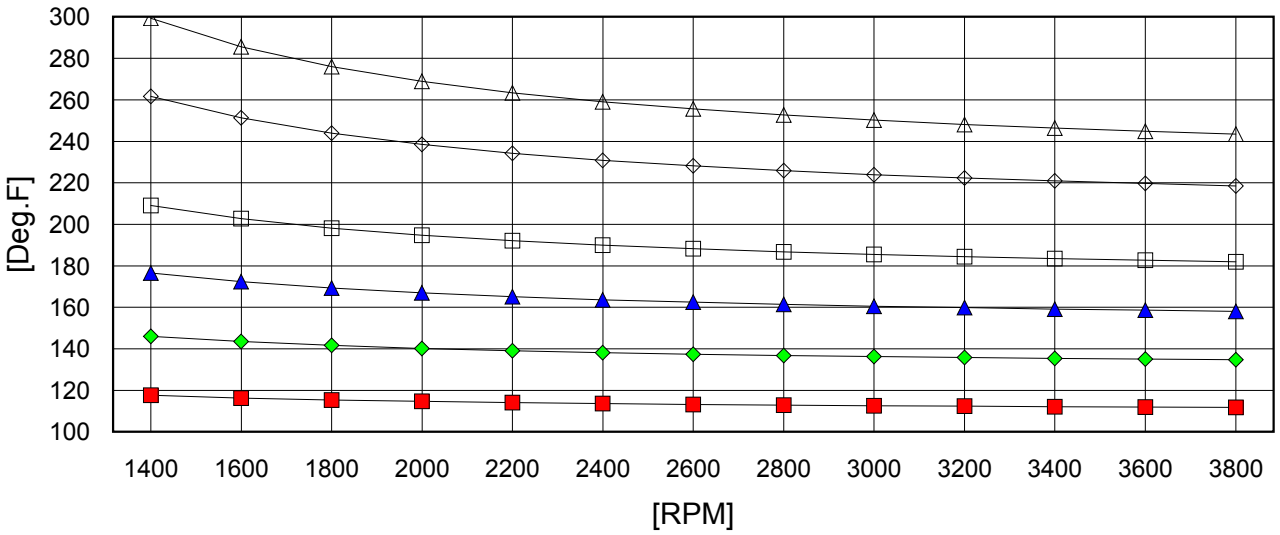


Performance data based on air @ 68 deg.F/ 14.7 psia inlet.

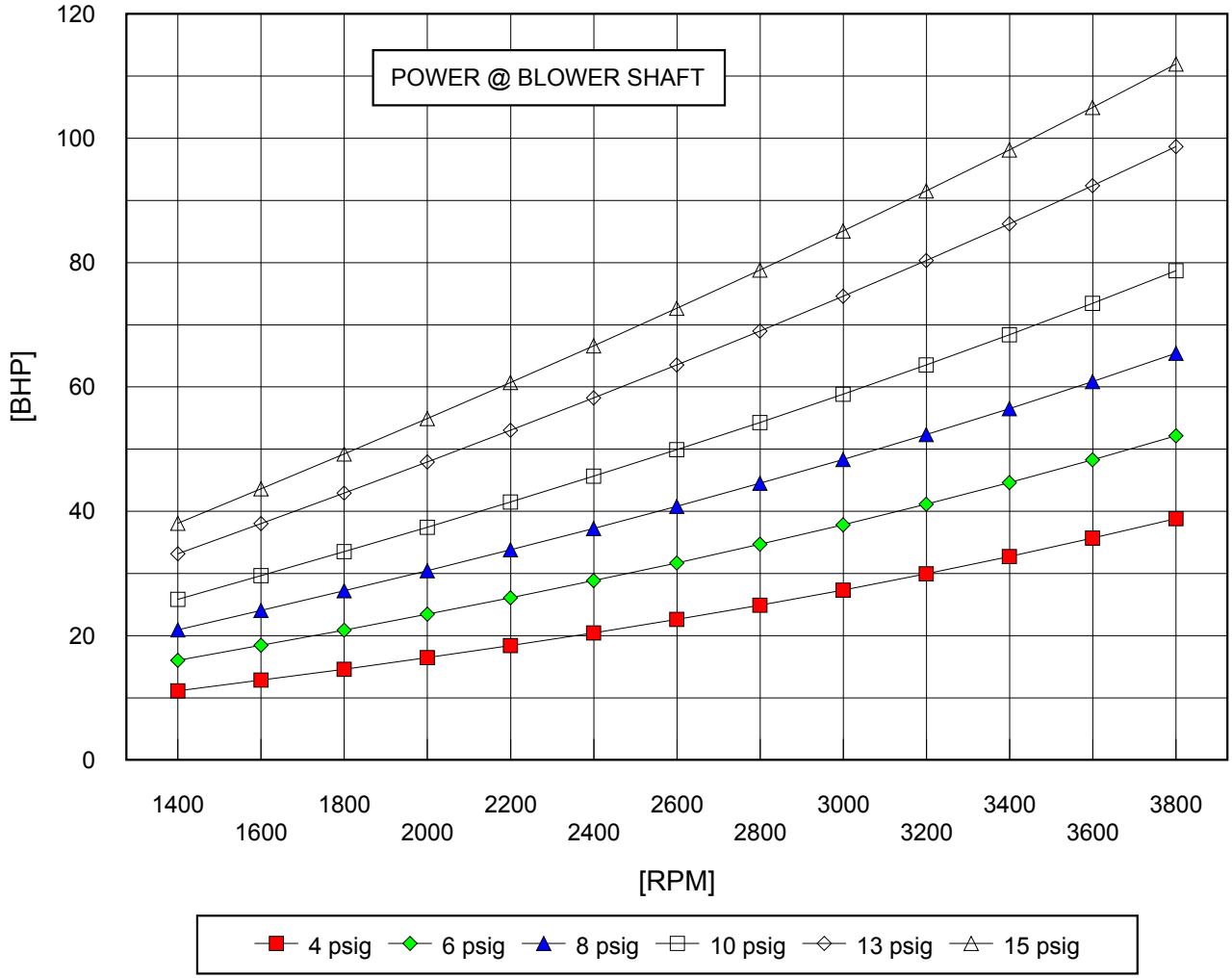
See temperature chart on second sheet for allowable operating range.

AERZEN GM 35S DELTA PACKAGE, PRESSURE

DISCHARGE TEMPERATURE



MAXIMUM ALLOWABLE DISCHARGE TEMPERATURE: 285 deg.F
Performance data based on air @ 68 deg.F/ 14.7 psia inlet.



SAMPLE – FOR REFERENCE ONLY

Aerzen USA Corporation

108 Independence Way
Coatesville, PA 19320
(610) 380-0244 ph
(610) 380-0244 fax

Aerzener Machinenfabrik GmbH
Since 1864
Reherweg 28 - D31855 Aerzen
Telefon: 0 51 54 / 810
Telefax: 0 51 54 / 811 91

Certified Test Report

evaluated date: **1-Aug-19**
evaluated by: Rzepka
certified by: Jarrow

Customer De Nora Water Technologies, Inc.
Customer PO# 23007-T019266

Aerzen reference # SO-18-01343

Performance & Order Data
Blower Model GM 90S **Serial #** 1619621

			Metric units		**US units**	
1)	Inlet flow	Q_1	56.19	m^3/min	1984.51	Icfm
2)	differential pressure	Δp	724	mbar	10.5	psig.
3)	Shaft Power	kW	85.15	kW	114.30	Bhp
4)	Blower Speed	rpm	1622	rpm	1622	rpm

Test Result			**Metric units**		**US units**	
5)	Volumetric Efficiency	$\eta_{vol, um}$	80%		80%	
6)	Actual Slip	$V_{verl, um}$	13.27	m^3/min	468.49	cfm
7)	Theoretical Volume	$V_{0, UM}$	67.35	m^3/min	2,378.28	cfm
8)	Actual Volume	$V_{1, UM}$	54.15	m^3/min	1,912.39	cfm
9)	Flow Variance	$V_{t, UM}$	-3.62%		-3.62%	
10	Actual Power	$P_{KU, UM}$	85.09	kW	114.10	Bhp
11	Power Variance	$P_{KU, UM}$	-0.08%		-0.08%	

Explanation and Summary
Lines 1), 2), 3). 4) above show required performance data (what was ordered).
Lines 5) through 11) show data that resulted from the performance test on the actual blower.
Line 9) shows a variance of 3.62% in the flow capacity of this unit.
Line 11) shows a variance of 0.08% in the power consumption of this unit.

Standard accepted tolerance is +/- 5%. The unit would be acceptable if the flow was no more than 5% below the expected flow and the power was no more than 5% of expected power.

For this specific case the flow is -3.62% **less than expected.**
For this specific case the power is -0.08% **less than expected.**

Serial number 1619621 **Model number GM 90S** **meets and exceeds the standard tolerance.**

Blower Test Report will be provided in the project O&M Manual.

EC Declaration of Conformity

according to the Machinery Directive 2006/42/EC, Annex II, No.1 A

Company Name : Aerzener Maschinenfabrik GmbH
Reherweg 28
31855 Aerzen
Germany

Product Details :

The Declaration of Conformity for this piston engine is supplemented by the technical details in the chapter entitled "Performance Data".
The details provided therein identify the product and must be applied together with this Declaration of Conformity.

Appointed agent for the compilation of the technical documentation : Mr. Irtel, Managing Director
Aerzener Maschinenfabrik GmbH
Reherweg 28
31855 Aerzen
Germany

We hereby declare that the aforementioned product complies with all relevant provisions of Machinery Directive 2006/42/EC for the conveyance and compression of gaseous media.

The aforementioned product also fulfils all provisions of the following relevant EC-directives:

- EMC / Electromagnetic Compatibility 2004/108/EC
- Pressure Equipment Directive 97/23/EC
- The protection targets of the Low Voltage Directive 2006/95/EC have been fulfilled in accordance with Annex I, No. 1.5.1 of the Machinery Directive.

The following harmonised standards were applied:

• DIN EN ISO 12100	03-2011	Safety of Machines - General Design Principles Risk Assessment and Risk Reduction
• DIN EN 1012-1	02-2011	Compressors and Vacuum Pumps - Safety Requirements - Part 1: Compressors

This Declaration of Conformity applies to the product in its original state as placed on the market by the manufacturer. Any retrospective changes and/or retrospective work undertaken shall void this Declaration of Conformity.

Aerzen, 09-01-2012
Place, Date of issue

Mr. Björn Irtel, Managing Director-
Details of the Undersigned

SECTION 2

ROTARY LOBE BLOWER PACKAGES

DELTA BLOWER GENERATION 5

Intake volume flow from 20 cfm to 8,800 cfm

Quiet, Compact, Energy Efficient

Delta Blower 5 Generation

AERZEN

aerzenusa.com

Aerzen's Generation 5 Delta Blower

The 5th generation of Aerzen modular compact packages combines tradition and innovation.

1 Easy installation with forklift or pallet jack for placement

2 Room-saving, compact, side-by-side installation

3 Easy access to all components with one oil drain/oil fill point

4 Oil level can be observed from the outside

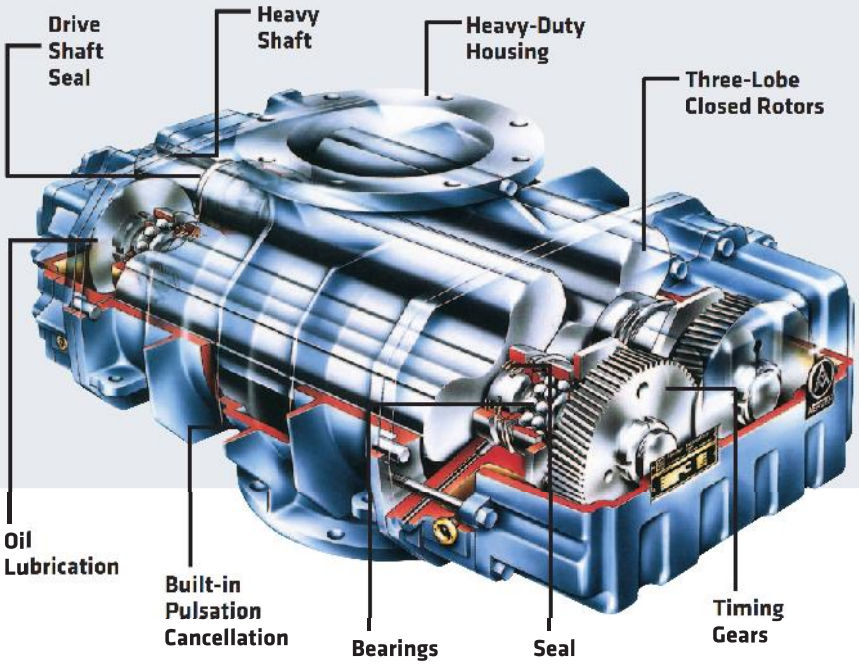
5 Automatic belt tension– No adjustment required

6 Typical machinery noise average SPL 75-80 dB(A) with acoustic hood

Aerzen Delta G5 Blower Stage

The details that set Aerzen Blowers apart.

Pulse Cancellation Built In, Active Noise Cancellation Built In

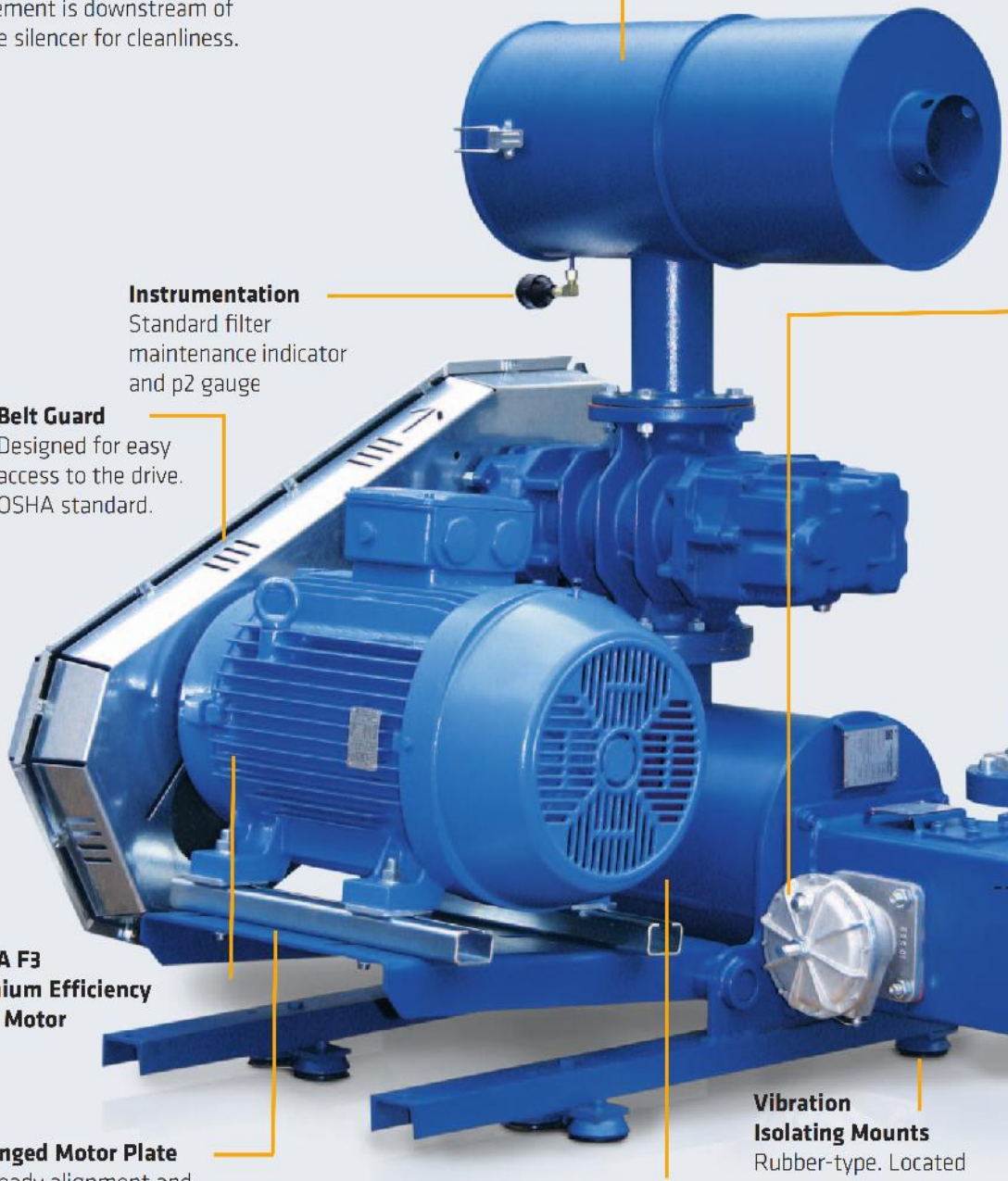


7 No need for additional electric motor and interlocks with shaft-mounted cooling fan for forced ventilation of the enclosure

8 Reactive discharge silencer without internal absorption material

For more information, visit **www.aerzenusa.com**

The accessories that make the difference.



Inlet Filter/Silencer
Easily replaceable filter element is downstream of the silencer for cleanliness.

Instrumentation
Standard filter maintenance indicator and p2 gauge

Belt Guard
Designed for easy access to the drive. OSHA standard.

NEMA F3 Premium Efficiency TEFC Motor

Hinged Motor Plate
Steady alignment and consistent tension provided by the motor weight. No springs needed. Constant high efficiency.

Reactive Discharge Silencer & Blower Base
Machined support surface for blower. Stiff for installation on vibration isolating mounts. Low pressure drop design. No absorption packing material. ATEX spark arrestor.*

Vibration Isolating Mounts
Rubber-type. Located under the supporting base. No special foundation required.

Discharge Flexible Connector
Reinforced rubber. Downstream of discharge silencer to reduce transmission of structure-borne noise.

Pressure Safety Valve
Spring-loaded. Specifically designed for low pressure applications. Mounted vertically downstream of the silencer for longevity.*

Aeromat Start Unloading Valve (Optional)
Allows startup of the main motor with no load. The valve is completely self activating and does not need any auxiliary electrical or pneumatic power source.

Discharge Manifold*
With integral full bore check valve for low pressure drop. The check valve can be inspected without disconnecting the piping. Non-chatter check valve suitable for adjustable speed operation.

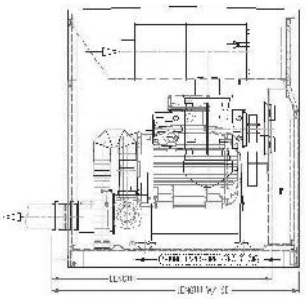
Instrumentation package:
AERtronic Control System includes pressure transmitters for intake, discharge and oil pressure, as well as resistance temperature detectors (RTD) discharge and oil temperature and operator interface.

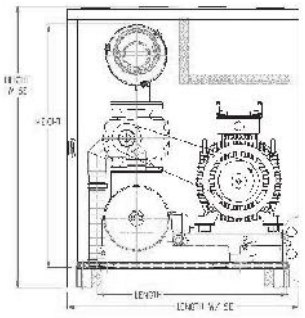
*PED compliant pressure vessel

G5 Blower Dimensions								
Aerzen Blower Model	Length (inches)	Width (inches)	Height (inches)	Weight (lbs)	Nominal Nozzle Size	Nominal Discharge Pipe Diam. (inches)	Max. Flow (icfm) at 10 psi rise	Pressure (psi)
GM 3S	31	33	43	485	DN-50	2	131	15
GM 4S	48	36	52	695	DN-80	3	184	15
GM 7L	48	36	52	706	DN-80	3	270	10
GM 10S	48	36	52	759	DN-80	3	339	15
GM 10S	55	51	61	1120	DN-100	4	385	15
GM 15L	55	51	61	1153	DN-100	4	576	10
GM 25S	59	55	61	1279	DN-125	5	823	15
GM 30L	80	73	78	2161	DN-150	6	1186	10
GM 35S	80	73	78	2293	DN-150	6	1370	15
GM 50L	80	73	78	2492	DN-150	6	1494	10
GM 50L	78	84	86	2889	DN-200	8	1896	10
GM 60S	78	84	86	3219	DN-200	8	2020	15
GM 80L	99	90	94	7872	DN-250	10	2828	10
GM 90S	99	90	94	8004	DN-250	10	3090	15
GM 130L	126	116	96	7111	DN-300	12	4449	9
GM 150S	126	116	96	7651	DN-300	12	5120	15
GM 240S	(depends on motor size)				DN-400	16	8800	12

Notes

1. *For informational use only. Dimensions shown are close estimates and are subject to change without notice. Contact Aerzen USA if certified dimensions are required. Dimensions are in inches, weights are in lbs.*
2. *Weight notes: motor not included.*
3. *Oversize/overweight motors may require hinge plate support; dimensions and weights may vary. Consult Aerzen USA with specific application.*
4. *Packages available w/o sound enclosure. Consult Aerzen USA.*





Aerzen means trouble-free compression.

Aerzen's modular blower packages have been offered since the 1960s. Aerzen Delta Blower packages have been in successful operation since the 1990s. They are just one of the offerings in our single stage positive displacement program. Whatever your application and installation requirements, be sure to consider Aerzen.

Delta Care Maintenance Agreement

Warranty: 5 years optional with our Care Maintenance Agreement

For Pressure

- Up to 15 psi: G5 Blower packages
- Delta Hybrid up to 22 psi
- 10 to 51 psi: Oil-free and air-cooled VM and VML screw compressors

For Vacuum (Dry)

- Up to 15″ Hg: G5 Blower packages
- Hybrid up to 20″ Hg
- Up to 25″ Hg: G5 Blower packages with pre-inlet cooling
- Up to 25.5″ Hg: Oil-free and air-cooled VM screw compressors at same flow (30% more efficient than PD blowers)
- Vacuum boosters to 10-3 mbar absolute

For Extended Pressure/Vacuum

- Up to 40,000 cfm available
- For other gases, higher pressure/vacuum consult factory

Aerzen USA
108 Independence Way, Coatesville, PA 19320
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AERZEN
EXPECT PERFORMANCE

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AERZEN DELTA BLOWER GENERATION 5
North American Standard
Positive Pressure

Standard range

Blower sizes: .....GM 3S to GM 150S

Package nominal sizes:.....2” (DN 50) to 12” (DN 300)

Medium: .....Air

Flow range: .....35 to 5297 icfm (1.0 to 150 m^3/min)

Differential pressure: .....15 psi (1000 mbar) for “S” and 10 psi (700 mbar) for “L” machines

Maximum operating temperature: 285ºF (140ºC)

Drive:.....V-belt drive with totally automatic belt tension adjustment

Introduction

The Aerzen Blower is renowned for its performance and its reliability. There is no secret: From the blower-stage through the accessories, Aerzen enhances key features of each component by applying sound engineering, precision machining, and superior workmanship.

The Delta Blower Generation 5 (G5 for short) is the synthesis of four previous Aerzen blower package generations combined with an array of new technical innovations to provide five key advantages to our customers:

- The machinery noise level has been lowered yet another 6-8dBa[1] on average compared to the previous Delta Blower
- The blower package is even more user friendly especially in transport, installation, operation, and maintenance
- The oil level is visible from the outside of the package, so the blower does not need to be shut down
- No absorption material is used in the discharge combination silencer; this eliminates the possibility of foreign objects contaminating the air or gas stream
- Use of a shaft mounted cooling fan, which reduces installation and operating costs by eliminating extra wiring, motor starters, and its interlocking with the main blower motor
- The compact footprint allows units equipped with sound enclosure to be mounted side-by-side since there is only one main maintenance access side

[1] Measured in 1m free-field conditions

Aerzen Delta Blower Generation 5 are pre-engineered modular compact packages, which offer a wide range of options from proven and standardized components at reasonable costs and short delivery times.

Shipped completely assembled, the Aerzen Delta Blower Generation 5 is indoor and outdoor rated. There is no extensive installation work - neither grouting nor special anchoring is required, just simply level it and bolt it to any standard industrial flooring or surface.

Scope of supply: basic configuration

- Aerzen Rotary Lobe Blower stage
- Combination Base Frame / Silencer combined with hinged motor plate for automatic belt tensioning – with 2 ½" diameter discharge pressure gauge
- Making belt changes as easy as possible a motor hinge plate lifting and locking mechanism is included with DN100-300 units and a hydraulic bottle jack is supplied with DN50 and 80 units.
- Set of vibration isolating mounts under the entire blower package
- Inlet silencer – filter with filter maintenance indicator
- Narrow V-belt drive and protection guard
- Pressure safety valve
- Discharge manifold with integral check valve and flexible pipe connector
- Standard paint system
- NEMA electric motor TEFC, Premium efficiency, VFD duty, with conduit box on top
- First oil fill and "Service kit"
- Packaging for domestic trucking
- Standard documentation in electronic format: English language, drawings with US-customary and metric units of measure

Standard options include (not limited to)

- Inlet pipe connection kit
- Sound enclosure with skid / oil-drip pan and forced ventilation
- Start-unloading valve Aeromat, with or without solenoid valve
- Pressure modulating valve Aeropress or Aeropress10S, pilot operated
- Other motors, e.g. misc vendors Premium Efficiency with conduit box on top
- Instrumentation & controls, e.g. AERtronic Aerzen blower controller

Description of the main components

The combination of key components marked with a * in the description below significantly contribute to the reliability and performance of the Aerzen Blower:

At the heart of the package: The Aerzen Rotary Lobe Blower

Low vibration and low pulsations - a key feature:

* Internal pulsation interference channels in conjunction with 3-lobe rotors reduce the pulse in the discharge air stream by as much as 90% or 20 dB at the lobe-passing frequency. This significant attenuation contributes strongly to reducing vibrations in the entire package and lowering the noise emitted by the downstream piping.

Positive displacement characteristic:

- The blower moves a fixed volume of gas with each shaft rotation, nearly independently from the operating pressure.
- At constant differential pressure, the load torque remains constant.
- For a given pressure, the power is directly proportional to the speed.

Flow across the blower stage:

- Vertical from top to bottom

Drive shaft location:

- On the left when facing the blower shaft

Rotation:

- Counterclockwise when facing the blower shaft

Housing:

- The central section, “the cylinder” and the two side-plates house the rotors, while a gear case and a drive end cover contain the lubricating oil for bearings and gears. Individual side plates allow for optimal setting of the radial rotor clearances: a valuable feature on blowers with the gas flowing perpendicular to the rotors.
- Connections: full-size, flat-faced flanges
- * Maintaining internal alignment under all operating conditions is paramount for the reliability of any rotating equipment. The housing is, for this purpose, designed to support the entire blower stage on its outlet flange only; no need to worry about a “soft foot” or uneven base support
- Materials: Gray cast iron EN-GJL-200 equivalent to ASTM A48 Cl.30 AISI A278 Cl. 30

Rotors:

- Up to and including the model GM 80L, rotors and shafts are made of a single, drop forged steel piece made from C45 steel equivalent to AISI Type 1045. Models GM35S, 50L, 90S, and 130L are made from a single piece of EN-GJS-500-7 nodular cast iron equivalent to ASTM A 536. Model GM150S rotors are comprised of a through shaft made from C45 steel equivalent to AISI Type 1045 and a rotor made from EN-GJS-400-15 nodular cast iron equivalent to ASTM A536 Gr. 60-40-18. Solid or dust-tight rotors do not have any open cavities that can trap contaminants. This is particularly important in food applications and applications requiring high purity. Moreover, rotor balance is maintained, and vibration is therefore minimized.
- Stiff rotor design: the rotors' first critical speed is always at least 10% above the maximum operating speed.
- The rotors meet or exceed the ISO 1940 / ANSI S2.19 G6.3 criteria of dynamic balancing

Timing gears:

- Helical gears with hardened and ground teeth to meet AGMA 12 quality standard with an AGMA service factor of 1.70.
- To maintain the advantage of high-quality gears, the gear wheels are secured onto the shafts by means of a tapered interference fit. Optimum concentricity is achieved and neither gear hub nor shaft keys are used. To prevent damaging the seats, gear installation and removal are carried out using hydraulic pressure to expand the gear wheels within their elastic limit.

Bearings:

- The rotors are supported by anti-friction bearings
- The bearings are housed in the side-plates and are sized for an expected 5 years between overhauls.
- The drive-shaft bearing is a cylindrical roller bearing whereas the other bearings are selected to achieve the proper clearances between rotors and housing, axial loads from the helical bearings: smaller machines up to GM 50L feature double angular ball bearings.

Lubrication:

- Oil splash lubrication of all bearings and gears through oil spray disks on both blower ends
- An oil sight glass is provided on each oil sump.
- An oil drain valve is provided on each oil sump (units without sound enclosure). The oil drain valves are directly mounted to the oil sump covers for clean, easy and fast oil change.
- Units with sound enclosure are plumbed together to an oil reservoir that serves as oil fill and drain device, and its oil sight glass is visibly mounted to the maintenance side of the enclosure.
- Aerzen USA provides the first oil fill with a lubricant as recommended in the operating manual as well as a service-kit containing oil fill funnel, and oil drain hose.

Seals at the rotor chamber:

- The rotor chamber is sealed from the oil chambers by four, all metal, non-rubbing seals, each consisting of the following components and in that sequence:
  - Oil slinger ring
  - Two restrictive piston-rings in a labyrinth
  - "Neutral chamber" located between the piston rings used for venting the seal
  - Two restrictive piston-rings in a grooved labyrinth bushing

Seal at the drive shaft:

- Double, permanently lubricated Viton seal ring
- Shaft sleeve: replaceable, hardened steel

Testing

- Each blower stage is subject to a full-load test to verify the volumetric flow and power values.
- Acceptance criteria are +5% on power and –5% on flow for all machine sizes.
- Orifice flow measurement and conversion of results to the operating conditions in accordance with ISO 1217, simplified

The package component Aerzen Rotary Lobe Blower

Intake air silencer & filter

- Absorption-type silencer upstream of the air filter element. For reasons of cleanliness, there is no silencing material between the filter and the inlet blower flange.
- The carbon steel housing is powder coated. Quick-release latches for quick access to the filter element
- Filter performance: G4 per EN 779 (greater than 90% of synthetic dust particles), equivalent to ASHRAE 52.2 MERV 7 (50-70% @3-10 microns)
- Progressively compressed, thermally bound polyester fibers, free of PVC, smoothened and compressed on the clean airside for highest dust separation and retention capacity. The filter media is made of a single, 30 mm thick continuous mat that is white in color and is food safe. Filter element mounts with a quick release turn and lock arrangement.
- Included is a filter maintenance indicator. If the sound enclosure option is selected, the filter maintenance indicator is mounted to the enclosure wall.

Base with integral discharge silencer:

- In addition to the blower's internal pulsation cancellation feature, the combination discharge, three-chamber reactive silencer is used to further reduce the noise and residual pulsation in the air stream across a wide range of operating speeds. The residual pulsation downstream of the silencer meets or exceeds the API 619 recommended 2% peak-to-peak of the absolute line pressure.
- The discharge silencer is combined with the support base into one compact rugged unit. It is made from pressure vessel steel it forms a torsion resistant cylindrical vessel supporting the blower stage and other components.
- The mounting surface for the blower is a full-size steel flange machined and continuously welded to the base with the full number of tapped holes for the studs to fasten the blower to the base - no need to align blower feet or to worry about a soft-foot condition. A surface sealant is used instead of a gasket.
- Maximum operating pressure: 1.1 bar gauge (16 psig) and 150ºC (300ºF), built and certified to the latest European Pressure Vessel Code, PED. Test pressure: 1.9 bar g. (27.6 psig)
- The base is mounted on a set of vibration-isolating mounts

Belt drive

- Narrow, anti-static V-belts
- Selected for a minimum service factor of 1.4 times operating power (BHP), or 1.1 times the motor nominal power (nameplate HP), whichever is greater.[2]
- The Aerzen Delta Blower Generation 5 package provides entirely automatic tensioning of the belts. Thanks to the package configuration, the drive geometry is such that the motor hinges parallel to the motor shaft centerline, using only the motor mass to maintain this tension without need for adjustments or springs. This not only reduces maintenance; it also reduces the potential for operating with too little (slipping belts) or excessive belt tension (excessive bearing and shaft load).
- DN100-300 blower packages feature a multipurpose lifting device for the motor swing plate. In its most basic function, it serves as shipping locking device preventing the motor from unwanted movement. It also serves as the lifting mechanism for changing out the drive belts. Another additional purpose is limiting the belt tension when oversized motors are used. Finally, the device can be configured to aid limited movement for seismic or mobile blower package service. The maintenance kit provided by Aerzen USA also includes a ratchet wrench used for lifting the motor to change V belts.
- DN50 & DN80 blower packages have a simple to use bracket and hydraulic jack included in the maintenance kit to lift the motor and change or install the belts.
- Sheaves and bushings are dynamically balanced to ISO 1940 / ANSI S2.19 G6.3. For linear tip speeds > 6500 ft/min (33 m/s), nodular cast-iron, ventilated sheaves are used.

Belt guard

- OSHA compliant personnel guard, made of galvanized steel: either perforated steel or solid sheets with vents, depending upon the model.
- Units with sound enclosure feature hand protection fan and belt guards, and the enclosure itself serves as the ultimate protection device. The removable maintenance panels comprise lockable latches that help facilitate OSHA prescribed tag-out-lock-out procedures.

Vibration isolating mounts

- A set of vibration isolating mounts are located under the blower package to hinder the transmission of structure borne noise from the blower and the discharge silencer into any structure the package is installed on, such as a mounting skid if supplied with acoustic enclosure.

Discharge manifold

- Flange-mounted to the discharge silencer, the discharge manifold serves for mounting the pressure safety valve, an optional start-unloading valve and for connecting the blower package to the discharge piping.
- Materials of construction: Gray Cast Iron EN-GJL-250 equivalent to ASTM A48 (Aluminum stub pipe for DN50)
- The discharge manifold houses the discharge check-valve

Pressure safety valve

- DN100-300 blower packages have a vertically mounted, spring loaded, safety pressure valve sized for the full flow of the blower. DN50 and DN80 blower packages feature horizontally mounted safety relief valves.

---

[2] Higher values are not necessarily better as they could lead to belt slippage due to excessive stiffness, and also shaft damage (deflection) caused by higher tension values required by over sized v-belt drives.

* — The valve's characteristic is nearly proportional. It not only opens, but also closes at the set pressure
* — The valve has a built-in dampener that allows the valve to actuate smoothly, which prevents the "pop-off" effect commercially available valves exhibit.
— Pressure rise up to 10% at full flow. Certification of conformity to PED
— Being an all-metal valve, it is not suitable as a pressure modulating valve. If this function is needed use an Aerzen pilot operated Aeropress or Aeropress10S pressure modulating valve.
— Materials: seat of gray cast iron and, depending on the size, a brass or anodized aluminum bell and piston, galvanized spring, steel spring rod, and an aluminum or fabricated external steel cylinder.
— Standard set points are 15.2 psig (1050 mbar) for "S" model blowers operating above 10 psi (700 mbar), and 10.9 psig (750 mbar) for all machines operating under 10 psi (700 mbar), including all "L" model blowers[3].
— The valve protects the blower stage against line surges, and spikes. It does not protect against prolonged overloads or excessive discharge temperature. Therefore, it is not an absolute protection device, nor is it "bubble tight".

Discharge check valve

* — A full-bore check valve that can be easily removed for inspection and maintenance without disconnecting the discharge piping[4]
— With its horizontal top-located steel shaft[5], the check valve naturally closes by gravity at no-flow.
— Without any springs, the check valve will not chatter, even at low flow conditions (for example in adjustable speed applications)
— Flap material: EPDM on steel for operating temperatures up to the blower limit
— Optional check valve flap material: Silicone rubber

Discharge flexible connector

— A reinforced silicone-rubber discharge flexible connector with heavy-duty clamps connects to the discharge piping.
— It prevents the transmission of structure-borne noise from the blower and its discharge silencer to the discharge piping.
* — Located downstream of the silencer and with only a small gap (~1/2") between the package and the pipe, the noise sent to the outside is maintained at a minimum.
— The sleeves are sized for standard, schedule 40 pipe diameters.

Discharge pressure gauge

— Liquid filled, 2 ½ "dial. Units: mbar and psi
— If the sound enclosure option is selected, the discharge pressure gauge is mounted to the sound enclosure wall.

[3] The valves are adjustable, and different springs are available for other set points depending upon operating conditions, motor limitations, or customer's requests.

[4] Except DN50

[5] Except DN50

Optional sound enclosure

- — Covering the entire blower package with the drive motor, the enclosure provides suitable protection for outdoor installation up to 50 mph winds and 25 lb/ft^2 snow load and rain at a 45º angle
- * — The enclosure and the blower package are both mounted on a skid / oil-drip pan, designed for meeting environmental protection standards as well as for easy transportation and installation.
- * — The unique Aerzen package design makes it possible to mount multiple blowers side-by-side without hindering access to the maintenance side (front). All pipe and wiring connections are made from the backside. This offers the best use of available floor space.
- * — All maintenance activities can be carried out from the front of the package, e.g. air filter, belts, and oil maintenance. The oil level is visible from the outside and eliminates any guesswork. Oil can be filled and drained from a common reservoir that also houses the oil level gauge.[6] The oil level check can be done with the blower in operation.
- — The enclosure reduces the package noise level to less than 80 dB(A) – 75dB(A) in most cases- at 1 m, free field, per DIN 45635.
- — Quick release panels, each less than 50 lb (as mandated by MSHA) provide quick and easy access to the blower and the package components for routine maintenance.
- * — Blower packages are fitted with a shaft-mounted cooling fan for sufficient heat removal. There is no need for a separate electric driven fan and required interlock and controls.
- — Aerzen mounts the blower package in the sound enclosure at our factory prior to shipment.
- * — Panels are made of galvanized steel sheet, with self-extinguishing, non-dripping high-density polyester foam as absorption material.
- — The enclosure is powder coated in a UV resistant Aerzen Royal Blue color, accented with light gray maintenance panels

[6] Except DN50

Hebevorrichtung für Motorwippe

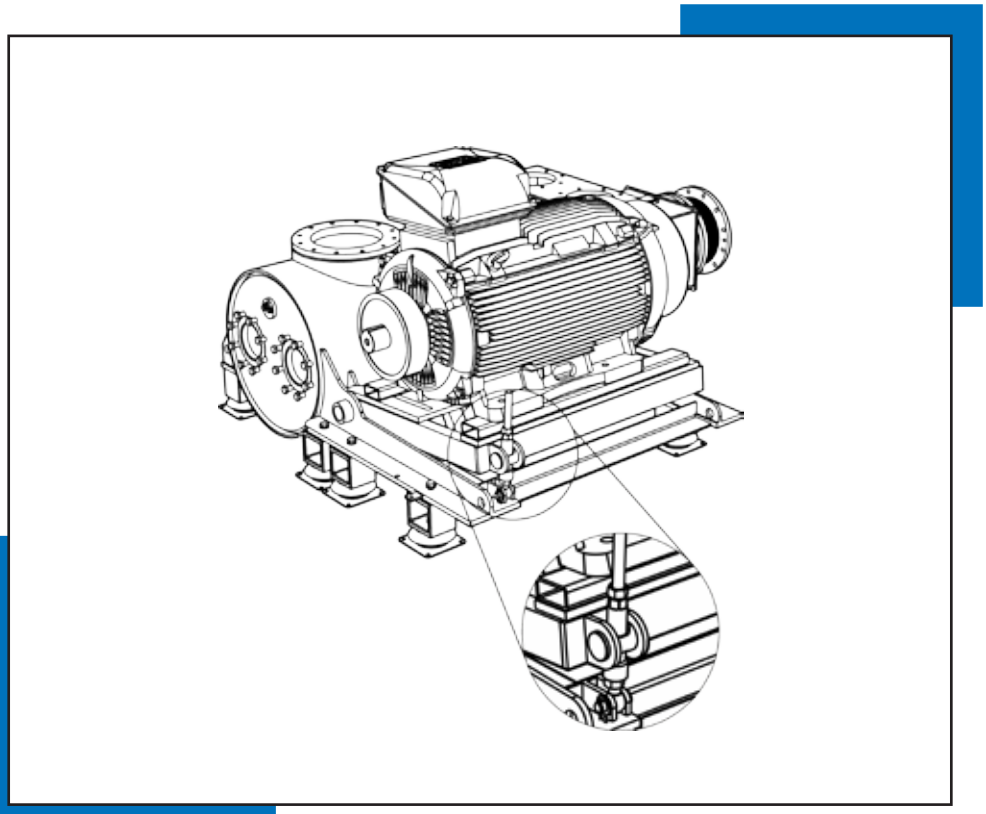
Lifting device for motor base

Dispositif de levage pour moto-interrupteur à bascule

Hijsinrichting voor motorwip

Mecanismo de elevación para base de motor

Dispositivo di sollevamento per basamento oscillante del motore



AERZEN

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Aerzener **M**aschinenfabrik
Abteilung Technische Dokumentation
Technische Illustration & Redaktion
H.Nickel Technischer Autor

Typ / *type*

Delta Hybrid
Delta Blower Generation 5
Delta Screw Generation 5

1. General notes

- This description serves as guide for the operation of the hinged motor lifting device.
- Usage requires special knowledge in using and handling this kind of machine.
- For correct operation of the hinged motor in the Delta unit, qualified and trained specialists are required.
- Only use envisaged and suitable tools for adjusting the hinged motor.

Every person involved in the adjustment of the hinged motor should read and understand this description and the corresponding operating instructions and especially the safety instructions!

WARNING!
Danger of injury if insufficiently qualified!
Incorrect use can lead to considerable personal injury and property damage.

- All actions should therefore only be carried out by adequately qualified specialists.

Specialists
are due to their technical training, knowledge and experience as well as knowledge of the relevant provisions able to carry out all work assigned to them and to recognise and avoid possible dangers.

Only personnel are allowed to work whom it can be expected to carry out the work in a reliable manner.

Persons whose responsiveness is influenced due to drugs, alcohol or medication are not allowed.

Age and job-specific regulations should be taken into consideration with the choice of personnel.

2. Safety information

The hinged motor should only be set or adjusted when the machine is not in operation and secured against reactivation!

Securing against reactivation

The machine should be secured against reactivation for all actions that require the machine to be in a non moving condition (e.g. work or fault rectification).

WARNING!
Lethal danger due to unauthorised, uncontrolled or impermissible reactivation!
Unauthorised or uncontrolled reactivation of the machine can lead to serious injuries or death!
Persons could be in the hazardous area.

Applying power can lethally injure these persons.
- Secure the main switch and lock.
- Signs should be placed on the main switch and users informed of the possible dangers.
- Before reactivation ensure that all safety equipment is assembled and fully functional and that there are no dangers existing to persons.
- Always adhere to the following procedure for securing against reactivation.

1. Switch off energy supply.
2. Secure the main switch using a lock which should be locked and a relevant sign should be placed on the main switch.
3. The key should be kept safe with a responsible person.
4. If the main switch cannot be secured, relevant signs should be placed indicating the dangers.
5. After all work is completed check that there are no persons in the hazardous area.
6. Make sure that all protection devices are installed and fully functional.
7. Unlock the main switch and remove the signs.

Typ / *type*

Delta Hybrid
Delta Blower Generation 5
Delta Screw Generation 5

CAUTION!
Danger of injury due to sharp edges and pointed corners!
Sharp edges and pointed corners can cause abrasions and cuts to the skin.
- Proceed carefully when working near sharp edges and pointed corners.
- If in doubt wear protection gloves.

WARNING!
Danger of injury due to moving and rotating components!
Moving and rotating components can cause serious injuries.
- Correctly take the machine out of operation and secure against reactivation before adjusting the hinged motor.
- During the adjustment of the hinged motor do not touch or grasp any moving components.
- Wear close fitting protective clothing with a low tear resistance when in the hazardous area.

WARNING!
Shear and crushing danger due to moving parts!
Moving components can cause shear and crushing injuries.
- Do not grasp between any moving components when working on the hinged motor.
- Never enter the swivel range of the hinged motor.

- Only use the ratchet spanner and the original mounting material that were delivered to adjust the hinged motor!

- The hinged motor should not rest on the guide bushing when in the operating position.
  Exception: Hinged motor support for motors with increased weight.

  Otherwise the belts slip and wear out sooner.
  Danger of property damage!

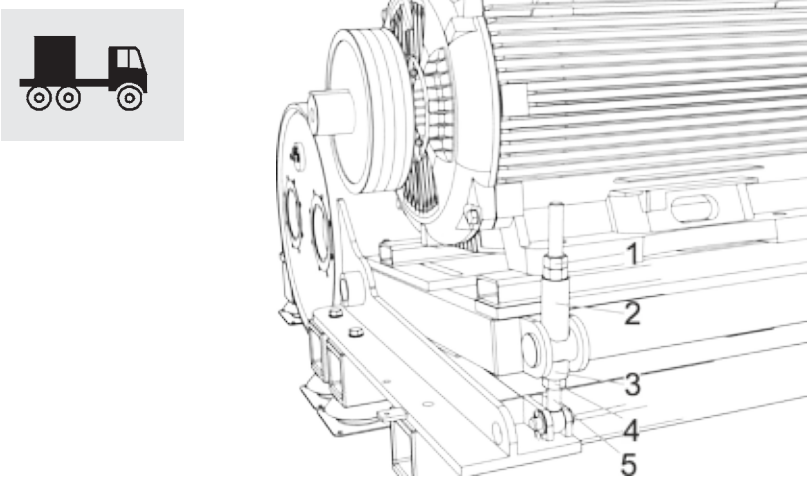
  The hinged motor should also have sufficient space to place the guide bushing after the belt has stretched.

Design with acoustic hood

- After adjusting the hinged motor correctly close the acoustic hood.

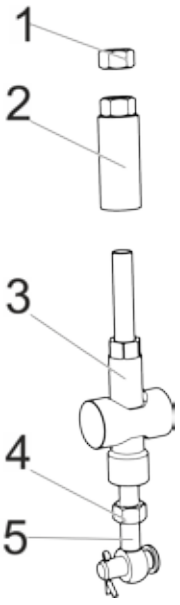
3. Delivery condition

Factory delivery condition / without drive belts.



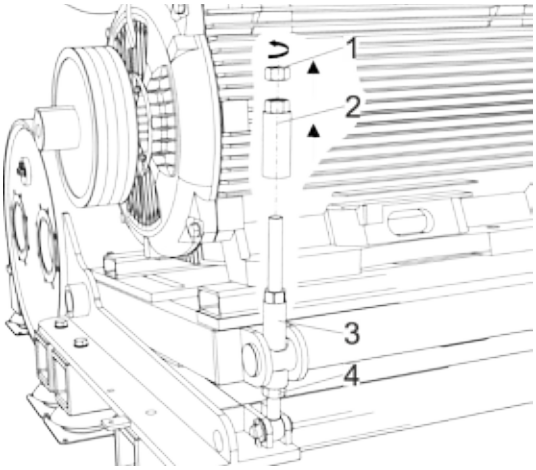
Fixed hinged motor / transportation lock

4. Assembly overview



Pos.	designation
1	Locking nut 1
2	Locking sleeve
3	Guide bushing
4	Locking nut 2
5	Eyebolt

5. Adjusting the hinged motor before commissioning



- Disassemble locking nut (1) and locking sleeve (2).

Check to direction of rotation
Observe the red direction of rotation label on the unit.
Briefly start the drive motor. (approx. 1 - 2 seconds)

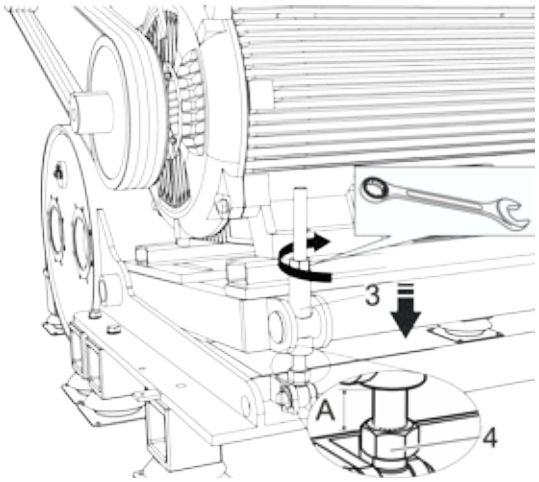
Important: WITHOUT belt on the motor disc!

Incorrect direction will destroy the unit!
Direction of the drive motor and the unit must be the same.

- Mount the belt.

Typ / *type*

Delta Hybrid
Delta Blower Generation 5
Delta Screw Generation 5



Pre tension the belt

- Screw down the guide bushing (3) with the ratchet spanner.
- The hinged motor is still slightly on the guide bushing (3).

Adjust dimension A

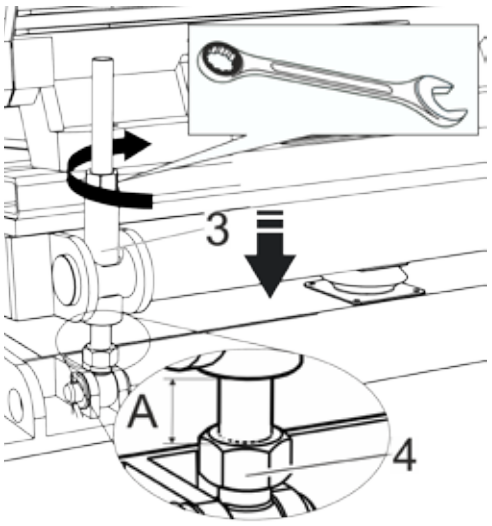
- Adjust the locking nut (4) to dimension A.
- Turn the guide bushing (3) onto the locking nut (4) with the ratchet spanner.

Delta Blower

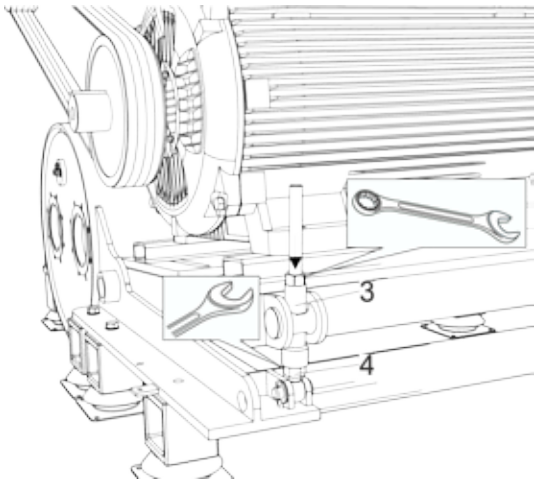
DN	dimension A in mm
80	20
100	25
125	30
150	35
200	40
250	45
300	50

Delta Hybrid

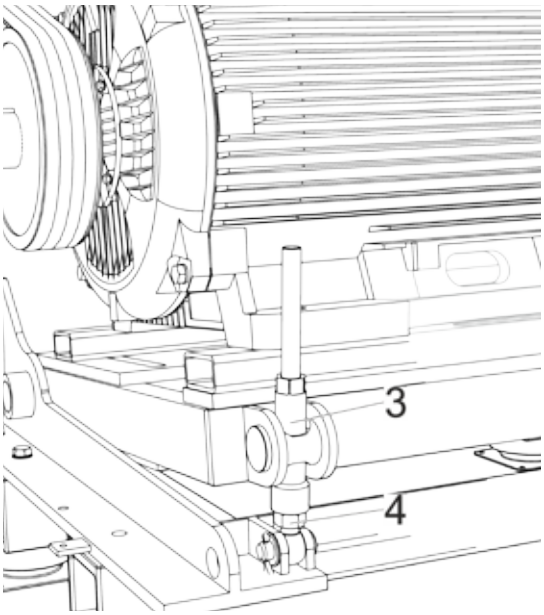
DN	dimensions A in mm
100	25
125	25
150	30
200	35
250	40
300	45



- Lock the guide bushing (3) against the locking nut (4).
- The hinged motor is completely held into place by the belt drive.



6. Operating condition, normal use



7. Adjustment of the hinged motor for truck, ship and earthquake preparation

Prepare the lifting device as with the standard application and set dimension A.

Rocker limit set to the upper position.

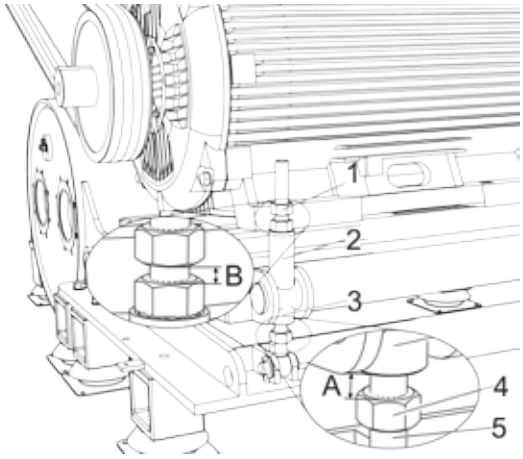
- Screw and tighten the locking sleeve (2) completely onto the eyebolt (5),
- Adjust the locking nut (1) to dimension B.

Delta Blower

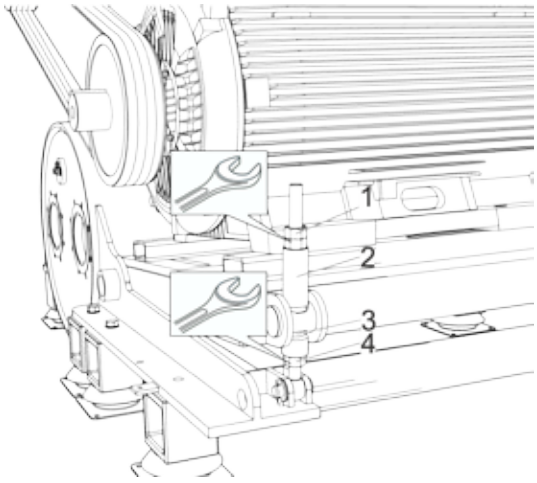
DN	Size B in mm
80	5
100	5
125	5
150	10
200	10
250	10
300	10

Delta Hybrid

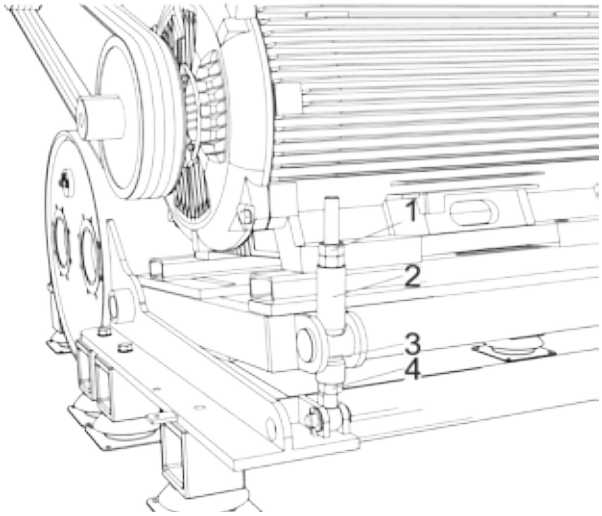
DN	Size B in mm
100	**5**
125	**5**
150	**5**
200	**5**
250	**5**
300	**5**



- Loosen the locking sleeve (2) turn upwards and lock with the locking nut (1).



8. Operating condition
Truck, ship and earthquake preparation

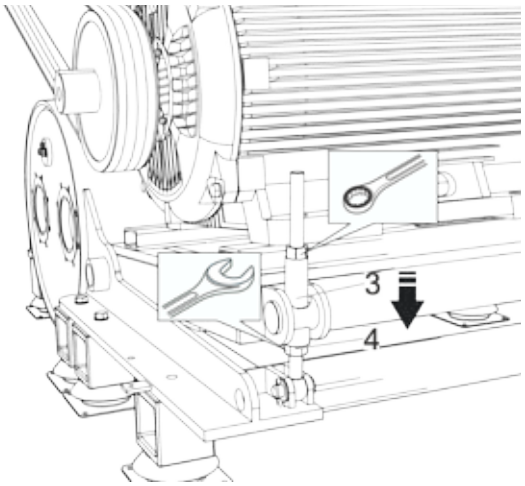


9. Adjustment of the hinged motor for rocker support

Prepare the lifting device as with normal use.

Lower the hinged motor until the belt is tensioned.

- Check the belt tension.
- If the belt tension is incorrect, lock the guide bushing (3) and the locking nut (2).
- Check the belt tension after the following intervals and adjust if necessary:
  after 24 op. hrs. after 500 op. hrs after 4000 opt. hrs

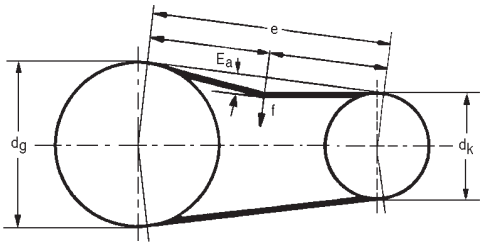


Belt tensioning

1. Set the testing force via the profile type.
2. Determine the disc diameter **dk** on the drive and derive from this the indentation depth **E.**
3. Calculate the indentation depth**Ea** with the existing axial distance **e.**
4. The testing force **f** is to be asserted in the middle of the axial distance **e** on the drive belt. The testing force should be exerted vertically on the strand! Pretension the drive to the calculated indentation depth **Ea.**

Pretension example: **Profile** = SPZ; **dk** = 100 mm; **e** = 380 mm; **f** = 2.5 daN; **E** = 2.00 mm; **Ea** = 7.6 mm

The drive belts should be re-tensioned after 30 min. of operation and be checked if possible after 24 hours.



e = axial distance
E = indentation depth every 100 mm axial distance
E_a = indentation depth of the strand
f = testing force

$$E_a = \frac{E \cdot e}{100}$$

Profile	Testing force f for each drive belt (daN)	Diameter d_k (mm)	indentation depth E (mm) each 100 mm Strand length with initial assembly	indentation depth E (mm) each 100 mm Strand length in operation after running in.
SPZ/3V XPZ/3VX	2.5	≥ 56 - 71 > 71 - 90 > 90 - 125 > 125	2.20 1.95 1.50 1.20	2.45 2.20 2.00 1.70
SPA XPA	5.0	≥ 71 - 100 > 100 - 140 > 140 - 200 > 200	2.80 2.50 2.20 2.15	3.20 2.85 2.55 2.40
SPB/5V XPB/5VX	7.5	≥ 112 - 160 > 160 - 224 > 224 - 355 > 355	2.40 2.10 1.70 1.40	3.00 2.65 2.22 1.90
SPC XPC	12.5	≥ 180 - 250 > 250 - 355 > 355 - 560 > 560	2.30 1.90 1.65 1.60	2.65 2.30 1.90 1.70

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Gegenüber Darstellungen und Angaben dieser Betriebsanleitung sind technische Änderungen,
die zur Verbesserung der Drehkolbenmaschinen notwendig werden, vorbehalten.
This operating- and installation manual is subject to engineering changes necessary for the compressor advancement.
Nous nous réservons le droit dans les instructions de service procéder à toutes modifications techniques utiles visant à améliorer la qualité des compresseurs.
Wat de betrft de tekeningen en gegevens in deze bedienings- en opstellings-hanleiding verbetering van de schroefcompressor noodzakelijk worden, voorbehouden.
Nos reservamos el derecho de efectuar, frente a las representaciones e indicaciones de esta
instrucciones de montage servicio modificaciones técnicas necesarias para perfeccionar.
Rispetto all'illustrazione ed alle indicazioni di questa Istruzioni di Esercizio ci si riserva quelle modifiche tecniche che sono necessarie per migliorare i compressori.

Technische Dokumentation

Technical Documentation

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e-mail info@airental.nl

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SECTION 3

G-5 Combination Base - Discharge Silencer

Description: Combination base - discharge silencer

Base/discharge silencer includes three-chamber reactive silencer built as a pressure vessel, blower mounting-flange with studs, discharge connection with integrated check valve, hinged motor plate, entirely supported on vibration isolating feet.

Materials of construction:

Silencer: Pressure vessel quality carbon steel S 235 JR (St 37-2) equivalent to ASTM A 283 Grade B

Pressure vessel code: PED (European directive) PED – AD 2000, DGRL 97/23/EG with consideration given to static and dynamic stress (fatigue resistance)

Maximum operating data: 150 ºC (300 ºF) and 1.1 bar gauge (16 psig)

Test pressure: 1.9 bar gauge (27.5 psig)

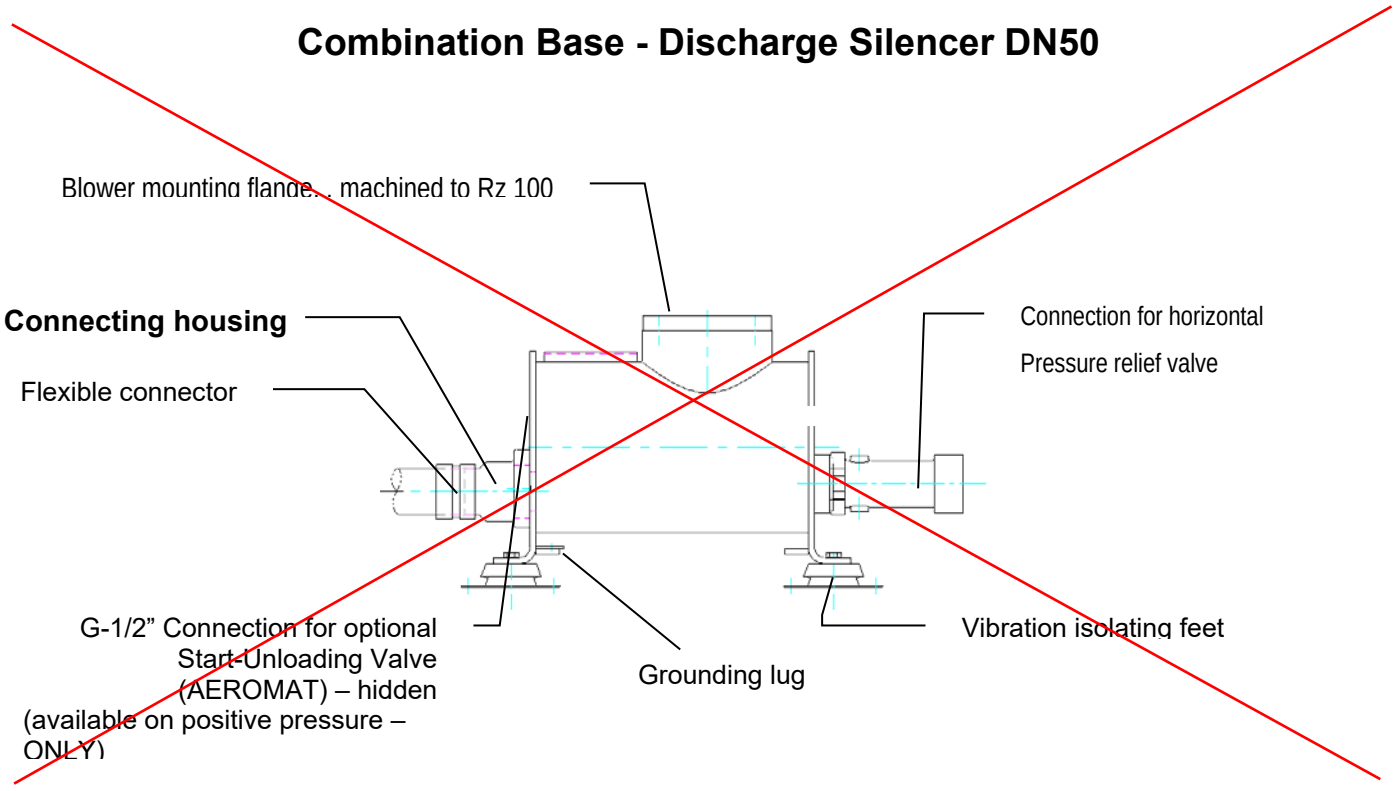
Shell wall thickness: depending on size: 6mm (1/4") for DN-50 → 15mm (5/8") for DN-300

Performance:

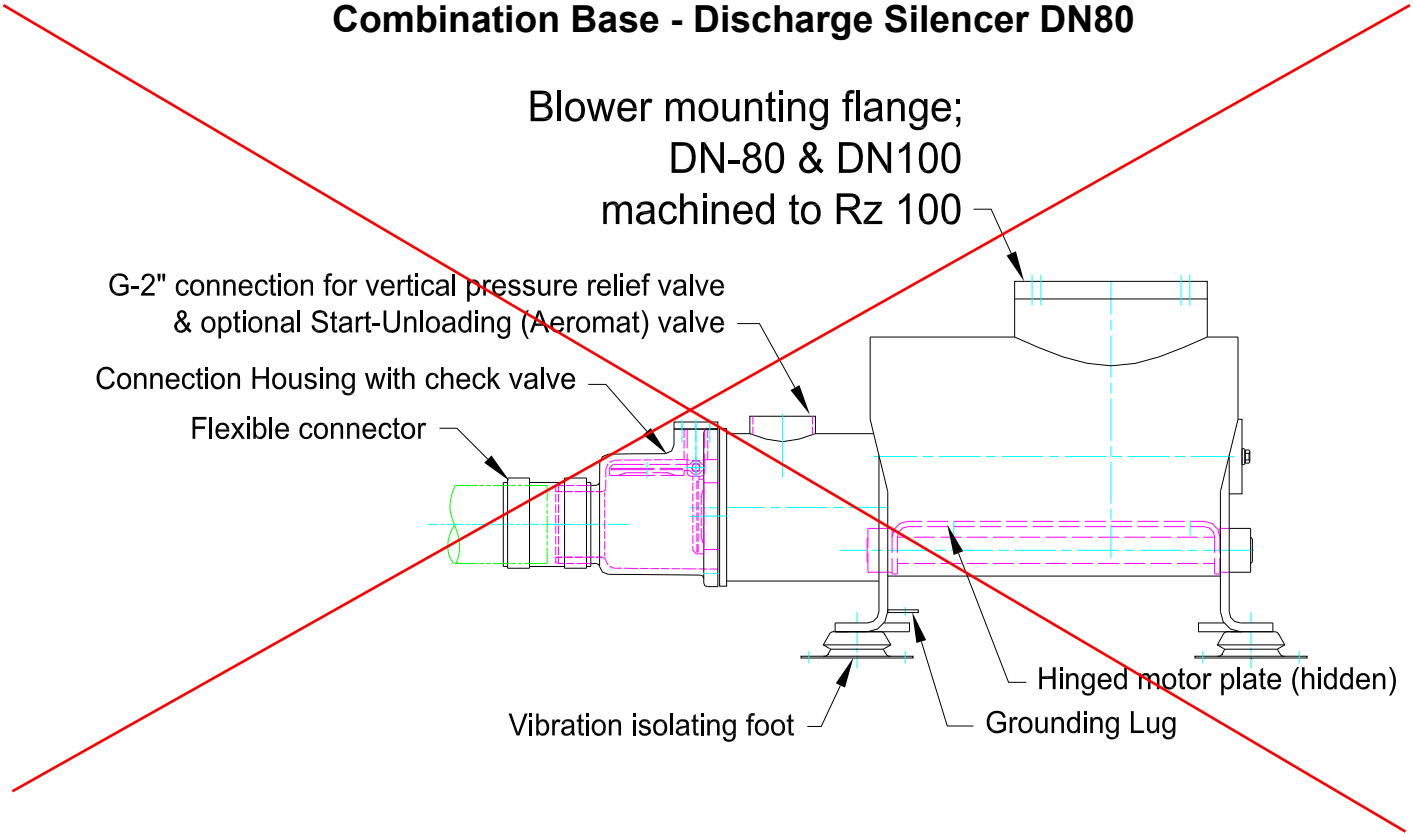
Pulsations in the air stream are reduced below the API 619 standard of 2% peak-to-peak of the mean line pressure.

Pressure drop of the entire Base-Silencer with connecting housing and check valve, at the maximum allowable flow: 35 mbar (0.5 psi); included in the power calculations of the Delta Blower package

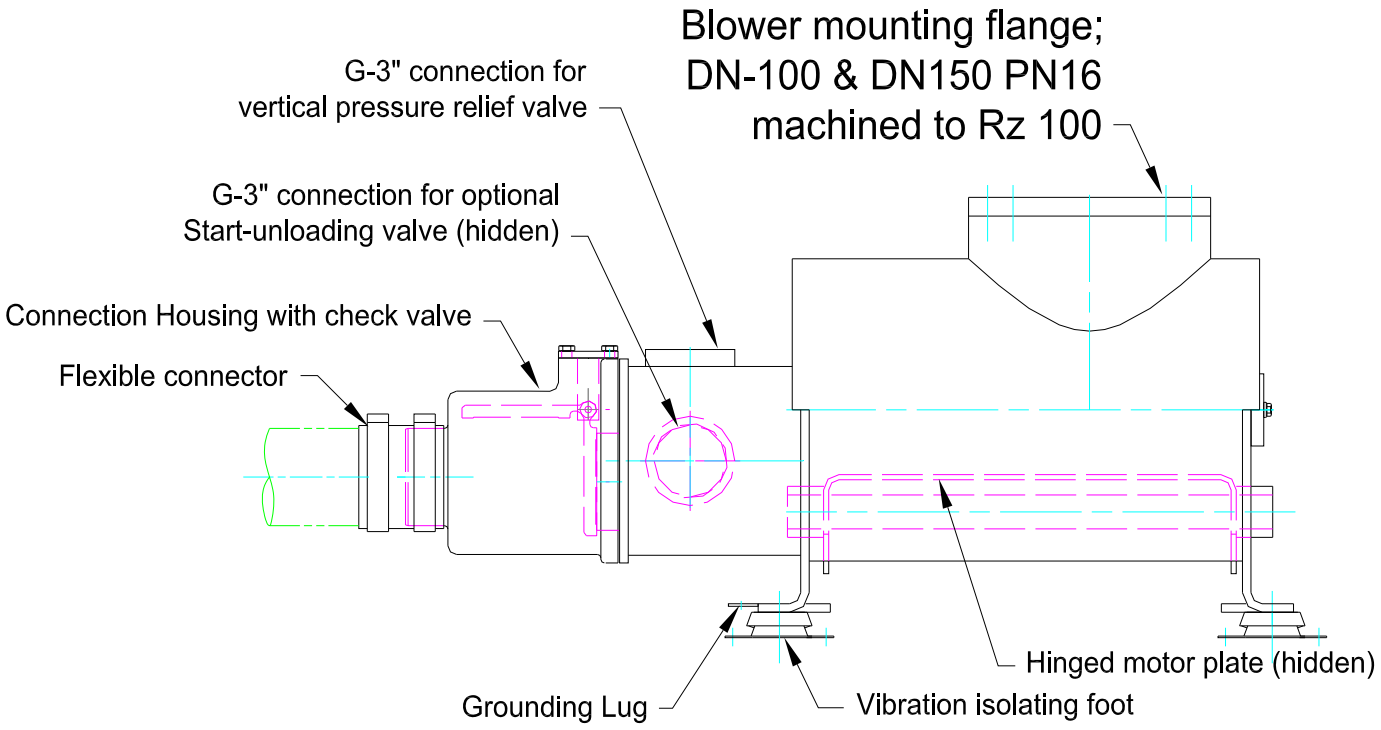
Combination Base - Discharge Silencer DN50



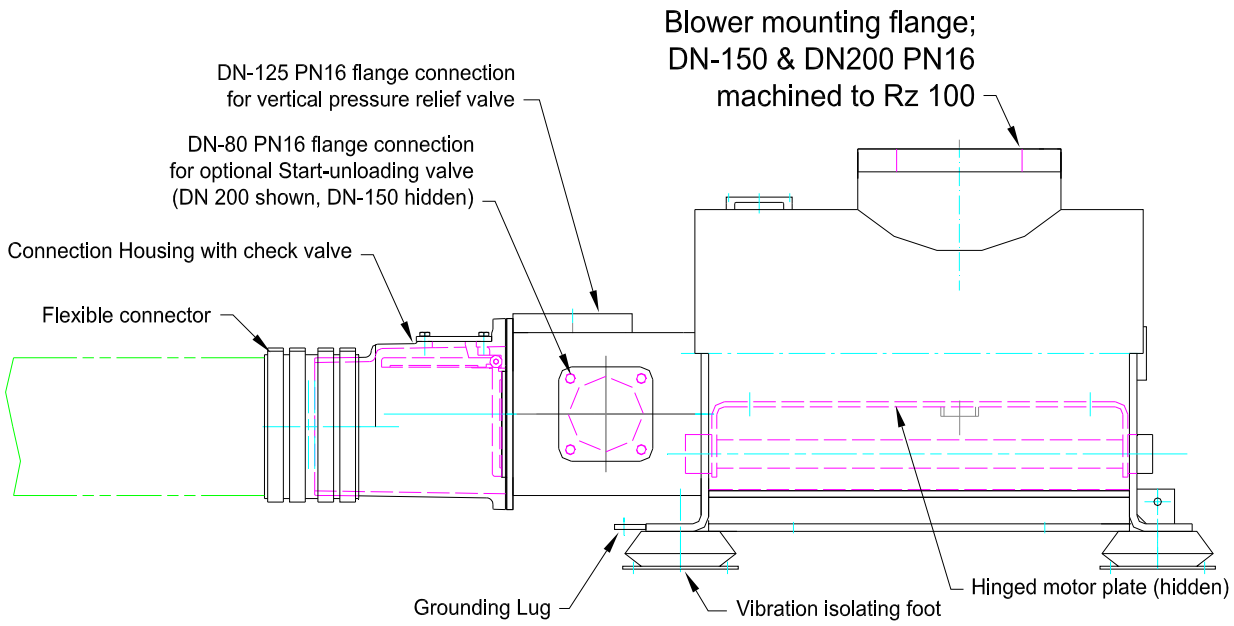
Combination Base - Discharge Silencer DN80



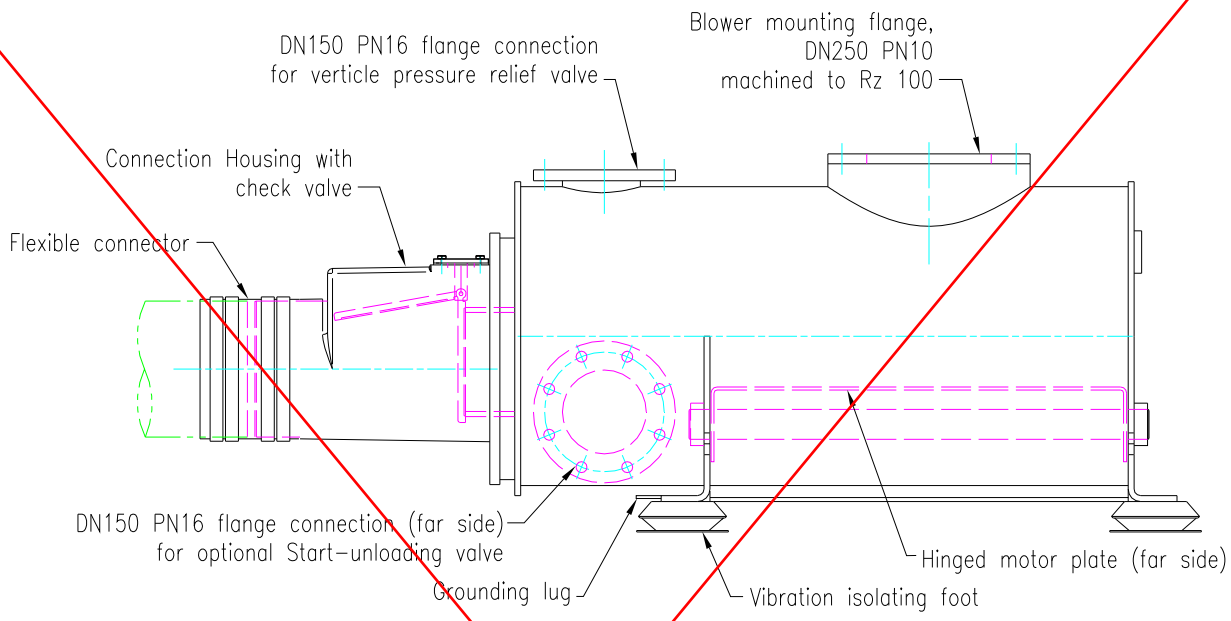
Combination Base - Discharge Silencer DN100/125



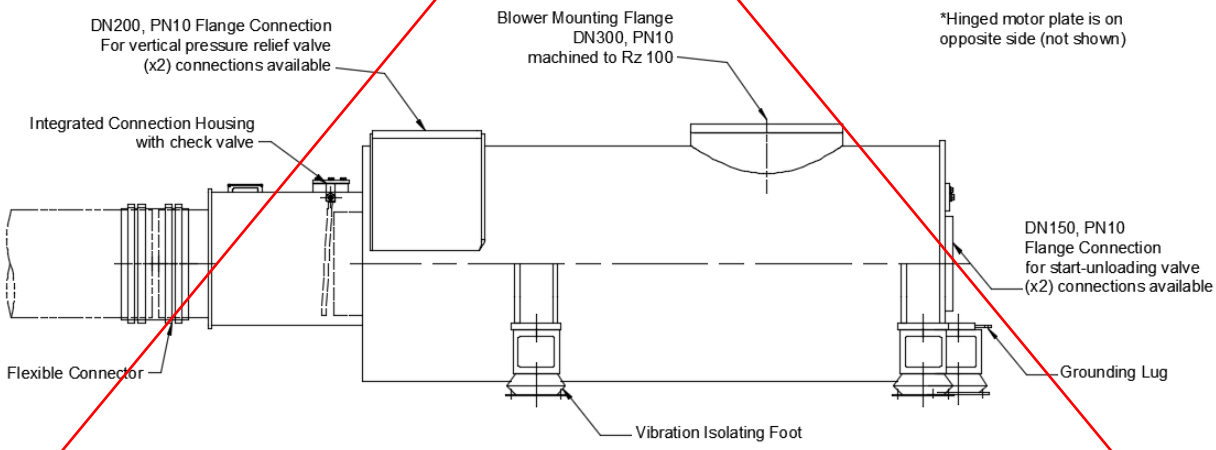
Combination Base - Discharge Silencer DN150 & DN-200



Combination Base-Discharge Silencer DN-250



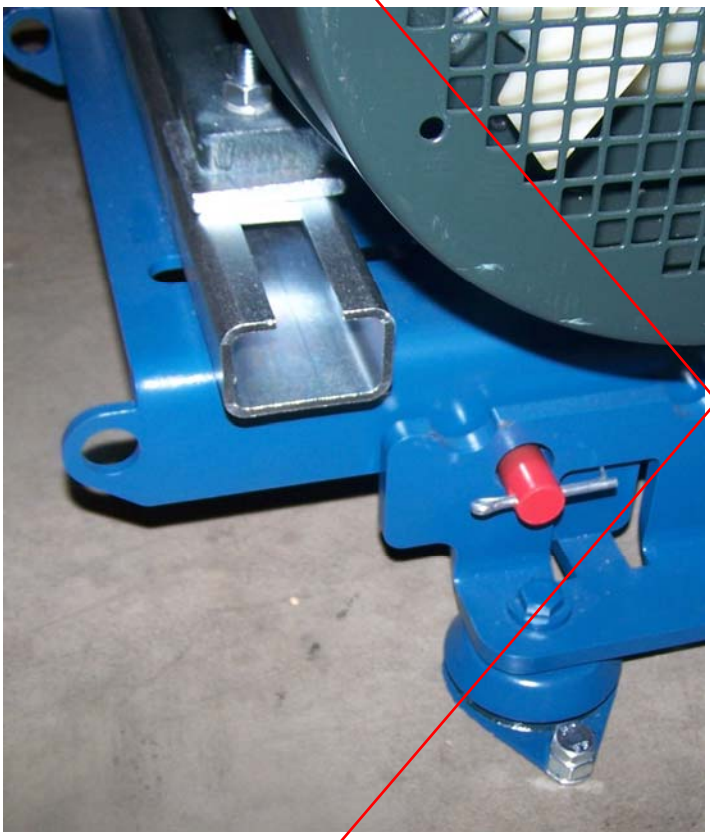
Combination Base-Discharge Silencer DN-300



Combination Base - Discharge Silencer

Hinged Motor Plate DN50 –DN80

The hinged motor plate of the base frame in sizes DN50 and DN80 allows the motor mass to properly tension the drive belts during normal operation. The motor is mounted and aligned before leaving the factory. The hinged motor plate is then locked in place for shipment. (see photo on the left below) Remove the red locking bar and use the Aerzen supplied bracket and hydraulic jack to raise the hinged motor plate for installation or maintenance of the drive belts. (see photo on the right below) Refer to the Operations Manual for commissioning and maintenance of the blower.



Hinge Plate with Locking Pin on Arrival

The red locking pin serves to keep the motor swing plate stable during shipping. Remove before attempting to raise the motor hinge plate.

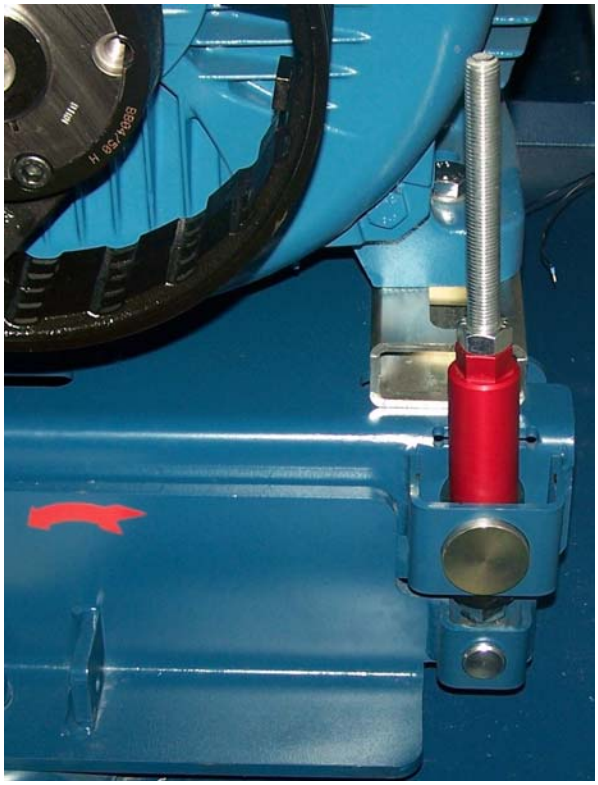
Raising the Hinged Motor Plate

Use the Aerzen supplied bracket and jack to raise the hinged motor plate when installing or maintaining the belts.

Combination Base - Discharge Silencer

Hinged Motor Plate DN100 –DN300

The hinged motor plate for sizes DN100 through DN250 features a multipurpose lifting device. In its most basic function it serves as shipping locking device (red part) preventing the motor from unwanted movement. It also serves as the lifting mechanism (black part) for changing the drive belts. During normal operation the motor mass tensions the drive belts in the tried and true Aerzen way. The motor swing plate does not rest on the lifting mechanism (see photo on the right below). No special adjustments are necessary during normal operation of the blower package. Another additional purpose is limiting the belt tension when oversized motors are used. Finally, the device can be configured to aid limited movement for seismic or mobile blower package service. Refer to G4-079 B XT for operation of Multipurpose Lifting Device. Depending on motor weight, DN300 units can have (1) or (2) lifting devices.

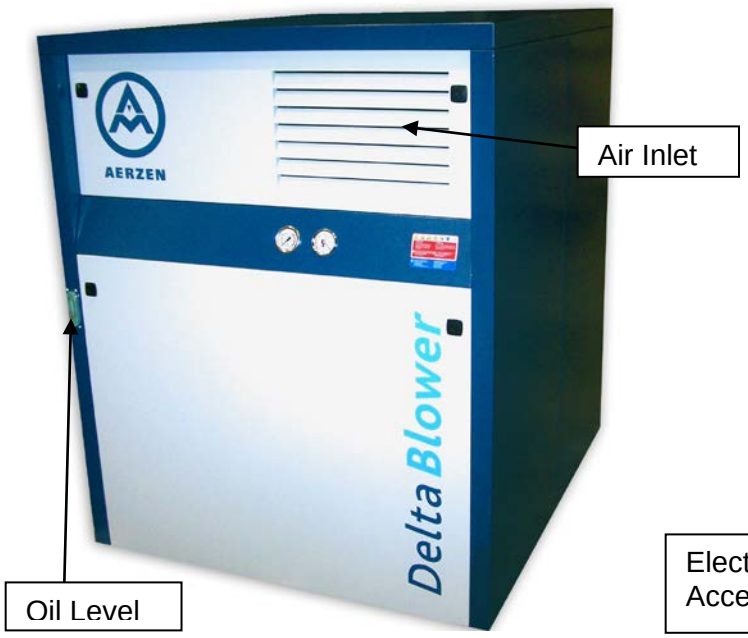


Lifting Device on Arrival

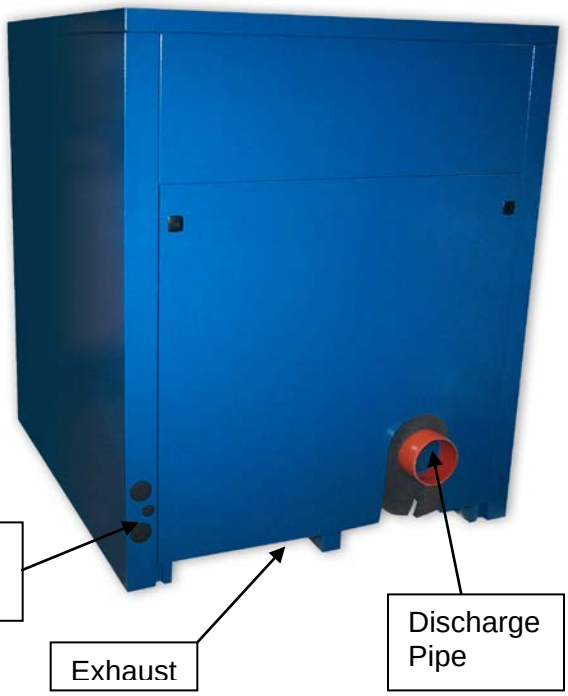
The red locking sleeve serves to keep the motor swing plate stable during shipping. It may also be used in seismic and mobile applications as a motor swing stop

Lifting Device in Normal Operation

The black guide bushing serves as a belt installation aid. Using an Aerzen supplied ratchet wrench, it helps lift the motor swing plate during belt installation and maintenance. Once new belts are installed it is backed down to the lock nut. **The motor hinge plate does not rest on the guide bushing during normal operation**. The guide bushing may also be used as tension limiter for use with overweight motors.



Shown is a DN-125 Sound Enclosure



Rear View of the Enclosure

Description: The sound enclosure surrounds the entire blower package to reduce noise and protect the machine from the weather while allowing easy access for maintenance. The base of the enclosure supports the entire blower package and contains an oil drip pan for environmental protection. Aerzen mounts the entire blower package within the sound enclosure at the factory prior to shipment. Transportation and installation are simplified by having the entire package supported and contained within the enclosure. The unit may be moved with a pallet jack or forklift.

The sound enclosure is designed with strategic consideration for airflow through the unit. A fan is mounted on the end of the blower shaft, so there is no need for a separate electric motor driven fan. From the cool, front side of the blower, air is drawn in through a sound trap. The air then passes over the motor and blower housings and finally is exhausted through the floor at the rear of the unit.

Quick release panels, each less than 45 lbs., provide access for routine maintenance of the blower and the package components. All maintenance and connections are located in the front and rear, allowing multiple machines to be placed side-by-side.

The oil level gauge is visible from the outside of the sound enclosure in sizes GM 4S DN-80 through GM 150 S DN-300 with the oil fill port and drain mounted to the enclosure just inside a removable panel.

The smallest size, GM 3S DN-50, has an easily removable roof to facilitate maintenance.

Materials:

Base pan – Polyester based powder coated steel weldment, 3 to 5 mm thick

Exterior panels - Polyester based powder coated galvanized steel

Sound insulation -Self-extinguishing, non-dripping high-density polyester foam

Technical:

Package noise level reduced to 80 dB, or less, at 1 m, free field, per DIN 45635.

Snow Load – 122 kg / m^2 (25 lbs / ft^2)

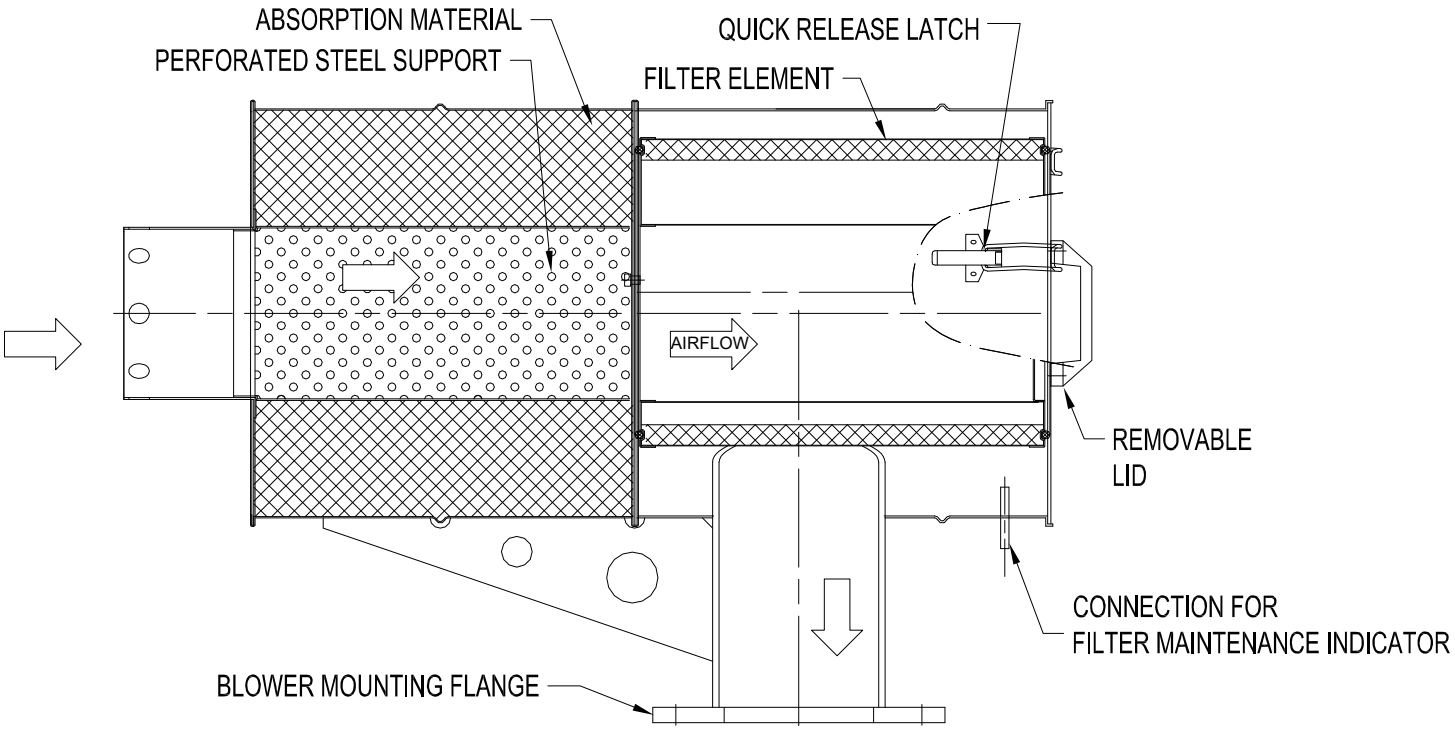
Wind Load – 80.4 km / hr (50 mph)

Suitable for indoor or outdoor installation

Part Numbers:

Size	Part No.
DN-050	180723
DN-080	180724
DN-100	180725
DN-125	
DN-150	180740
DN-200	180741
DN-250	181753
DN-300	184737

G5 Pressure Inlet Filter/ Silencer
DN 50 - DN 300



Description: Combination dry air intake filter and absorption type silencer with filter (or strainer) element located downstream from the silencer chamber

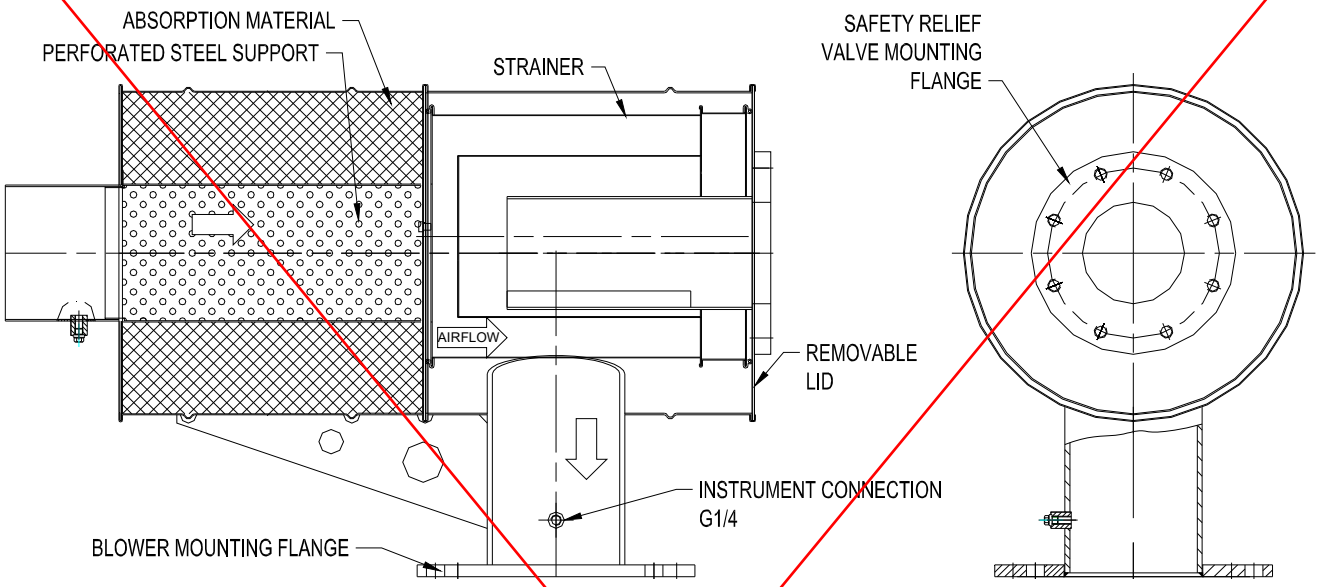
Materials of construction:

Casing:	Powder coated (RAL# 5001) Carbon Steel
	Maximum operating data: 60 °C (140 °F) and – 70 mbar (-2.07"Hg)
	Removable maintenance lid is held in place with quick release clamps
Absorption material:	Flame retardant, polyester based urethane foam, grey in color,
	secured in place with perforated steel
Filter element:	Thermally bound, food safe, polyester fibers, free of PVC, white in color
	Filter element mounts with a quick release turn and lock arrangement.

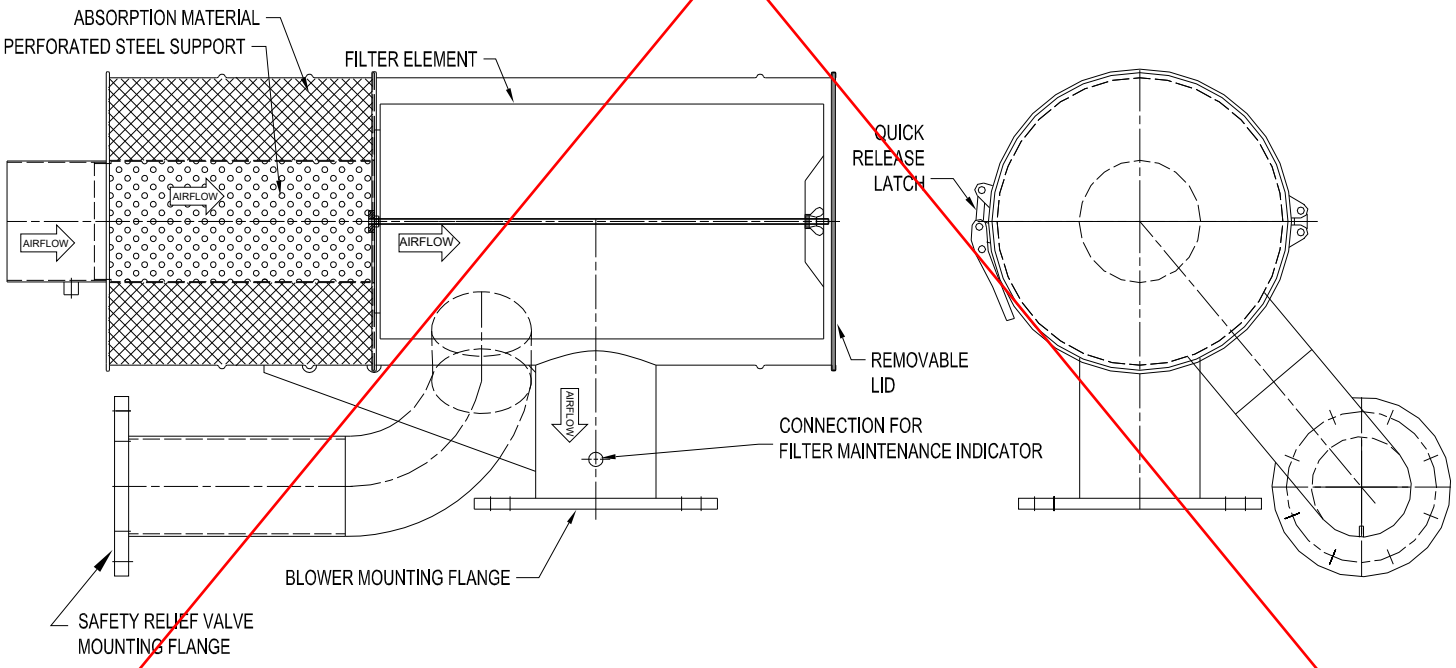
Performance:

Filtration class: G4 per EN 779 (greater than 90% of synthetic dust particles),
equivalent to ASHRAE 52.2 MERV 7 (50-70% @3-10 microns)
Pressure-drop of the entire silencer and clean filter at the maximum allowable flow: 10 mbar (0.15 psi)
Pressure drop filter element: 5 mbar (2" WC) clean, or replace at 45 mbar max. (18" WC)
Noise reduction: 10-15 dB mean noise reduction across audible octave bands

G5 Vacuum Inlet Silencer w/ Internal Strainer (No Filter)
DN 80 - DN 200



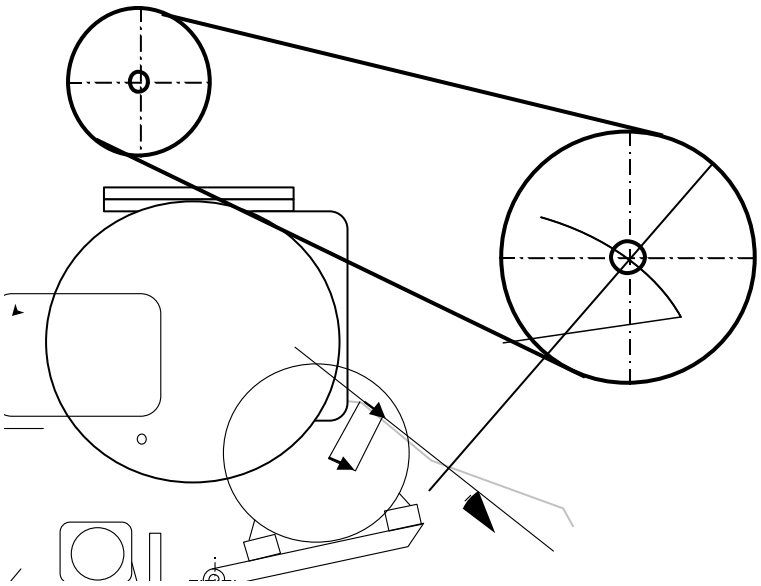
G5 Vacuum Inlet Filter/ Silencer
DN 80 - DN 200



G5-WA Inlet Silencer Part Numbers

Filter nominal size	DN50	DN-80		DN-100	DN-125	DN-150		DN-200	DN-250	DN-300
Blower size	**GM3S**	**GM 4S GM 7L**	**GM 10S**	**GM 10S GM 15L**	**GM 25S**	**GM 30L GM 35S**	**GM 50L**	**GM 50L GM 60S**	**GM 80L GM 90S GM 100S**	**GM 130L/ GM 150S**
Pressure Filter / Silencer Assembly	182111	182112	182113	182114	182115	182116	182117		183114	184444/ 184443
Pressure Replacement Filter Element	175884	175239		175240		175241	176206		170836	170837
Vacuum Inlet Silencer Assembly (No Filter)	182119	182120	182121	182122	182123	182124		182125	N/A	
Vacuum Filter / Silencer Assembly	N/A	184238001	184239001	184234001	184235001	186234000		184252001	N/A	
Vacuum Replacement Filter Element	N/A	2000008104		2000008109		185662		2000008113	N/A	

Aerzen Delta Blower + G5

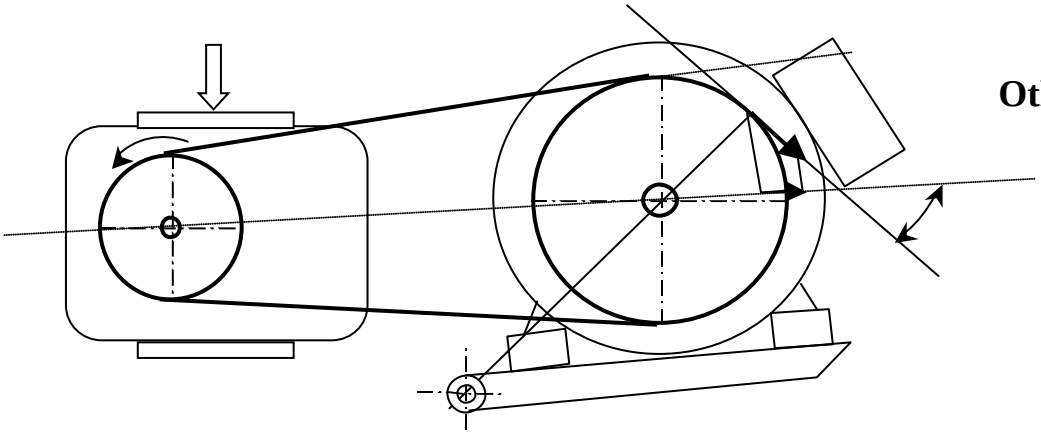


The drive configuration of the Aerzen Delta Blower is such that any change in the belt length (due to belt stretching) results in a nearly proportional displacement of the motor. Therefore, the motor weight alone can be used reliably for automatic belt tension adjustment.

This, however, is not achievable with a different geometry, such as shown below: In such cases, a slight change in the belt length requires a much greater displacement of the motor making a manual adjustment necessary. Improper adjustment leads to belt failure and other, more significant damages can follow.

Our belt tensioning principle offer two more benefits to the user, which are superior to any other system offered: We do not need any other tensioning mechanisms to tension the belts. This eliminates further wear and tear items that the user does not have to maintain or even check up on. Secondly, we have eliminated the need for re-aligning the motor upon changing belts. The motor stays put and is merely pivoted up and down during a belt change.

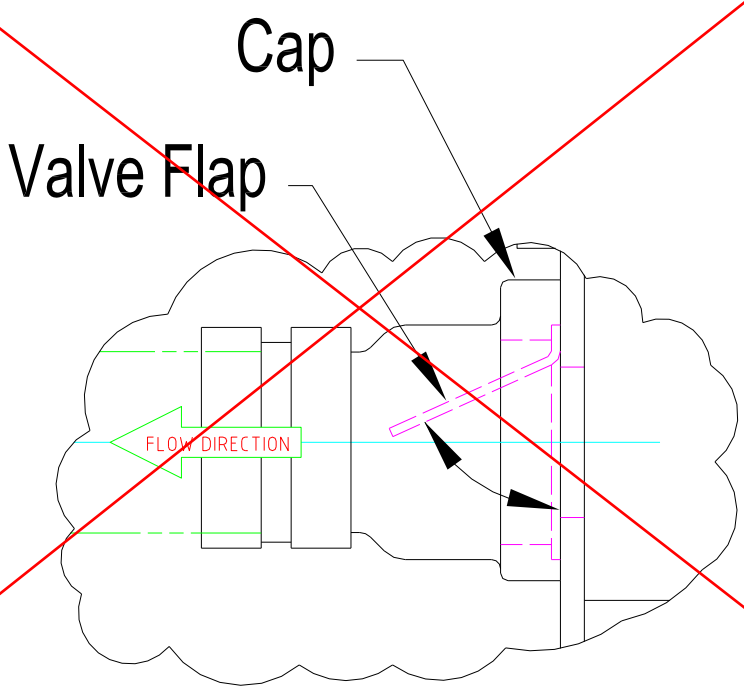
Others



DN-50 Check Valve

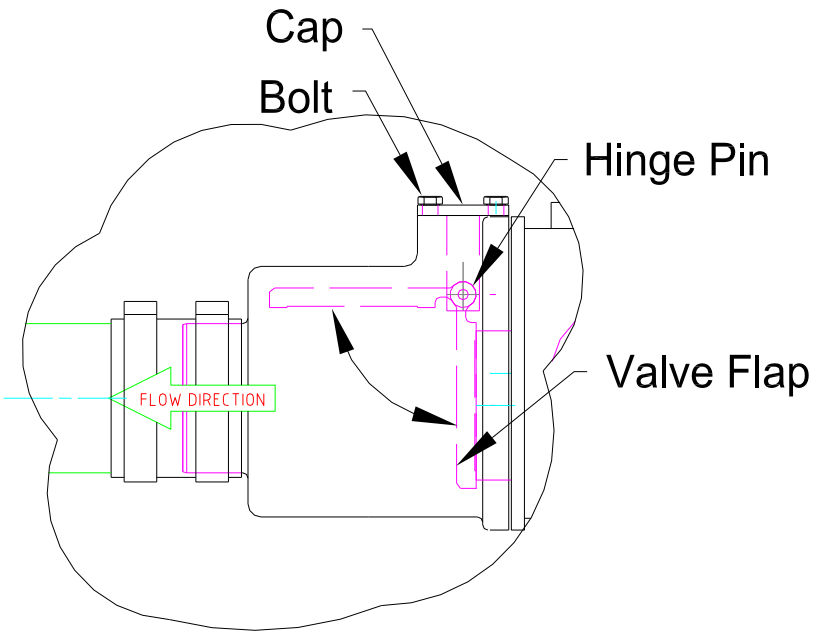
Description: The DN-50 check valve is a full-bore, cast aluminum housing with an embedded Viton flap sandwiched between the connection housing and the baseframe. The hinge is integrated to the rubber and closes naturally by gravity without use of a spring. Operating range is up to 150°C or 302°F.

Check Valve Assembly w/ Viton flap P/N: **146756**



Check Valve - DN-80 Through DN-300

Description: Housed in the connecting housing is a full-bore, steel embedded in rubber check-valve that closes naturally by gravity without use of spring. The check-valve flap can easily be pulled out for inspection, maintenance or replacement without disconnecting the piping: removing the bolts and lifting the cap.



Materials of construction:

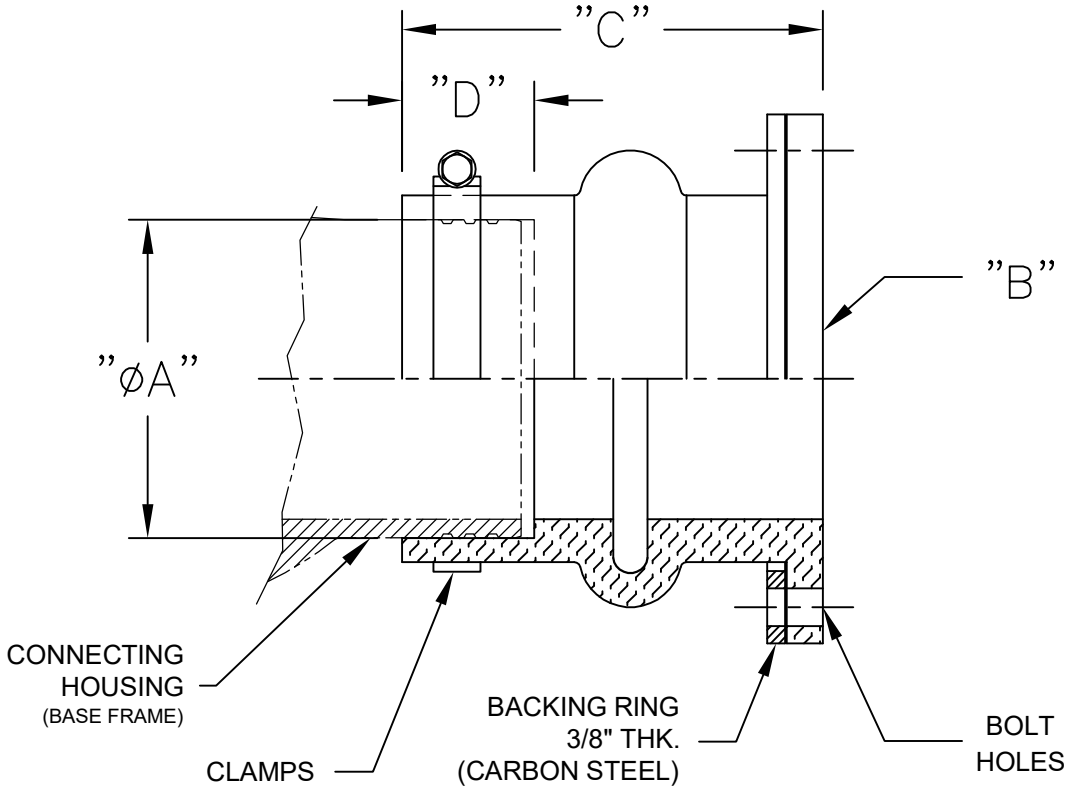
Temperature	Flap Sealing Material
Up to 149 °C (300 °F)	EPDM (standard)*
~~Up to 200 °C (392 °F)~~	~~Silicon*~~

*DN-250 & DN-300 units: Stainless steel plate with outer ring made of the sealing material

**DN-200 and smaller units: Steel plate fully embedded in the sealing material

Part Numbers:

Size DN	EPDM Check Valve Assembly P/N	EPDM Flap Only P/N	~~Silicone Check Valve Assembly P/N~~	~~Silicone Flap Only P/N~~
80	178653	178647	~~180877~~	~~178650~~
100	178654	178648	~~180878~~	~~178651~~
125	178654	178648	~~180878~~	~~178651~~
150	178655	178649	~~180879~~	~~178652~~
200	178655	178649	~~180879~~	~~178652~~
250	168705	N/A	~~168711~~	~~N/A~~
300	158608	N/A	~~178266~~	~~N/A~~



MEDIA BEING CONVEYED = AIR OR NITROGEN

BACKING RING INCLUDED WITH JOINT

MATERIALS OF CONSTRUCTION: EPDM

MATERIAL	MAX. TEMP.	DESIGN PRESSURE
EPDM	300°F	-15"Hg to 25 psig

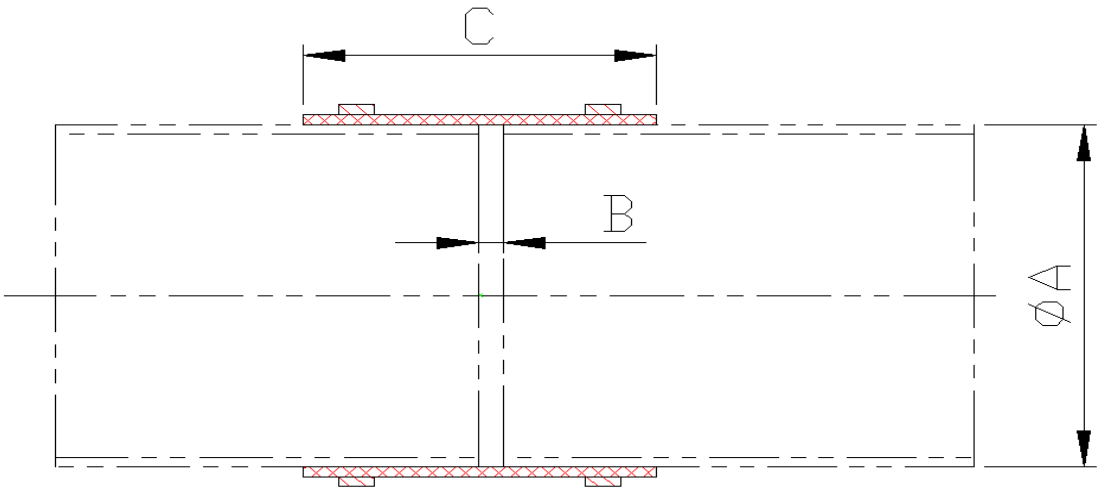
PACKAGE SIZE	Ø A (Sleeve ID)	B (150# ANSI Flange size)	C (Length)	D (Pipe Engagement)	PART No. 21-003168-____ MATERIAL EPDM	EXPANSION JOINT SPECIFICATIONS				CLAMPS	
						AXIAL COMPRESSION	AXIAL EXTENSION	LATERAL OFFSET	ANGULAR ROTATION	QTY	PART No. 21-000910-____
DN-050	2 3/8	2	8.00	2.31	-02X02EG	0.50	0.25	0.50	2°	1	_079-085
DN-080	3 1/2	3	8.00	2.31	-03X03EG	0.50	0.25	0.50	2°	1	_104-112
DN-080	3 1/2	4	8.00	2.31	-03X04EG	0.50	0.25	0.50	2°	1	_104-112
DN-100	4 1/2	4	8.00	2.31	-04X04EG	0.50	0.25	0.50	2°	1	_130-140
DN-125	5 9/16	5	9.00	2.5	-05X05EG	0.50	0.25	0.50	2°	2	_150-162
DN-125	5 1/2	5	9.00	2.5	-05X05EG-A1	0.50	0.25	0.50	2°	2	_150-162
DN-125	5 9/16	6	9.00	2.5	-05X06EG	0.50	0.25	0.50	2°	2	_150-162
DN-125	5 1/2	6	9.00	2.5	-05X06EG-A1	0.50	0.25	0.50	2°	2	_150-162
DN-150	6 5/8	6	9.00	2.5	-06X06EG	0.50	0.25	0.50	2°	2	_187-200
DN-150	6 5/8	8	10.00	2.5	-06X08EG	0.50	0.25	0.50	2°	2	_187-200
DN-200	8 5/8	8	10.00	2.75	-08X08EG	0.75	0.25	0.50	2°	2	117191 (AMD)
DN-200	8 5/8	10	10.00	2.75	-08X10EG	0.75	0.25	0.50	2°	2	117191 (AMD)
DN-250	10 3/4	10	10.00	2.75	-10X10EG	0.75	0.25	0.50	2°	2	_290-305
DN-250	10 3/4	12	10.00	2.75	-10X12EG	0.75	0.25	0.50	2°	2	_290-305
DN-300	12 3/4	12	10.00	2.75	-12X12EG	0.75	0.25	0.50	2°	2	160404000

* Dimension in INCHES

Aerzen USA Corp.
108 Independance Way, Coatesville PA, 19320
(610) 380-0244 PH, (610) 380-0278 FX
www.aerzenusa.com

EPDM EXPANSION JOINT WITH CLAMPS
PIPE SLEEVE TO ANSI FLANGE

DATE	DOCUMENT NO.	REVISION	SHEET
7/29/2013	XA-005207_EG	B	1 of 1



Nominal Pipe		Sleeve	Pipe O.D A		End Clearance B		Maximum Misalignment		Sleeve Length C		# of clamps	Clamp P/N
DN	USA	P/N	mm	in.	mm	in.	mm	in.	mm	in.		
50	2”	176095	60.3	2-3/8	10	3/8	1	.04	50	2	2	168036
80	3”	159128	88.9	3-1/2	10	3/8	1	.04	100	4	2	163238
100	4”	159129	114.3	4-1/2	10	3/8	2	.08	100	4	2	169603
125	5”	162677	139.7	5-1/2	10	3/8	2	.08	150	6	2	162923
150	6”	159131	168.3	6-5/8	10	3/8	3	.12	150	6	4	165903
200	8”	159132	219.1	8-5/8	10	3/8	4	.15	150	6	4	168658
250	10”	159134	273	10-3/4	15	5/8	6	.23	200	8	4	159353
300	12”	159135	323.9	12-3/4	20	3/4	10	.39	200	8	4	160404
400	16	157607	406.3	16	20	3/4	12	.47	300	12	4	157608

Technical Data

Maximum operating pressure: 1.2 bar g (17.4 psig)

Test pressure: 2.4 bar (34.8 psig)

Operating temperature –40 to 180°C (-40 to 356°F)

Materials

Silicone Rubber with embedded woven fiber reinforcement up to DN-300

Perbunan rubber in DN-400

60 +/- 5 Shore A

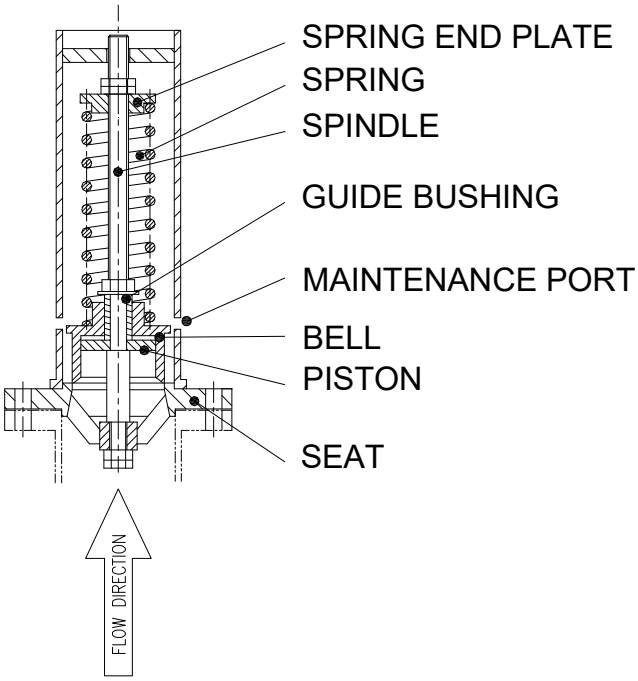
Shelf-life: up to 20 years, under clean, cool & dry conditions

CAUTION:

- Pipe misalignment could cause leaks and premature failure of the sleeve.
- It is imperative to maintain the recommended pipe-end clearance for the pipe connection to retain its flexibility, and reduce the transmission of noise and vibrations from the blower package to the process piping.

Description:

The Pressure Relief Valve is designed for use with air or inert gasses to protect the blower and its accessories from damage in the event of excessive pressure. It is not to be used as a pressure regulating device. It contains a spring-loaded valve guided by a spindle and surrounded by a protective sheath that is capable of venting the entire volume flow of the blower. In positive pressure machines, it is installed downstream from the positive displacement blower and before the check valve or any shut-off valve. In vacuum applications, it is installed on the intake side of the blower.



QTY	DESCRIPTION	MATERIAL
1	Connection Flange or Thread with Valve Seat	Grey Cast Iron
1	Valve Spindle	Carbon Steel
1	Bell	Brass
1	Spring End Plate	Carbon Steel
2	Hex Nut	Carbon Steel

QTY	DESCRIPTION	MATERIAL
2	Guide Nut	Carbon Steel
1	Spring	Spring Steel
1	Valve Disc / Piston	Brass
1	Valve Guide / Bushing	Brass
1	Cover	Aluminum

Technical Data:

Maximum Temperature: 150° C (302° F)

Conforms to PED 97 / 23 / EG

Maximum Pressure: 1.1 Bar (15.9 PSIG)

Valve Characteristic: Proportional

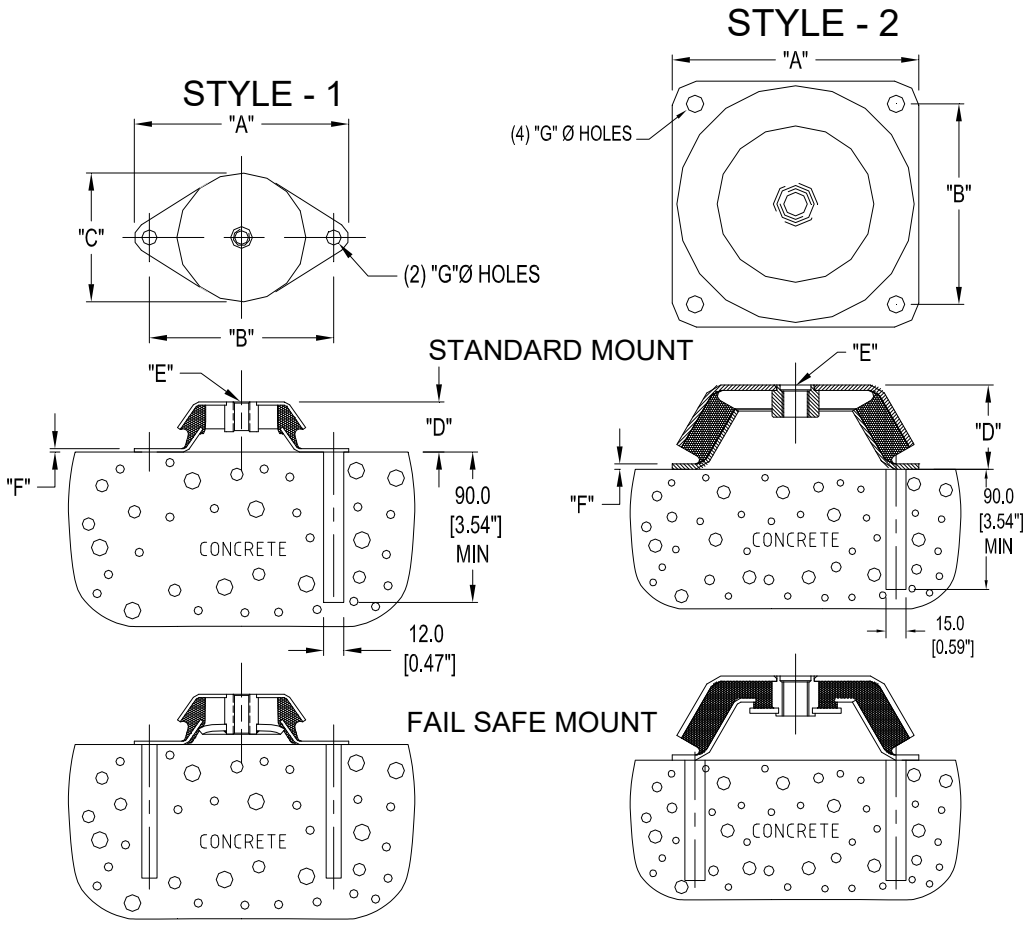
Pressure Rise: 10%

Relief Valves

Nominal Package Size	Blower Designation	Valve Size	Positive Pressure Valve Connection	Vacuum Valve Connection
DN-50	GM 3S	DN -50	G-2” External	DN-50 PN 16 Flange
DN-80	GM 4S			
	GM 7L			
	GM 10S			
DN-100	GM 10S	DN-80	G-3” External	DN-80 PN 16 Flange
	GM 15L			
DN-125	GM 25S			
DN-150	GM 30L	DN-125	DN-125, PN16 Flange	DN-125, PN16 Flange
	GM 35S			
	GM 50L			
DN-200	GM 50L			
	GM 60S			
DN-250	GM 80L	DN-150	DN-150, PN16 Flange	DN-150, PN16 Flange
	GM 90S			
	GM100S			
DN-300	GM 130L	DN-150	DN-150, PN16 Flange	DN-150, PN16 Flange
	GM 150S			

Maintenance:

Periodically inspect for free movement of the valve. While the machine is stopped and the motor locked out, insert flat blade screw drivers into both maintenance ports and lift the valve. Remove the screw drivers and visibly ensure the valve is properly seated. When operated in clean environments, inspect valve either every six months or 1000 run hours, whichever occurs sooner. In dusty conditions, inspect every month. Refer to document G4-002 for complete operating instructions.



Only (1) anchor per foot is required for Standard mounts, anchor each hole (“G”) for Fail-safe mounts.

Standard mounts are not recommended for use where negative loads occur, (marine or earthquake zones) use Fail-safe mounts or contact Aerzen for alternates.

All vibrations isolators have a natural frequency that will not interfere with the fundamental blower package frequencies.

Baseframe	Standard P/N	Fail Safe P/N	Style	A (mm)	B (mm)	C (mm)	D (mm)	E	F (mm)	G (mm)	Maximum Load Per Foot		Recommended Anchor
											KN	Lbf	Aerzen P/N
DN-50	175802	184818	1	127	110	77	30	M10	2	9	1,4	315	120813
DN-80	176394	184819	1	127	110	77	30	M10	2	9	2	450	120813
DN-100													
DN-125													
DN-150	177128	184820	2	168	132	-	50	M16	4	13	4	899	120835
DN-200	177129	184821	2	184	150	-	60	M20	4.5	13	9	2023	120835
DN-250			2	184	150	-	60	M20	4.5	13	9	2023	120835
DN-300													

Aerzen USA Corporation
108 Independence Way – Coatesville, PA 19320
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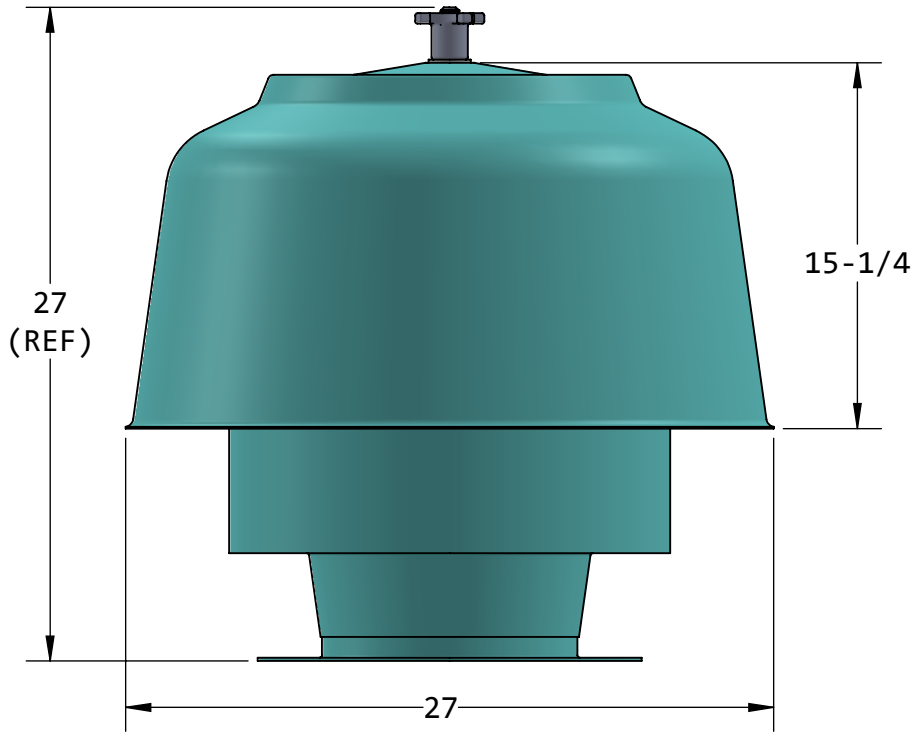
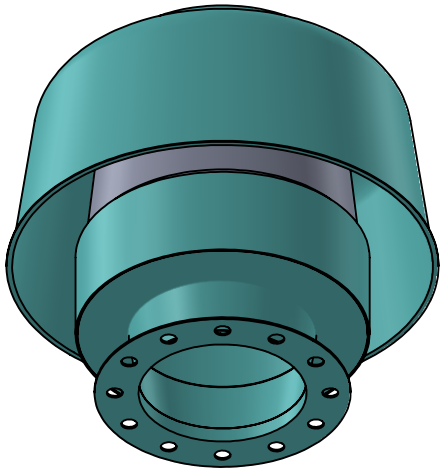
www.aerzen.com/en-us

Vibration Isolators – G5 Blowers

Date	Doc #	Page
9/5/2019	B-6-0194 revision “J“	Page 1 of 1





SPECIFICATIONS

1. ENDUSTRA TRI-VENT® SERIES P09 INTAKE FILTER SILENCER
2. 10" 125/150# ANSI FLANGE DRILLING OUTLET (16 OD W/ QTY (12) 1" HOLES ON 14-1/4 BCD)
3. 1590 SCFM @ 1/2" WG MAX INITIAL; NOT TO EXCEED 12" WG
4. INCLUDES 316 STAINLESS STEEL TRI-VENT® ELEMENT W/ ALUMINUM WIRE MESH MEDIUM, 60% AC FINE DUST
5. NO-TOOLS ELEMENT CHANGES
6. POWDER COATED
7. WEIGHT: 75#
8. HOOD: 20#
10. ELEMENT: 20#

TRI-VENT® ELEMENT P/N: E049445T316

ENDUSTRA FILTER MFG

CUSTOMER:	AERZEN USA	PART NO:	P09RK-E049445T316		
QUOTE:		DWG NO:	J112520-6		
ATTENTION:		ORIGINAL:	11/25/2020	DRAWN BY:	JRB
		REVISION:		CERT BY:	REG
		SCALE:	1:8	APPROVAL:	
		TOLERANCES:	±1/8	DATE:	
		DIMENSIONS:	INCHES	SHEET 1 OF 1	

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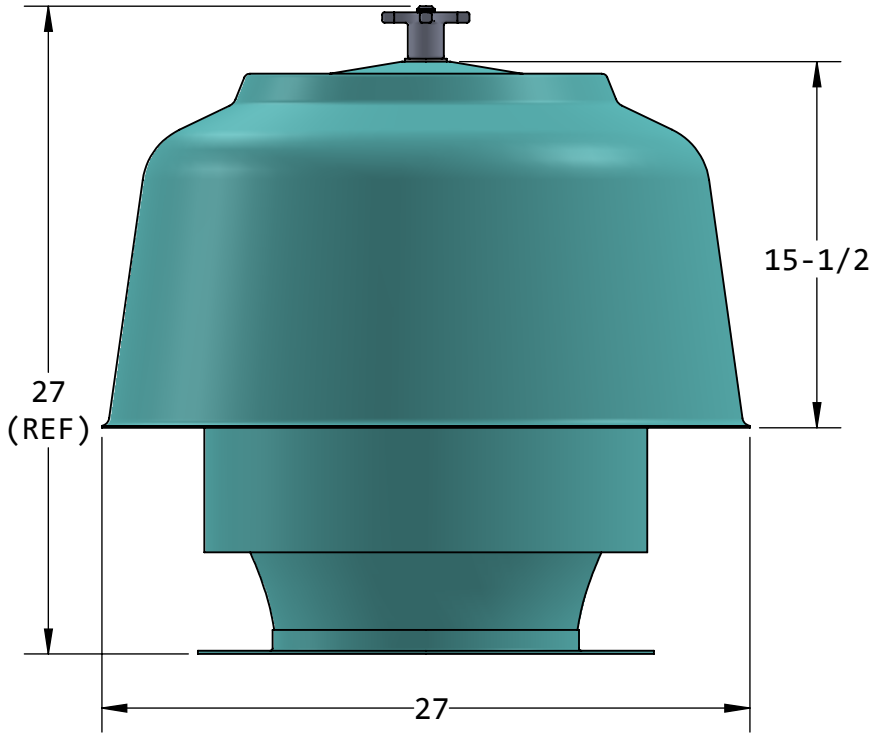

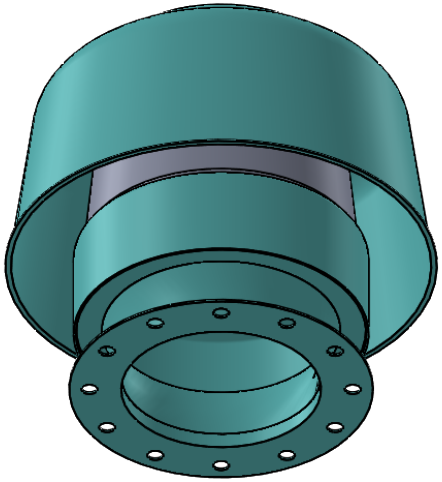

SPECIFICATIONS

1. ENDUSTRA TRI-VENT® SERIES P09 INTAKE FILTER SILENCER
2. 12" 125/150# ANSI FLANGE DRILLING OUTLET (19 OD W/ QTY (12) 1" HOLES ON 17 BCD)
3. 3451 SCFM @ 1" WG MAX INITIAL; NOT TO EXCEED 12" WG
4. INCLUDES 316 STAINLESS STEEL TRI-VENT® ELEMENT W/ ALUMINUM WIRE MESH MEDIUM, 60% AC FINE DUST
5. NO-TOOLS ELEMENT CHANGES
6. POWDER COATED
7. WEIGHT: 80#
8. HOOD: 20#
10. ELEMENT: 20#

TRI-VENT® ELEMENT P/N: E049445T316

ENDUSTRA FILTER MFG

CUSTOMER:	AERZEN USA	PART NO:	P09RL-E049445T316		
QUOTE:		DWG NO:	J112520-5		
ATTENTION:		ORIGINAL:	11/25/2020	DRAWN BY:	JRB
		REVISION:		CERT BY:	REG
		SCALE:	1:8	APPROVAL:	
		TOLERANCES:	±1/8	DATE:	
		DIMENSIONS:	INCHES	SHEET 1 OF 1	

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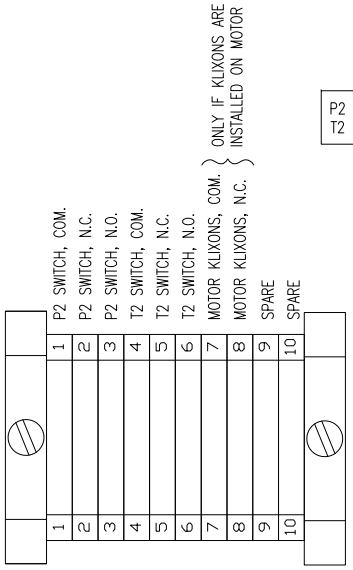
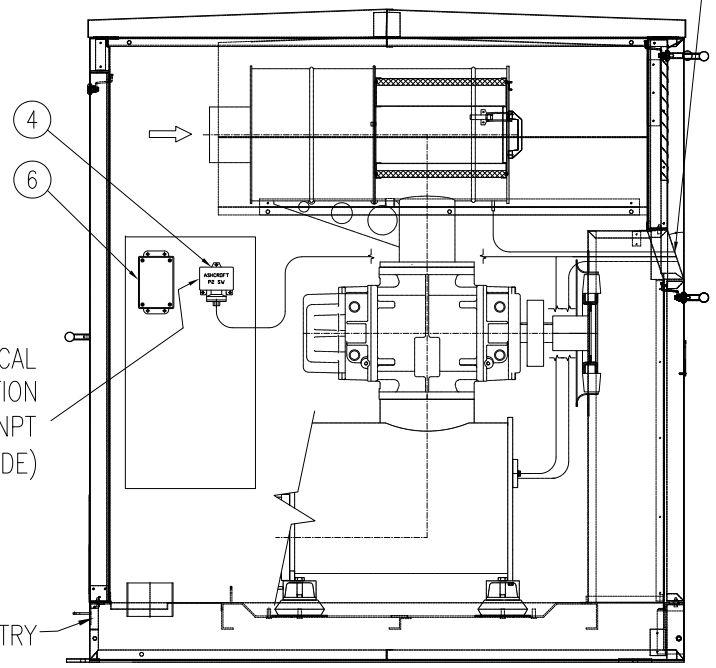
SECTION 4

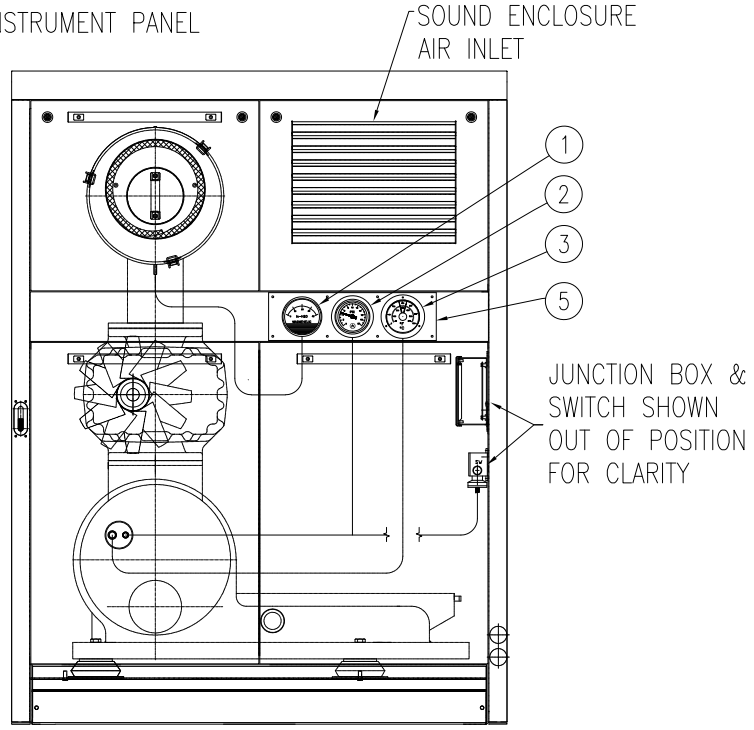
P2 = DISCHARGE PRESSURE
T2 = DISCHARGE TEMPERATURE



CUSTOMER CONNECTION SIDE
RATED: 30VDC/250VAC @ 2.0A

DETAIL
TERMINAL BLOCK DIAGRAM
FOR JUNCTION BOX





FRONT PANEL

NOTES:
1. ALL PRESSURE GAUGES & SWITCHES ARE INSTALLED WITH PULSATION DAMPERS. (EXCEPT IF GAUGE HAS A LIQUID FILL)

MAIN COMPONENTS

ITEM	DESCRIPTION	PART NO.
1	GAUGE, FILTER MAINTENANCE INDICATOR	21-006757
2	GAUGE, DISCHARGE PRESSURE	21-006758
3	GAUGE/SWITCH, DISCHARGE TEMPERATURE	21-006756
4	SWITCH, DISCHARGE PRESSURE	21-000746-02
5	MOUNTING PLATE, FOR GAUGES	21-002110-99
6	JUNCTION BOX	21-000990_06X04_01

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AERZEN USA CORP.
108 Independence Way, COATESVILLE PA 19320
(610) 380-0244 PH, (610) 380-0278 FX

TITLE
G-5 BLOWER - INSTR. (S.E.)
FILTER MAINTENANCE INDICATOR
DISCHARGE PRESSURE GAUGE & SWITCH
DISCHARGE TEMPERATURE GAUGE/SWITCH

DATE	DRAWN BY:	CHECKED BY:	P.M. APPROVAL :	SCALE:
07/12/2017	RJP	DLM	–	MSPACE 1 :1

DRAWING NO:	REVISION NO:	SHEET:
G5-IM-PS07-4001-00	C	1/1

ALL STAINLESS STEEL LOW PRESSURE GAUGE

REOTEMP's Series PC low pressure gauges offer accurate and reliable measurements of gaseous media. Offered with stainless steel internals, the Series PC is designed to withstand corrosive media and ensure a long-lasting instrument.

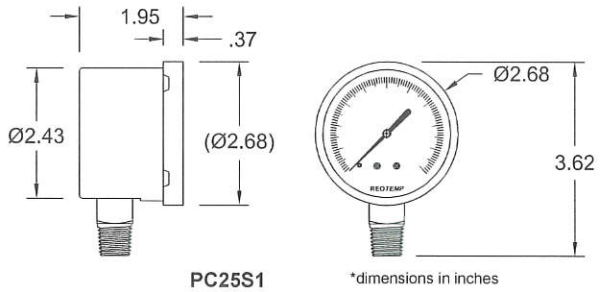
PC25S1 PC40S1 PC60S1

Dials Custom Logo Diaphragm Seal Compatible

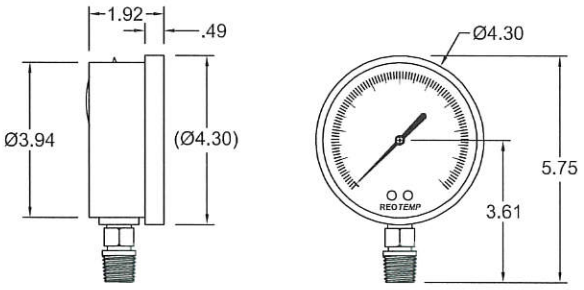
FEATURES / BENEFITS

- Sensitive Diaphragm/Capsule Mechanism
- All-Welded 316 Stainless Steel Capsule and Socket
- Easy-Access Zero Reset Screw on Dial

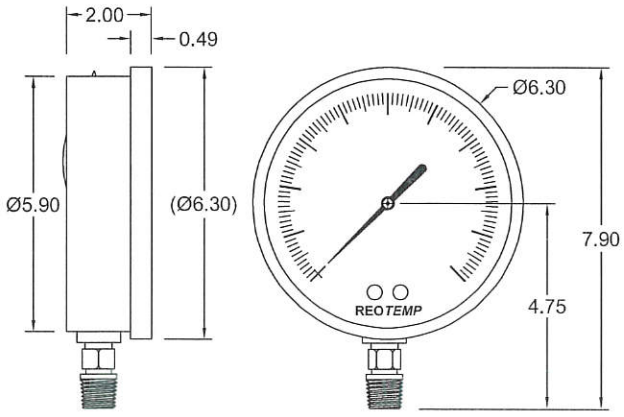
ASME B40.100 NACE



PC25S1 *dimensions in inches



PC40S1 *dimensions in inches



PC60S1 *dimensions in inches

SPECIFICATIONS

Construction Materials:

Non Wetted
- Case: 304SS
- Ring: 304SS, Bayonet Twist-Off
- Dial: White Aluminum, Black Letters

Wetted
- Capsule: 316LSS
- Socket: 316SS

Case-to-Socket
- Screw Connection
- Vented Case

Lens
- Tempered Safety Glass (Standard), Plastic, or Laminated Safety Glass

Temperature Limits:

Ambient
-40°F — 150°F

Process
-40°F — 200°F

Process Temperature Limits When Assembled with a Diaphragm Seal

-60°F — 350°F
Direct Mount

-100°F — 750°F
Remote Mount or Cooling Tower

*Exact temperature limits will depend on diaphragm seal & fill fluid.

Accuracy: 2-1.6-2%
Fillable: No
Restrictor Screw: Yes
Weight: 2.5" = 0.5 lbs
4" = 1.1 lbs
6" = 2.1 lbs
Maximum Working Pressure:
Stable = 100%
Momentary = 130% of scale

ALL STAINLESS STEEL LOW PRESSURE GAUGE

Visit reotemp.com

✓ Check Stock ✓ Get Price
✓ Configure Part # ✓ Download PDF Data Sheets

HOW TO ORDER: Choose options to build a part number. For example: PC40S1A2P52-D-T-HV

PC40	S	1	A	2	P52	-D	-T	-HV
DIAL SIZE	CASE TYPE	CAPSULE & SOCKET	MOUNT TYPE	CONNECTION	RANGE CODE	CASE FILL	LENS	OPTIONS

DIAL SIZE

PC25 = 2.5"
PC40 = 4"
PC60 = 6"

CASE TYPE

S = 304SS Case & Bezel w/ Removable Bayonet, Zero Correction on Dial
C = crimped ring 304SS

CAPSULE & SOCKET

1 = 316SS
2 = copper alloy

MOUNT TYPE

A = Bottom
B = Bottom/Rear Flange
*C = Center Back
*D = Center Back "U" Clamp
*E = Center Back/Front Flange

A = Bottom
B = Bottom/Rear Flange
*C = Lower Back
*E = Lower Back/Front Flange

CONNECTION

4 = 1/4" NPT
2 = 1/2" NPT

RANGE CODE

See Master Range Code Sheet on Page 46

Common Ranges
P50 = 0-10 in H_2O
P51 = 0-15 in H_2O
P52 = 0-30 in H_2O
P53 = 0-60 in H_2O
P54 = 0-100 in H_2O
P55 = 0-160 in H_2O
P56 = 0-200 in H_2O

Available Ranges
- 10" to 300" Water Column
- Gauge Pressure, Vacuum, or Compound

Standard Units
= in H_2O

Available Units
- kPa
- mbar
- psi
- mmH_2O
- inHg
- mmHg
- oz/in^2
- & more

P905 = -40..0 "H20

CASE FILL

Case is Not Fillable
-D = Dry

LENS

-T = Tempered Safety Glass (std)
-P = Plastic
-S = Laminated Safety Glass

OPTIONS

-HV = Hi-Vis™ Dial
-OX = Cleaned for O_2 Service
-C3 = 3 pt. Calibration Certificate
-TS = Stainless Steel Tag
-NC = NACE Compliance Certificate
-PM = Positive Material Identification Certification
-R5 = 1.5% Full Scale Accuracy (Not Available on Compound Ranges)

*Non-standard configuration

Diaphragm Seal Suitability Guide

Low pressure capsule gauges are very sensitive and require diaphragm seals with high fluid displacement. If a diaphragm seal is required to isolate the process fluid from the pressure gauge, the following seal model types are available for the Series PC.

Diaphragm Seal Model

High Displacement

Total Gauge Span* (in H_2O)

	10"	15"	20"	30"	40"	60"	100"	160"	200"	300"
W6	X	X	X	X	X	X	S	S	T	T
W7	X	X	X	S	S	T	T	T		
V5	X	S	S	T	T	T	T	T		
T6	X	X	X	X	X	S	S	S	S	S

*Total gauge span is additive of negative and positive pressures.

Example: -15 - 0 - 30 psi = 45 psi span

- Assembly will function correctly with minimal accuracy degradation.
- T — Assembly will function correctly given stable temperature.
- S — Assembly is highly sensitive to orientation and temperature variance. REOTEMP cannot guarantee a stated accuracy.
- X — Assembly will not work. The diaphragm does not displace enough fill fluid to drive the pressure gauge.

PRESSURE GAUGE RANGES AND CODES

SPECIAL RANGE TYPES

Receiver Ranges		
Code	Element	Dial Range
P60	3-15psi	0-100%
P61	3-15psi	0-10 sq rt
P62	3-15psi	0-100% & 0-10 sq.rt.

Refrigerant Ranges		
Code	Dial Range	Refrigerant
N06	-30inHg to 160psi	Ammonia
R06	-30inHg to 160psi	R134A
R06A	-30inHg to 160psi	R22
R06C	-30inHg to 160psi	R404A
N07	-30inHg to 200psi	Ammonia
N08	-30inHg to 300psi	Ammonia

Tank Level Ranges	
Code	Range
F14	0-24ft H2O
F15	0-30ft H2O
F15C	0-40ft H2O
F16	0-60ft H2O
F165	0-100ft H2O

LOW PRESSURE RANGES (PC SERIES ONLY)

Low Pressure Ranges									
inH_2O		oz/in²		inH_2O & oz/in²		mbar		psi	
Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
P50	0-10	Z50	0-6	Q50Z	0-10 inH_2O & 0-6 oz/in²				
P51	0-15	Z51	0-8			M51	0-40		
P49	0-20	Z49	0-10	Q49C	0-20 inH_2O & 0-12 oz/in²				
P515	0-25	Z52E	0-15						
P52	0-30			Q52N	0-30 inH_2O & 0-18 oz/in²	M521	0-70	I52	0-1
P525	0-40	Z52	0-20	Q525W	0-40 inH_2O & 0-24 oz/in²	M525	0-100		
P53	0-60	Z53	0-30	Q53	0-60 inH_2O & 0-35 oz/in²	M53F	0-150	I53	0-2
P54	0-100	Z54	0-60	Q54B	0-100 inH_2O & 0-60 oz/in²	M54	0-250	I54	0-3
P55	0-160					M55	0-400	I55	0-5
P56	0-200	Z56	0-100	Q56C	0-200 inH_2O & 0-115 oz/in²	M56	0-500	I56	0-7
Vacuum Ranges									
P88	-10-0	Z88	-6-0	Q88	-10/0 inH_2O & -6/0 oz/in²				
P90	-30-0	Z90	-20-0	Q90	-30/0 inH_2O & -18/0 oz/in²	M905	-100-0	I90	-1-0
P91	-60-0	Z91	-30-0	Q91	-60/0 inH_2O & -35/0 oz/in²	M94	-200-0	I91	-2-0
P92	-100-0	Z92	-60-0	Q92	-100/0 inH_2O & -60/0 oz/in²	M95	-400-0		
Compound Ranges									
P7A	-5/0/5	Z7A	-3/0/3			M71	-20/0/20		
P70	-10/0/10			Q70C	-10/0/10 inH_2O & -6/0/6 ozin²	M72E	-30/0/30		
P71	-15/0/15					M72	-40/0/40		
P72	-20/0/20	Z72	-10/0/10	Q72C	-20/0/20 inH_2O & -12/0/12 oz/in²			I73	-1-0-1
P73	-30/0/30			Q73C	-30/0/30 inH_2O & -18/0/18 oz/in²	M735	-100/0/100	I74	-2-0-2
P74	-60/0/60	Z745	-30/0/30					I55U	-3/0/3
P75	-100/0/100			Q75B	-100/0/100 inH_2O & -60/0/60 oz/in²			P14C	-5/0/5

DIFFERENTIAL PRESSURE RANGES (DP GAUGES ONLY)

psid		inH_2Od		bard		mbard		kPad	
Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
PD1	0-1	ID10	0-10	BD1	0-1	MD40	0-40	AD2.5	0-2.5
PD3	0-3	ID20	0-20	BD1.6	0-1.6	MD60	0-60	AD6	0-6
PD5	0-5	ID30	0-30	BD2.5	0-2.5	MD100	0-100	AD10	0-10
PD10	0-10	ID50	0-50	BD4	0-4	MD160	0-160	AD25	0-25
PD20	0-20	ID100	0-100	BD6	0-6	MD250	0-250	AD40	0-40
PD50	0-50	ID150	0-150	BD7	0-7	MD400	0-400	AD100	0-100
PD100	0-100	ID200	0-200	BD11	0-11	MD600	0-600	AD250	0-250
PD200	0-200	ID400	0-400	BD55	0-55	MD1000	0-1000	AD700	0-700
PD6000	0-6000			BD400	0-400				

PRESSURE GAUGE OPTIONS

		Heavy-Duty Industrial Gauges				Process Gauges			Stainless Steel Case Industrial Gauges			Commercial Gauges		Low Pressure Capsule Gauges			Test Gauges
Part #	Description	PR25	PR35	PR40	PR60	PT45P	PT45T	PI45	PM	PG**C	PG**S	PD15/20/25	PD35/40	PC25N	PC25S	PC40/45/60	PL60/45
CASE FILL OPTIONS																	
-G	Glycerin Filled Case	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A
-W	Glycerin Water Filled Case (65/35)	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A
-S	Silicone Filled Case	✓	✓	✓	✓	✓	✓	N/A	✓	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-T	Teflon-coated Movement (No case fill)	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	✓
LENS OPTIONS																	
-P	Plastic Lens	STD	✓	✓	✓	✓	✓	STD	STD	STD	✓	✓	MQ	✓	✓	✓	✓
-T	Tempered Safety Glass Lens	✓	STD	STD	STD	STD	STD	N/A	N/A	N/A	STD	N/A	N/A	N/A	STD	STD	STD
-S	Laminated Safety Glass Lens	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	✓
-G	Plain Glass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	MQ	MQ	N/A	MQ	STD	N/A	N/A	N/A	N/A
POINTER OPTIONS																	
-RP	Red Pointer	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	✓
-MP	Min/Max Pointer (Drag Hand)	✓	N/A	✓	✓	✓	✓	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-MQ	Min/Max Pointer (Tamper-proof)	✓	N/A	✓	✓	✓	✓	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-RH	Red Set Hand (Manual Adjustment)	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-EC	Electrical Contacts	N/A	N/A	✓	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DIAL OPTIONS																	
-CL	Custom Logo Dial	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	✓
-HV	Hi-Vis Dial	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	N/A
-CB	Color Band	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	N/A
-CP	Color Pie	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	N/A
-DM	Dial Marking	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	✓	✓	✓	✓
-LP	Removable Lens Protector	N/A	N/A	N/A	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CALIBRATION OPTIONS																	
-R1	Upgrade to 1% FS Accuracy	✓	✓	STD	STD	N/A	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-R2	Upgrade to 0.5% FS Accuracy	N/A	N/A	✓	✓	STD	STD	STD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-R5	Upgrade to 1.5% FS Accuracy	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	N/A
-C1	1pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-C3	3pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-C5	5pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-CX	10pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	STD
-CS	Calibration Sticker (No logged pts.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
TAG OPTION																	
-TS	Stainless Steel Tag (1-10 Characters)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-TM	Stainless Steel Tag (11-80 characters)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-TP	Paper Tag	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CERTIFICATION OPTIONS																	
-CM	General Material Conformance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-NC	Certificate of NACE Compliance	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	✓
-PM	Positive Material Identifiaction Certificate (PMI)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-HT	Hydrostatic Test per ASME B31.3 (5 min)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-LC	Argon Leak Check Certificate	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CLEANING OPTIONS																	
-DG	Degreased - Wiped Clean of Oils, Shipped in Sealed Bag	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	✓	✓	✓	✓
-OX	Cleaned for Oxygen Service per ASME B40.1	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	✓	✓	✓	✓
-OY	Cleaned for Oxygen Service per MIL-STD-1330D	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	✓	✓	✓	✓

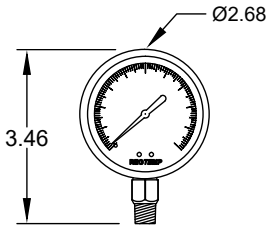
✓	Indicates that the option is available with the model.	N/A	Indicates the option is not available with this model.
STD	Indicates standard options with no additional cost.	MQ	Minimum order quantity applies.

INDUSTRIAL STAINLESS/BRASS GAUGE

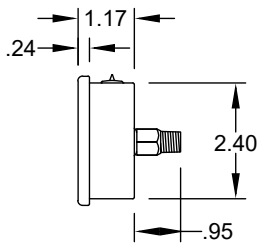
REOTEMP's Series PG gauges are an economical choice where ambient corrosion and vibration are of concern. The stainless steel case and ring offer excellent corrosion resistance, and is fillable for applications with vibration. It is suitable for all fluids compatible with copper alloys.

PG25C2

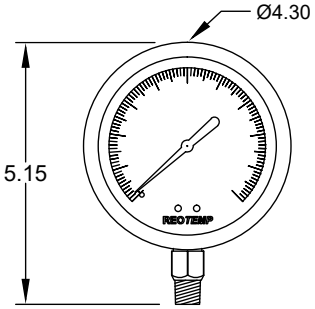
PG40C2



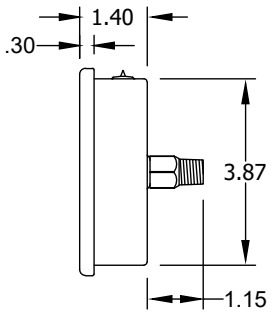
PG25C2



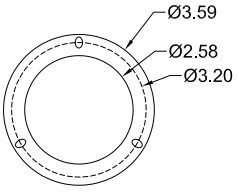
*dimensions in inches



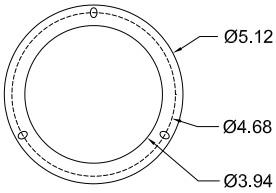
PG40C2



*dimensions in inches



2.5" MOUNTING FLANGE



4" MOUNTING FLANGE

Fillable Custom Logo

FEATURES / BENEFITS

- Stainless Steel Case
- Copper Alloy Wetted Parts
- Field Fillable Case
- Convenient Panel Mounting Adapters

ASME B40.100

SPECIFICATIONS

Accuracy	2.5" = 3 - 2 - 3%, ASME Grade B 4" = 2 - 1 - 2%, ASME Grade A
Ambient Limits	-40°F/140°F
Process Limits	-40°F/140°F
Process Limits with Diaphragm Seal	Cannot be mounted to a diaphragm seal.
Wetted Materials	Tube: Copper Alloy Socket: Copper Alloy
Lens	Plastic (Standard) or Glass
Other Materials	Case: 304SS Ring: 304SS Dial: White Aluminum, Black Letters Case-to-Socket: Screw Connection
Fillable	Yes
Restrictor Screw	Built-in, Non-Removable
Maximum Working Pressure	Stable = 100% Momentary = 110% of scale
Environmental Protection	NEMA 4X/IP65
Weight	2.5" = 0.25 lbs (0.4 lbs filled) 4" = 0.6 lbs (1.2 lbs filled)

INDUSTRIAL STAINLESS/BRASS GAUGE

Visit reotemp.com

- ✓ Check Stock
- ✓ Get Price
- ✓ Configure Part #
- ✓ Download PDF Data Sheets

HOW TO ORDER: Choose options to build a part number. For example: PG25C2A4P18-D-P-TS

PG25	C	2	A	4	P18	-D	-P	-TS
DIAL SIZE	CASE TYPE	TUBE & SOCKET	MOUNT TYPE	CONNECTION	RANGE CODE	CASE FILL	LENS	OPTIONS
PG25 = 2.5” **PG40** = 4”	**C** = 304SS Crimped Ring	**2** = Copper Alloy	**A** = Bottom **B** = Bottom/Rear Flange **C** = Center Back **D** = Center Back “U” Clamp **E** = Center Back/Front Flange	**4** = 1/4” NPT ***2** = 1/2” NPT	*Common Ranges* **P16** = 0-30 psi **P17** = 0-60 psi **P18** = 0-100 psi **P19** = 0-160 psi **P20** = 0-200 psi **P21** = 0-300 psi **P23** = 0-600 psi **P25** = 0-1,000 psi *Available Ranges* ■ Gauge Pressure, Vacuum, or Compound ■ Vac to 6,000 psi *For Additional Range Codes See Page 45*	**-D** = Dry **-G** = Glycerin **-W** = Glycerin/ Water (65/35) *Note: This model cannot be filled with silicone.*	**-P** = Plastic ***-G** = Glass	**-TS** = Stainless Steel Tag

*Non-standard configuration

Master Range Code Sheet

PRESSURE GAUGE RANGES AND CODES

VACUUM/COMPOUND RANGES

psi		Dual Scale & psi & Metric						Single Scale-Metric					
"Hg/0/psi		psi & bar		psi & kg/cm²		psi & kPa		bar		kg/cm²		kPa	
Code	Range	Code	Range	Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
P01	-30"Hg/0	D01	"Hg & -1/0 bar	G01	"Hg & -1/0 kg/cm²	L01	"Hg & -100/0 kPa	B00	-1/0 bar	K00	-1/0 kg/cm²	A00	-100/0 kPa
P02	-30/0/15	D02	psi & -1/0/1	G02	psi & -1/0/1	L02	psi & -100/0/100	B01	-1/0/1	K01	-1/0/1	A01	-100/0/100
P03	-30/0/30	D03	psi & -1/0/2	G03	psi & -1/0/2	L03	psi & -100/0/200	B02	-1/0/2	K02	-1/0/2	A02	-100/0/200
P04	-30/0/60	D04	psi & -1/0/4	G04	psi & -1/0/4	L04	psi & -100/0/400	B04	-1/0/4	K04	-1/0/4	A04	-100/0/400
P05	-30/0/100	D05	psi & -1/0/7	G05	psi & -1/0/7	L05	psi & -100/0/700	B07	-1/0/7	K07	-1/0/7	A07	-100/0/700
P06	-30/0/160	D06	psi & -1/0/11	G06	psi & -1/0/11	L06	psi & -100/0/1,100	B011	-1/0/11	K011	-1/0/11	A011	-100/0/1,100
P07	-30/0/200	D07	psi & -1/0/14	G07	psi & -1/0/14	L07	psi & -100/0/1,400	B014	-1/0/14	K014	-1/0/14	A014	-100/0/1,400
P08	-30/0/300	D08	psi & -1/0/20	G08	psi & -1/0/20	L08	psi & -100/0/2,000	B020	-1/0/20	K020	-1/0/20	A020	-100/0/2,000

PRESSURE RANGES

psi		Dual Scale & psi & Metric						Single Scale-Metric					
psi		psi & bar		psi & kg/cm²		psi & kPa		bar		kg/cm²		kPa	
Code	Range	Code	Range	Code	Range	Code	Range	Code	Range	Code	Range	Code	Range
P14	0-10 psi	D14	psi & .7 bar	G14	psi & .7 kg/cm²	L14	psi & 70 kPa						
P15	0-15	D15	psi & 0-1	G15	psi & 0-1	L15	psi & 0-100	B1	0-1 bar	K1	0-1 kg/cm²	A1	0-100 kPa
P16	0-30	D16	psi & 0-2	G16	psi & 0-2	L16	psi & 0-200	B2	0-2	K2	0-2	A2	0-200
P17	0-60	D17	psi & 0-4	G17	psi & 0-4	L17	psi & 0-400	B4	0-4	K4	0-4	A4	0-400
P18	0-100	D18	psi & 0-7	G18	psi & 0-7	L18	psi & 0-700	B7	0-7	K7	0-7	A7	0-700
P19	0-160	D19	psi & 0-11	G19	psi & 0-11	L19	psi & 0-1,100	B11	0-11	K11	0-11	A11	0-1,100
P20	0-200	D20	psi & 0-14	G20	psi & 0-14	L20	psi & 0-1,400	B14	0-14	K14	0-14	A14	0-1,400
P21	0-300	D21	psi & 0-20	G21	psi & 0-20	L21	psi & 0-2,000	B20	0-20	K20	0-20	A20	0-2,000
P22	0-400	D22	psi & 0-28	G22	psi & 0-28	L22	psi & 0-2,800	B28	0-28	K28	0-28	A28	0-2,800
P23	0-600	D23	psi & 0-40	G23	psi & 0-40	L23	psi & 0-4,000	B40	0-40	K40	0-40	A40	0-4,000
P24	0-800	D24	psi & 0-55	G24	psi & 0-55	L24	psi & 0-5,500	B55	0-55	K55	0-55	A55	0-5,500
P25	0-1,000	D25	psi & 0-70	G25	psi & 0-70	L25	psi & 0-7,000	B70	0-70	K70	0-70	A70	0-7,000
P30	0-1,500	D30	psi & 0-100	G30	psi & 0-100	L30	psi & 0-10,000	B100	0-100	K100	0-100	A100	0-10,000
P31	0-2,000	D31	psi & 0-140	G31	psi & 0-140	L31	psi & 0-14,000	B140	0-140	K140	0-140	A140	0-14,000
P32	0-3,000	D32	psi & 0-200	G32	psi & 0-200	L32	psi & 0-20,000	B200	0-200	K200	0-200	A200	0-20,000
P33	0-4,000	D33	psi & 0-280	G33	psi & 0-280	L33	psi & 0-28,000	B280	0-280	K280	0-280	A280	0-28,000
P34	0-5,000	D34	psi & 0-350	G34	psi & 0-350	L34	psi & 0-35,000	B350	0-350	K350	0-350	A350	0-35,000
P35	0-6,000	D35	psi & 0-400	G35	psi & 0-400	L35	psi & 0-40,000	B400	0-400	K400	0-400	A400	0-40,000
P36	0-8,000	D36	psi & 0-550	G36	psi & 0-550	L36	psi & 0-55,000	B550	0-550	K550	0-550	A550	0-55,000
P37	0-10,000	D37	psi & 0-700	G37	psi & 0-700	L37	psi & 0-70,000	B700	0-700	K700	0-700	A700	0-70,000
P38	0-15,000	D38	psi & 0-1,000	G38	psi & 0-1,000	L38	psi & 0-100,000	B1K	0-1,000	K1K	0-1,000	A1K	0-100,000
P39	0-20,000	D39	psi & 0-1,400	G39	psi & 0-1,400	L39	psi & 0-140,000						
P40	0-30,000	D40	psi & 0-2,000	G40	psi & 0-2,000	L40	psi & 0-200,000						
P41	0-40,000	D41	psi & 0-2,800	G41	psi & 0-2,800	L41	psi & 0-280,000						
P42	0-50,000	D42	psi & 0-3,500	G42	psi & 0-3,500	L42	psi & 0-350,000						

Don't See The Range You Need? REOTEMP has thousands of specialty dial ranges available and will work with you to create a custom range, just contact REOTEMP customer service.

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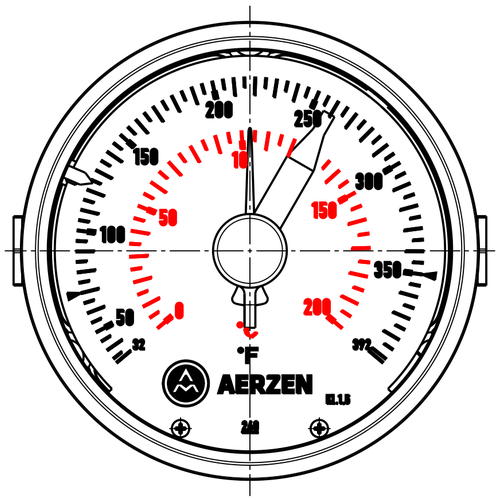
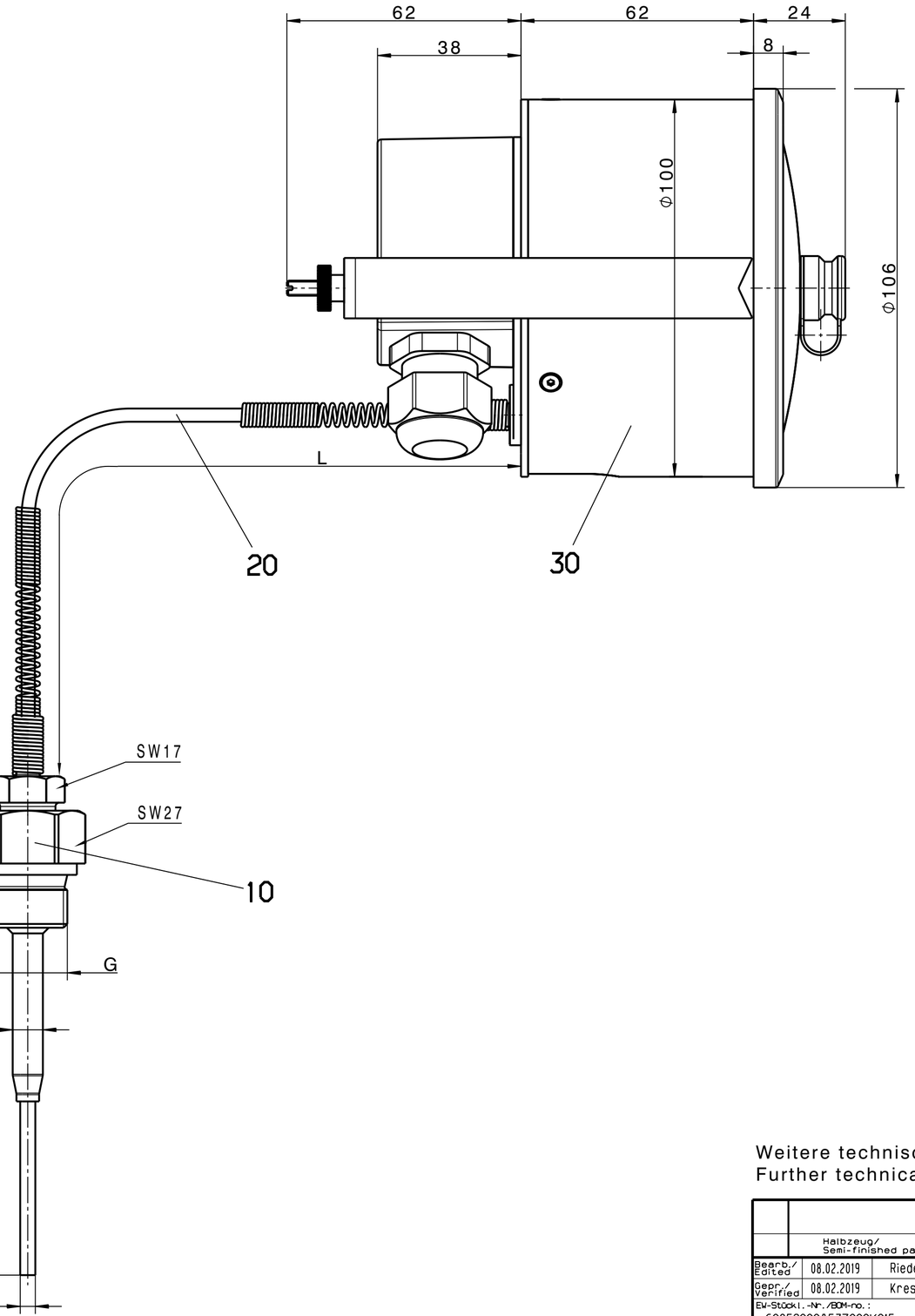
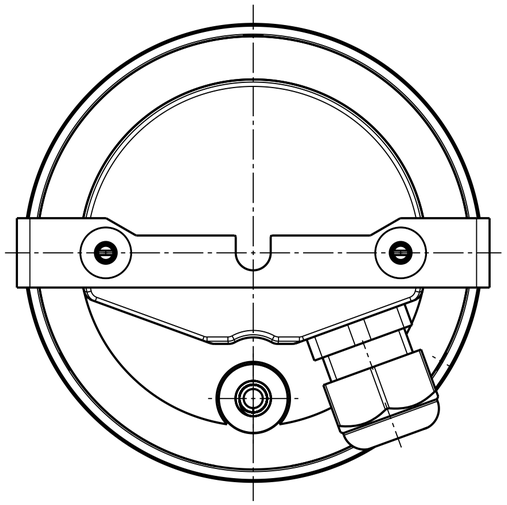
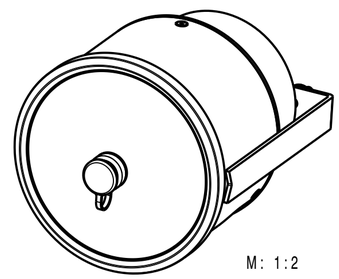
Dritten zugänglich gemacht werden.









M: 1:2

Typenschlüssel/ type code: 608520/2110-832-23-4000-876-8-104-26-46-106-20/426,430,477,522

Pos.	Pos.	001
Typ	type	2110
AB [°C]	display range	0...+200
AB-Einheit	display range oneness	°F/°C
Fl Typ	capillary typ	-
Werkst. Fühler	material bulb	CrNi
L [mm]	L	4000
L_2 [mm]	L_2	-
Anschluß	connection	SH 10
G Gewinde	treath	G1/2
Werkst. Anschluß	material connection	CuZn
d [mm]	d	4
D [mm]	D	8
S [mm]	S	106
Schaltausgang	switching output	SA20
TZ	extra code	426,430,477,522
Laser Nr	laser No.	2463
Weitere Angaben n. Typenblatt	more information at datasheet	60.8520
Bedienungsanleitung	user manual	B60.8520
Grundtyp	type	85.364.00.00
TN	partnumber	00717805

Weitere technische Daten nach Typenblatt 60.8520
Further technical details as per data sheet 60.8520

Halbzeug/ Semi-finished part	Werkstoff-Nr./ Material-no.	DIN-Kurzbezeichnung/ DIN-code	Oberfläche/ Surface

Bearb./ Edited	08.02.2019	Riedel	Zeigerkontakt-thermometer				
Gepr./ Verified	08.02.2019	Kress		02	EW-70	21.02.2019	Riedel
EW-Stückl.-Nr./BOM-no.: 60852000A53Z000K015 00718107			60852000A00Z001 K015	01	EW-70	14.02.2019	Riedel
			Zeichnungs-Nr./Drawing-no.	00	EW-70	08.02.2019	Riedel
			Ersatz für Nr./ Replace	Vers./ Rev.	Änderung/ Modification	Datum/ Date	Name

JUMO GmbH & Co. KG Fulda Germany

Maße ohne Toleranzangabe/ Tol. unless otherwise specified: DIN ISO 2768-m

Maßstab/Scale: 1:1

Teile-Nr./Part-no.

Größe/ Size: A2

Blatt/ Sheet: 01/01

PRESSURE GAUGE OPTIONS

		Heavy-Duty Industrial Gauges				Process Gauges			Stainless Steel Case Industrial Gauges			Commercial Gauges		Low Pressure Capsule Gauges			Test Gauges
Part #	Description	PR25	PR35	PR40	PR60	PT45P	PT45T	PI45	PM	PG**C	PG**S	PD15/20/25	PD35/40	PC25N	PC25S	PC40/45/60	PL60/45
CASE FILL OPTIONS																	
-G	Glycerin Filled Case	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A
-W	Glycerin Water Filled Case (65/35)	✓	✓	✓	✓	✓	✓	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A
-S	Silicone Filled Case	✓	✓	✓	✓	✓	✓	N/A	✓	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-T	Teflon-coated Movement (No case fill)	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	✓
-I	Inert Case Fill	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LENS OPTIONS																	
-P	Plastic Lens	STD	✓	✓	✓	✓	✓	STD	STD	STD	✓	✓	MQ	✓	✓	✓	✓
-T	Tempered Safety Glass Lens	✓	STD	STD	STD	STD	STD	N/A	N/A	N/A	STD	N/A	N/A	N/A	STD	STD	STD
-S	Laminated Safety Glass Lens	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	✓
-G	Plain Glass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	MQ	MQ	N/A	MQ	STD	N/A	N/A	N/A	N/A
POINTER OPTIONS																	
-RP	Red Pointer	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	✓
-MP	Min/Max Pointer (Drag Hand)†	✓	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-MQ	Min/Max Pointer (Tamper-proof)†	✓	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-RH	Red Set Hand (Manual Adjustment)	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-EC	Electrical Contacts	N/A	N/A	✓	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DIAL OPTIONS																	
-CL	Custom Logo Dial	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	✓
-HV	Hi-Vis Dial	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	N/A	✓	✓	N/A
-CB	Color Band	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	N/A
-CP	Color Pie	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	MQ	✓	✓	N/A
-DM	Dial Marking	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	✓	✓	✓	✓
-LP	Removable Lens Protector	N/A	N/A	N/A	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CALIBRATION OPTIONS																	
-R1	Upgrade to 1% FS Accuracy	✓	✓	STD	STD	N/A	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A
-R2	Upgrade to 0.5% FS Accuracy	N/A	N/A	✓	✓	STD	STD	STD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
-R5	Upgrade to 1.5% FS Accuracy	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	N/A
-C1	1pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-C3	3pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-C5	5pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
-CX	10pt. NIST Calibration Cert	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	STD
-CS	Calibration Sticker (No logged pts.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A
TAG OPTION																	
-TS	Stainless Steel Tag (1-10 Characters)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-TM	Stainless Steel Tag (11-80 characters)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-TP	Paper Tag	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CERTIFICATION OPTIONS																	
-CM	General Material Conformance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-NC	Certificate of NACE Compliance	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	✓	✓	✓
-PM	Positive Material Identification Certificate (PMI)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-HT	Hydrostatic Test per ASME B31.3 (5 min)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
-LC	Argon Leak Check Certificate	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CLEANING OPTIONS																	
-DG	Degreased - Wiped Clean of Oils, Shipped in Sealed Bag	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	✓	✓	✓	✓
-OX	Cleaned for Oxygen Service per ASME B40.1	✓	✓	✓	✓	✓	✓	✓	MQ	MQ	✓	MQ	MQ	✓	✓	✓	✓
-OY	Cleaned for Oxygen Service per MIL-STD-1330D	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	✓	N/A	N/A	✓	✓	✓	✓
OTHER OPTIONS																	
-NR	No Restrictor Screw	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓	N/A
-FI	Dry Gauge Shipped with Fill Plug Installed	N/A	N/A	N/A	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

✓	Indicates that the option is available with the model.	N/A	Indicates the option is not available with this model.
STD	Indicates standard options with no additional cost.	MQ	Minimum order quantity applies.

†This option is only available with a plastic lens.

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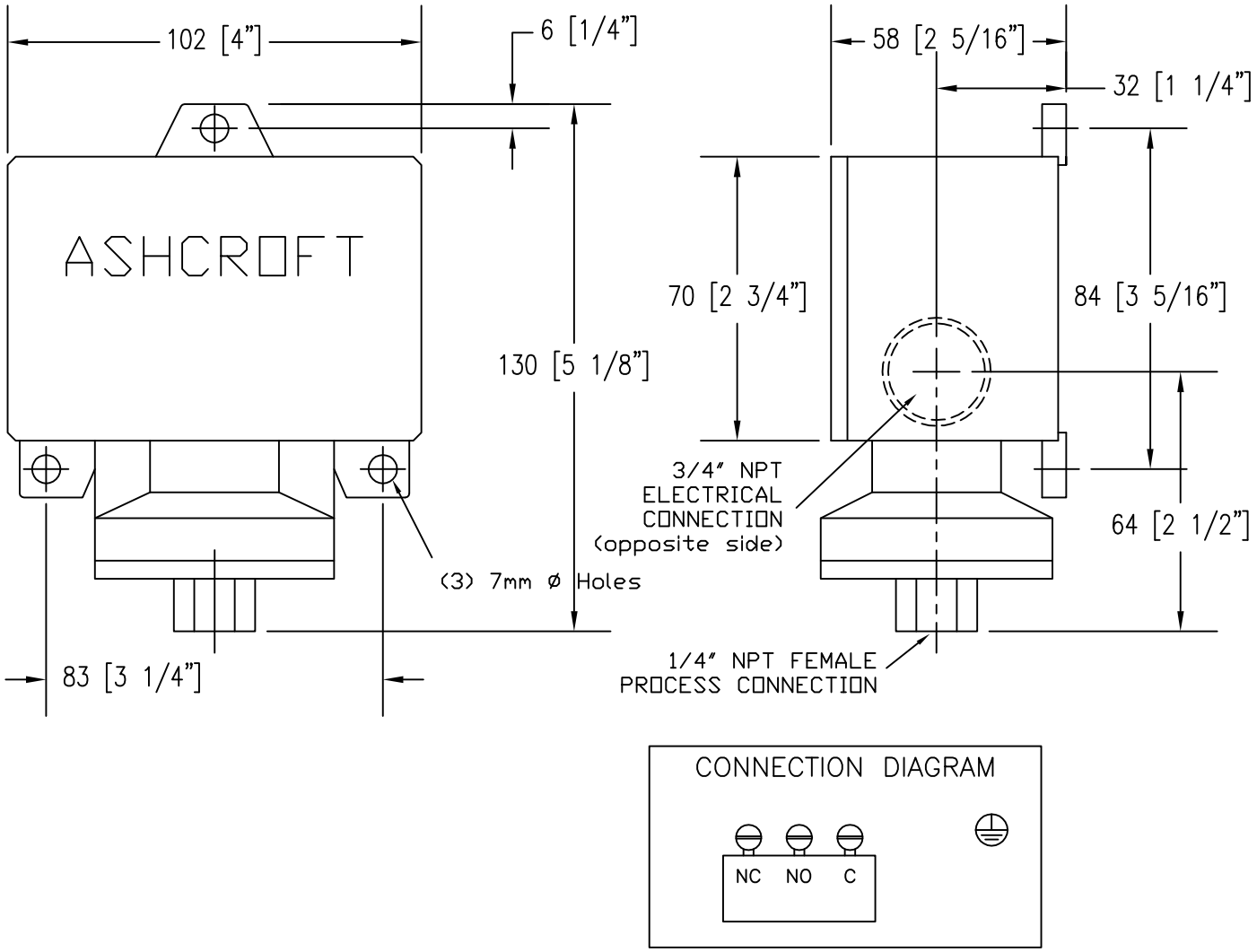
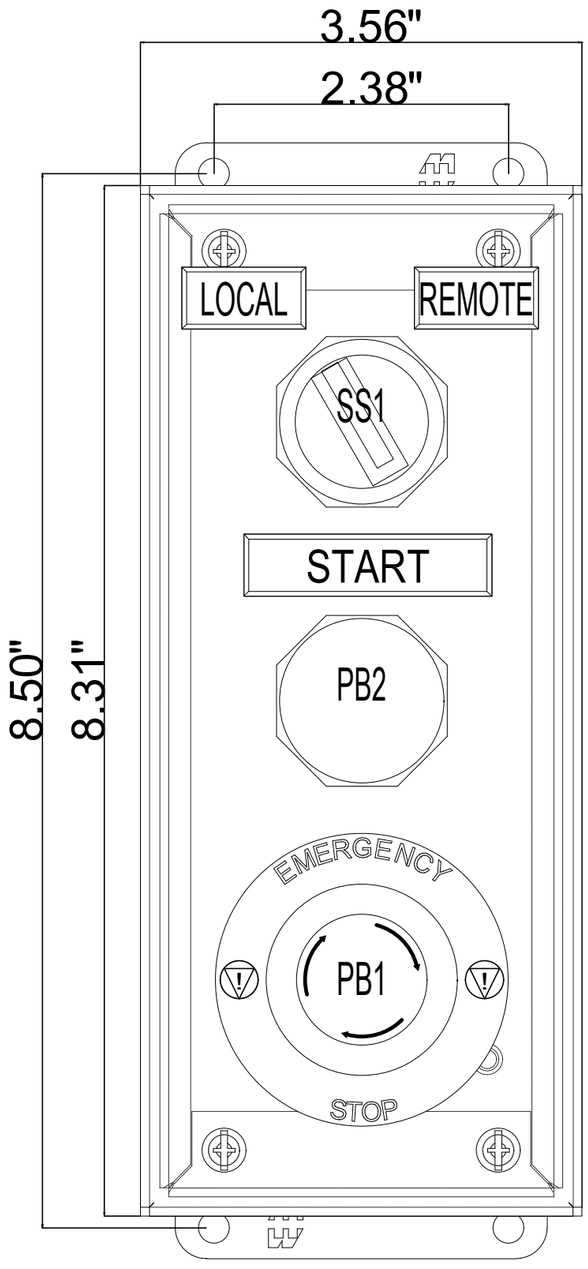
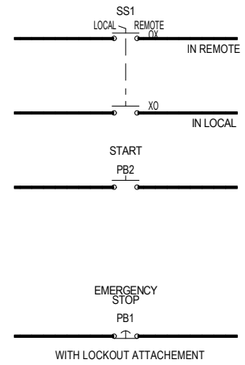


ASHCROFT TYPE B4–24–V–XRN–XJK–15 PSI

B4 = Type 400 Pressure Switch in NEMA 4X enclosure
24 = Single general purpose 15A, 110–480V switch
SPDT snap–acting,
V = Viton Actuator Seal (good for 20 to 300°F)
XRN = Internal Reference Scale
XJK = Left side conduit connection
15 = Operating Range (0 to 15 PSIG)

AERZEN	**Aerzen USA Corp.** 645 SANDS CT, COATESVILLE PA 19320 (610) 380–0244 PH, (610) 380–0278 FX www.aerzenusa.com	DISCHARGE PRESSURE SWITCH		
		Date May 2002	Doc # 32–0021–02 revision –	Page 1 of 1





BILL OF MATERIALS

ID	DEVICE DESIGNATION	NEC PART#	MANUFACTURER PART#	MANUFACTURER	QTY	DESCRIPTION
1	SS1	CBLK016	800T-XD1	A-B	1	CONTACT BLOCK, 1 N.O.
2	ENCL1	ENCL930	1435SSC	HAMMOND	1	ENCLOSURE, PUSHBUTTON, 3 HOLE, 30MM, NEMA 4X 304SS
3	PB1	PBTA086	800H-N314	A-B	1	LOCKING ATTACHMENT, 40MM MUSHROOM
4	PB1	PBTA208	KN9330	SQUARE D	1	LEGEND PLATE, E-STOP
5	PB1	PBUT174	800H-FRXT6D4	A-B	1	PUSH BUTTON, RED PUSH/PULL. TWIST HEAD
6	PB2	PBUT179	800H-AR1D1	A-B	1	PUSH BUTTON, GREEN FLUSH HEAD
7	SS1	SLSW015	800H-HR2D1	A-B	1	SELECTOR SWITCH, 2 POS.

2 PANEL TERMINAL
COMPONENT WIRING
FIELD WIRING
PANEL WIRING

REVISIONS

REV.	DATE	BY	CHKD	DESCRIPTION
1	3/8/21	EGW		REVISED STOP TO EMERGENCY STOP
0	12/8/20	AET		FOR APPROVAL

N.E. CONTROLS
SYRACUSE, NEW YORK 315-299-5161

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CUST PO#:

PUSHBUTTON STATION
NEMA 4X

DRAWING #: 30424E02

PAGE 1 OF 1

REV. 1

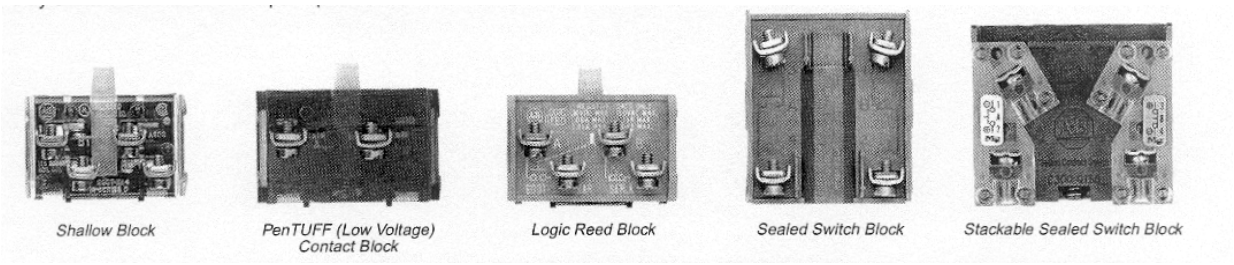
800T-XD1

NE Controls, L.L.C.
Syracuse, NY 13209 Telephone 315-299-5161

Product Profile

Contact Block
800T

Allen-Bradley
Contact Block, 1 NO, 1NC
800T



Shallow Block | *PenTUFF (Low Voltage) Contact Block* | *Logic Reed Block* | *Sealed Switch Block* | *Stackable Sealed Switch Block*

No. of Contacts	Shallow Block	Pen *TUFF* (Low Voltage) Block	Logic Reed Block	Sealed Switch Block	Stackable Sealed Switch Block
	Cat. No.	Cat. No.	Cat. No.	Cat. No	Cat. No.
1N.O.	800T-XD1	800T-XD1V	800T-XD1R	800T-XD1P	800T-XD1Y
1 N.C.	800T-XD2	800T-XD2V	800T-XD2R	800T-XD2P	800T-XD2Y
1 N.C. (Early Make)	800T-XD3	800T-XD3V	____	____	____
1 N.C. (Late Break)	800T-XD4	800T-XD4V	____	____	____
1 N.O. - 1 N.C.	800T-XA	800T-XAV	800T-XAR	800T-XAP	800T-XAY
2 N.O.	800T-XA2	____	800TXA2R	____	800T-XA2Y
2 N.C.	800T-XA4	____	800T-XA4R	____	800T-XA4Y
1 N.C. (Late Break) 1 N.O.	800T-XA1	____	____	____	____
1 N.C. (Late Break) 1 N.O.	800T-XA7	____	____	____	____

HAMMOND MANUFACTURING

Quality Products. Service Excellence.

Type 4, 4X Stainless Steel Pushbutton Enclosures *1435SS Series*

Application

- Designed to accept standard heavy duty oil tight pushbuttons, switches and pilot lights.
- Provides protection from dirt, dust, oil and large amounts of water from any angle, or where highly corrosive conditions exist.

Standards

- UL 508 Type 4 and 4X
- CSA Type 4 and 4X
- **Complies with**
  - NEMA Type 3R, 4 and 4X
  - JIC Standard EGP-1-1967
  - IEC 60529, IP66
- Appropriate components are required to maintain these standards.

Construction

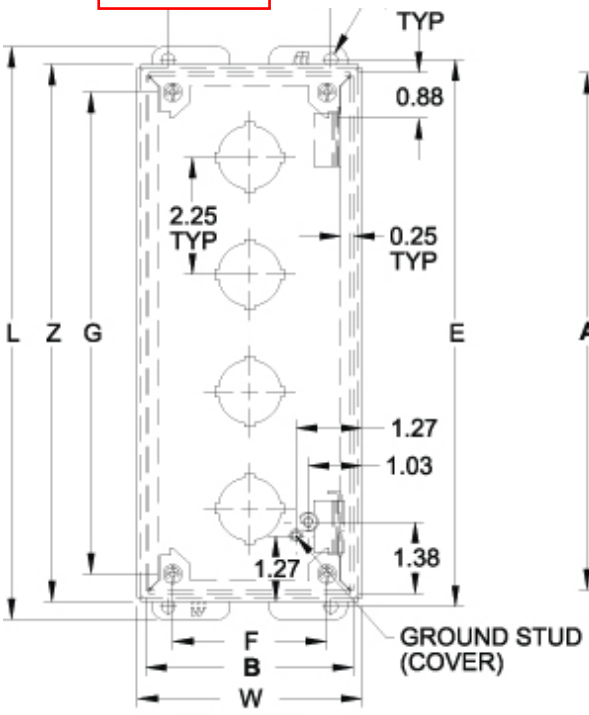
- Formed 14 gauge stainless steel except A and B which are 16 gauge. 304 or 316 SS.
- Smooth continuously welded seams.
- Welded brackets provide for enclosure mounting.
- Captive stainless steel cover screws thread into sealed wells.
- Larger enclosures provide internally hinged removable covers, designed to hold the cover open during wiring.
- Oil resistant gasket and adhesive.
- A bonding stud is provided on the door and a grounding stud is provided on the enclosure.

Finish

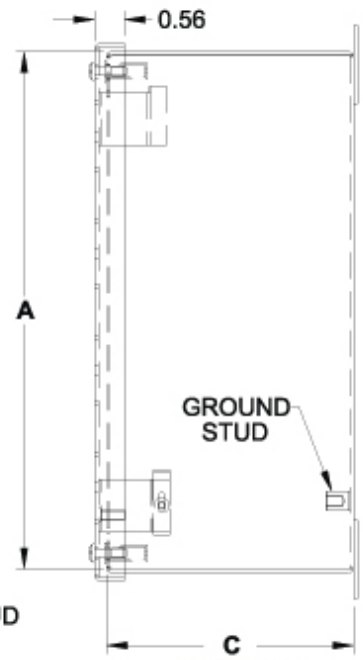
- Natural stainless steel with a smooth brushed finish.

Accessories

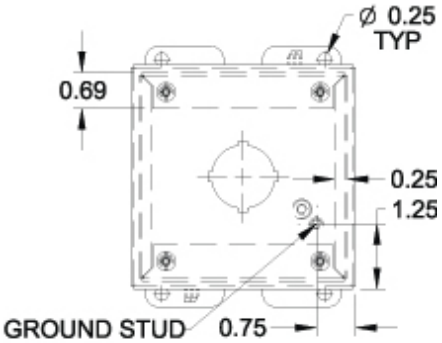
- Hole Plugs
- Ground Wire Kits



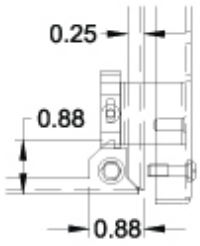
Front View
Body Type B through S
(Hinged)



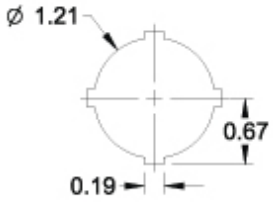
Side View



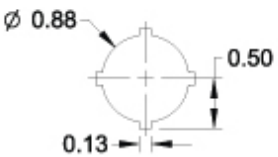
Front View
Body Type A
(Not Hinged)



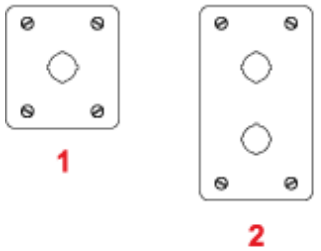
Hinge Detail
Retractable pin allows door to be mounted on left or right side



30.5mm Detail
(1435 Series)



22.5mm Detail
(1435M Series)



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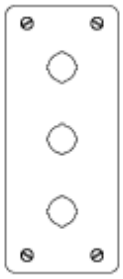

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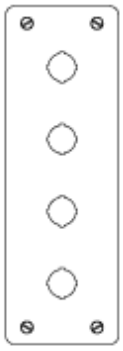

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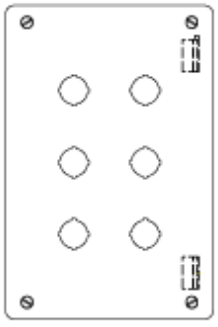

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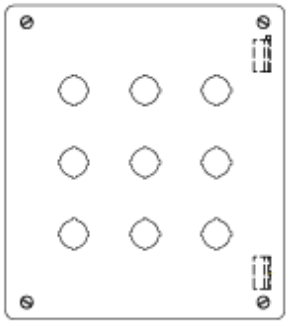

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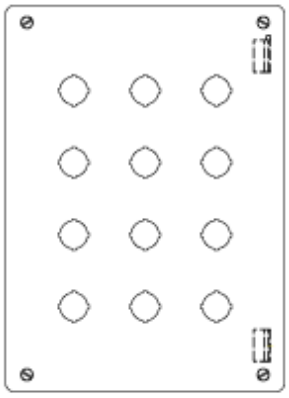
1435SSC



12

Part No.				No.								Overall Dimensions			Ship
304 S.S. 22.5mm	304 S.S. 30.5mm	316 S.S. 22.5mm	316 S.S. 30.5mm	Of Holes	A	B	C	D	E	F	G	L	W	Z	lbs.
1435MSSA[1]	1435SSA[1]	1435MS16A[1]	1435S16A[1]	1	3.50	3.25	2.75	2.38	4.00	2.21	2.75	4.50	3.56	3.81	2
1435MSSB[1]	1435SSB[1]	1435MS16B[1]	1435S16B[1]	2	5.75	3.25	2.75	2.38	6.25	2.21	5.00	6.75	3.56	6.06	3
1435MSSC[1]	1435SSC[1]	1435MS16C[1]	1435S16C[1]	3	8.00	3.25	2.75	2.38	8.50	2.21	7.25	9.00	3.56	8.31	3
1435MSSD[1]	1435SSD[1]	1435MS16D[1]	1435S16D[1]	4	10.25	3.25	2.75	2.38	10.75	2.21	9.50	11.25	3.56	10.56	4
1435MSSH	1435SSH	1435MS16H	1435S16H	6	9.50	6.25	3.00	5.38	10.00	5.21	8.75	10.50	6.56	9.81	6
1435MSSK	1435SSK	1435MS16K	1435S16K	9	9.50	8.50	3.00	7.63	10.00	7.46	8.75	10.50	8.81	9.81	7
1435MSSO	1435SSO	1435MS16O	1435S16O	12	11.75	8.50	3.00	7.63	12.25	7.46	11.00	12.75	8.81	12.06	8

[1] Not hinged

Data subject to change without notice.

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Locking Attachments

	Description	Cat. No.
Cat. No. 800T-N2 (Padlock not included)	**Bul. 800T** **Extended Head Push Button Padlocking Attachments** Permits locking in the depressed position. Locks the normally closed contact in the open position. For extended head non-illuminated momentary push buttons.	**800T-N2**
Cat. No. 800T-N10 (Padlock not included)	**Bul. 800T** **Flush Head Push Button Padlocking Attachments** Permits locking in the depressed position. Locks the normally closed contact in the open position. For flush head push button.	**800T-N10**
Cat. No. 800T-N315 (Padlock not included)	**Bul. 800T** **Momentary Mushroom Padlocking Attachments** For Bul. 800T non-illuminated momentary mushroom push button. Requires use of Cat. No. 800T-N311 mushroom cap. This device is used to lock the mushroom button in a depressed position.	**800T-N315**
Cat. No. 800T-N314 (Padlock not included)	**Bul. 800T/H** **Push-Pull Padlocking Attachment** For 2-position push-pull and push-pull/twist release illuminated and non-illuminated operators. Use on standard head only (40 mm dia.). Locks the normally closed contacts open only. Conversion of normally closed late break contacts to standard normally closed contacts are recommended when using this accessory. Made of stainless steel.	**800T-N314**
Cat. No. 800T-N163 (Padlock not included)	**Bul. 800T/H** **Padlocking Cover** Guards against unauthorized operation for non-illuminated, standard knob selector switches and potentiometers. Stainless steel and clear plastic construction.	**800T-N163**
	Bul. 800T/H **Trigger Action Padlocking Attachment** For 2-position trigger action E-stops with 45 mm heads.	800T-N378

Harmony™ 9001K/SK/KX 30 mm push buttons

9001K – Legend plates

KN9330

Note: When ordering, add prefix "9001" to the reference.

Legend Plates–Special Marking

Legend Plate	Description		Reference
KN100●P (Plastic) *(1)* 2.25 in Square	Standard Markings		**See page 25**
	Special Marking *(2)*	Silver Field, Black Letters	**KN199SP**
		White Field, Black Letters	**KN199WP**
		Red Field, Black Letters	**KN199RP**
		Black Field, White Letters	**KN199BP**
KN200 Aluminum	Standard Markings		**See page 25**
	Special Marking *(2)*	Black Field	**KN299**
		Red Field	**KN299R**
KN200●P (Plastic) *(1)* 1.7 in Square	Standard Markings		**See page 25**
	Special Marking *(2)*	Silver Field, Black Letters	**KN299SP**
		White Field, Black Letters	**KN299WP**
		Red Field, Black Letters	**KN299RP**
		Black Field, White Letters	**KN299BP**
KN300 Aluminum	Standard Markings		**See page 25**
	Special Marking *(2)*	Black Field	**KN399**
		Red Field	**KN399R**
KN400 Aluminum	Blank		**KN400**
	Any Marking *(2)*		**KN499**
KN500 Aluminum	Standard Markings		**Select from page 25**
	Special Marking *(2)*	Black Field	**KN599**
		Green Red Field	**KN519**
KN600 Aluminum	Blank	Black Field	**KN600**
		Red Field	**KN600R**
	Any Marking *(2)*	Black Field	**KN699**
		Red Field	**KN699R**
KN700●P (Plastic) *(1)* 2.5 in Square	Standard Markings		**Select from page 25**
	Special Marking *(2)*	Silver Field, Black Letters	**KN799SP**
		White Field, Black Letters	**KN799WP**
		Red Field, Black Letters	**KN799RP**
		Black Field, White Letters	**KN799BP**
KN800 Aluminum	Standard Markings		**Select from page 25**
	Special Marking *(2)*	Blue Field	**KN899**
		Red Field	**KN899R**
KN900 Aluminum	Blank		**KN900**
	Any Marking *(2)*		**KN999**

(1) Other colors available (see table below).
(2) Specify marking required.

Plastic Legend Plates—Other Colors

	Plate Color	Letter Color	1.7 in Square	2.25 in Square	2.5 in Square
Blank Legend Plates	Yellow	Black	**KN200YP**	**KN100YP**	**KN700YP**
	Green	White	**KN200GP**	**KN100GP**	**KN700GP**
	Blue		**KN200LP**	**KN100LP**	**KN700LP**
	Red		**KN200CP**	**KN100CP**	**KN700CP**
	Orange		**KN200AP**	**KN100AP**	**KN700AP**
	Burnt Orange	Black	**KN200HP**	**KN100HP**	**KN700HP**
Special Engraved Legend Plates	Yellow	Black	**KN299YP**	**KN199YP**	**KN799YP**
	Green	White	**KN299GP**	**KN199GP**	**KN799GP**
	Blue		**KN299LP**	**KN199LP**	**KN799LP**
	Red		**KN299CP**	**KN199CP**	**KN799CP**
	Orange		**KN299AP**	**KN199AP**	**KN799AP**
	Burnt Orange	Black	**KN299HP**	**KN199HP**	**KN799HP**

Maximum Number of Lines and Characters for 9001KN Legend Plates

Reference	KN100	KN200	KN300	KN400	KN500	KN600	KN700	KN800	KN900
Max. No. of Char. per Line	16	14	18	18	8 per field	22	17	18	18 per pos.
Max. No. of Lines	2	1	3	2	2 per field	4	2	2	1 per pos.

Note: The maximum number of characters and lines is a practical maximum, based on a minimum size of characters to facilitate easy reading.

Circular Legends for Emergency Stop Mushroom Heads (yellow background)

Diameter	Text	Reference
60 mm	—	**KN9100**
	EMERGENCY STOP	**KN9330**
90 mm	—	**KN8100**
	EMERGENCY STOP	**KN8330**

Legend Plate Position #1

Min. Centerline Spacing, 9001K Control Units

Legend Plate	Operator	Centerline Spacing (in) A	B	C	D	E	F
Legend Plate Orientation Position #1							
KN2	Standard Push Button	1.75	1.31	1.44	2.25	1.69	0.88
KN5	1.375 in Dia. Mushroom	1.75	1.31	1.44	2.25	1.69	0.88
	2.25 in Dia. Mushroom	2.25	1.31	1.44	2.25	2.25	1.12
	Selector Switch Knobs	1.75	1.31	1.44	2.25	1.69	0.88
KN3	Standard Push Button	2.00	1.31	1.44	2.25	1.75	0.88
	1.375 in Dia. Mushroom	2.00	1.31	1.44	2.25	1.75	0.88
	2.25 in Dia. Mushroom	2.25	1.31	1.44	2.25	2.25	1.12
	Selector Switch Knobs	2.00	1.31	1.44	2.25	1.75	0.88
KN4	Standard Push Button	1.94	1.31	1.44	2.25	1.62	0.88
	1.375 in Dia. Mushroom	1.94	1.31	1.44	2.25	1.62	0.88
	2.25 in Dia. Mushroom	2.25	1.31	1.44	2.25	2.25	1.12
	Selector Switch Knobs	1.74	1.31	1.44	2.25	1.62	0.88
KN6	Standard Push Button	2.38	1.62	1.44	2.25	2.25	1.12
	1.375 in Dia. Mushroom	2.38	1.62	1.44	2.25	2.25	1.12
	2.25 in Dia. Mushroom	2.38	1.62	1.44	2.25	2.25	1.12
	Selector Switch Knobs	2.38	1.62	1.44	2.25	2.25	1.12

Legend Plate Position #2

Legend Plate Orientation Position #2							
KN2	Standard Push Button	1.62	1.31	1.44	2.25	1.75	0.88
KN5	1.375 in Dia. Mushroom	1.62	1.31	1.44	2.25	1.75	0.88
	2.25 in Dia. Mushroom	2.25	1.31	1.44	2.25	2.25	1.12
	Selector Switch Knobs	1.62	1.31	1.44	2.25	1.75	0.88
KN3	Standard Push Button	1.75	1.31	1.44	2.25	2.00	0.88
	1.375 in Dia. Mushroom	1.75	1.31	1.44	2.25	2.00	0.88
	2.25 in Dia. Mushroom	2.25	1.31	1.44	2.25	2.25	1.12
	Selector Switch Knobs	1.75	1.31	1.44	2.25	2.00	0.88
KN4	Standard Push Button	1.62	1.31	1.44	2.25	1.94	1.00
	1.375 in Dia. Mushroom	1.62	1.31	1.44	2.25	1.94	1.00
	2.25 in Dia. Mushroom	2.25	1.31	1.44	2.25	2.25	1.12
	Selector Switch Knobs	1.62	1.31	1.44	2.25	1.94	1.00
KN6	Standard Push Button	2.25	1.31	1.62	2.38	2.38	0.88
	1.375 in Dia. Mushroom	2.25	1.31	1.62	2.38	2.38	0.88
	2.25 in Dia. Mushroom	2.25	1.31	1.62	2.38	2.38	1.12
	Selector Switch Knobs	2.25	1.31	1.62	2.38	2.38	0.88

Special Legend Plates

9001KN500
(For Use with Dual Function Operators: KR6, KR7 and KR67)
Standard Markings

Reference	Green	Red
KN500	Blank	Blank
KN501	Start	Stop
KN502	On	Off

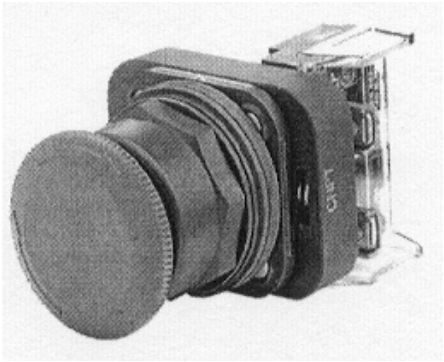
Reference	Black	Black
KN520	Blank	Blank
KN521	Start	Stop
KN522	On	Off
KN523	Forward	Reverse
KN524	Up	Down
KN525	High	Low
KN526	Open	Close

Product range: page 5 | Specifications: page 7 | Dimensions: page 30 | Mounting: page 31

800H-FRXT6D4

Allen-Bradley

2-Position Push-Pull/Twist Release, Non-Illuminated 30.5mm Push Buttons — Emergency Stop Operators Type 4/4X/13 Corrosion-Resistant/Watertight Oiltight



2-Position Push-Pull/Twist
Cat. No. 800H-FRXT6D4

Contact Type	Operator Position: Maintained Out	Operator Position: Maintained In	Button Color	Push-Pull/Twist Release Cat. No.
N.C.L.B. ❶	X	O	Red	800H-FRXT6D4
N.O. - N.C.L.B. ❶	O X	X O	Red	800H-FRXT6A1
N.C.L.B. - N.C.L.B. ❶	X X	O O	Red	800H-FRXT6A5

Note: X = Closed/O = Open

Note: A jumbo or large legend plate is recommended, if space allows.

Note: Emergency stop push buttons are compliant with EN-418 and IEC 60947-5-5 Standards when using N.C.L.B. contact blocks.

❶ Normally closed late break contact. When button is pushed from the OUT to IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.

800H-AR1D1

NE Controls, L.L.C.
Syracuse, NY 13209 Telephone 315-299-5161

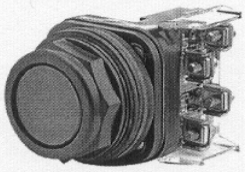
Product Profile

Push Buttons
Momentary
800H

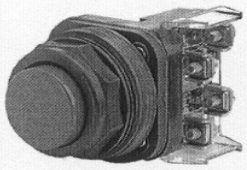
Allen-Bradley

Momentary Contact Push Button Units, Non-Illuminated
30.5mm Push Buttons
Type 4/4X/13, Corrosion-Resistant/Watertight/Oiltight

Booted Unit
Cat. No. 800H-R2A

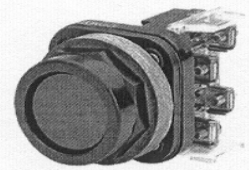


Bootless Flush Head Unit
Cat. No. 800H-AR1A



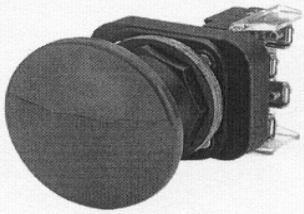
Bootless Extended Head Unit
Cat. No. 800H-BR6A

Contact Type	Button Color	Booted	Bootless Flush Head	Bootless Extended Head
		Cat. No.	Cat. No.	Cat. No.
No Contacts	Green	800H-R1	800H-AR1	800H-BR1
	Black	800H-R2	800H-AR2	800H-BR2
	Red	800H-R6	800H-AR6	800H-BR6
1 N.O.	Green	800H-R1D1	800H-AR1D1	800H-BR1D1
	Black	800H-R2D1	800H-AR2D1	800H-BR2D1
	Red	800H-R6D1	800H-AR6D1	800H-BR6D1
1 N.C.	Green	800H-R1D2	800H-AR1D2	800H-BR1D2
	Black	800H-R2D2	800H-AR2D2	800H-BR2D2
	Red	800H-R6D2	800H-AR6D2	800H-BR6D2
1 N.O. - 1 N.C.	Green	800H-R1A	800H-AR1A	800H-BR1A
	Black	800H-R2A	800H-AR2A	800H-BR2A
	Red	800H-R6A	800H-AR6A	800H-BR6A
2 N.O. - 2 N.C.				
	Green	800H-R1B	800H-AR1B	800H-BR1B
	Black	800H-R2B	800H-AR2B	800H-BR2B
	Red	800H-R6B	800H-AR6B	800H-BR6B



Bootless Guarded Head
Cat. No. 800H-GR1A

Bootless Mushroom Head
Cat. No. 800H-DR6A



Jumbo Mushroom Head
Cat. No. 800H-DR6JA

Contact Type	Button Color	Bootless Guarded Head	Bootless Mushroom Head	Jumbo Mushroom Head
		Cat. No.	Cat. No.	Cat. No.
No contacts	Green	800H-GR1	800H-DR1	800H-DR1J
	Black	800H-GR2	800H-DR2	800H-DR2J
	Red	800H-GR6	800H-DR6	800H-DR6J
1 N.O.	Green	800H-GR1D1	800H-DR1D1	800H-DR1JD1
	Black	800H-GR2D1	800H-DR2D1	800H-DR2JD1
	Red	800H-GR6D1	800H-DR6D1	800H-DR6JD1
1 N.C.	Green	800H-GR1D2	800H-DR1D2	800H-DR1JD2
	Black	800H-GR2D2	800H-DR2D2	800H-DR2JD2
	Red	800H-GR6D2	800H-DR6D2	800H-DR6JD2
1 N.O. - 1 N.C.	Green	800H-GR1A	800H-DR1A	800H-DR1JA
	Black	800H-GR2A	800H-DR2A	800H-DR2JA
	Red	800H-GR6A	800H-DR6A	800H-DR6JA

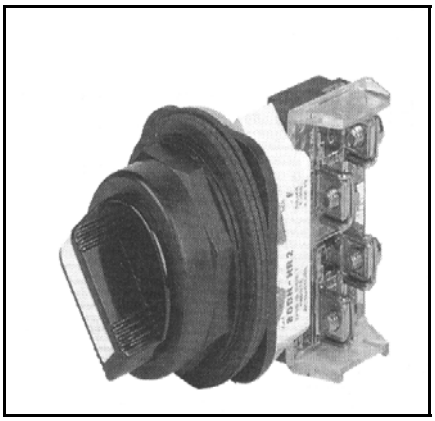
800H-HR2D1

NE Controls, L.L.C.
Syracuse, NY 13209 Telephone 315-299-5161

Product Profile

Selector Switch Maintained 800H-HR

Allen-Bradley Selector Switches Maintained Contacts Watertight/Oiltight



Technical Data

Mechanical life	1,000,000 ops.
Electrical life	1,000,000 ops.
Housing	glass filled polyester
Contacts	silver
Normal load break	3 amps @ 240vac
Terminals	brass
Terminal screws	brass

Note: X=Closed/O=Open

Contact Type	Contact Location		Operator Position		Operator Type M=Maintained S=Spring Return	Standard Knob	
	Side	Contact	↖	↗		Catalog Number	*
No Contacts	—	—	—	—	M M	800H-HR2	
					S→M	800H-HR4	
					M←S	800H-HR5	
1 N.O.	White	A	O	X	M M	800H-HR2D1	
					S→M ❶	800H-HR4D1	
					M←S	800H-HR5D1	
1 N.O. - 1 N.C.	White	A B	O X	X O	M M	800H-HR2A	
					S→M ❶	800H-HR4A	
					M←S	800H-HR5A	
2 N.O. - 2 N.C.	White Black	A B A B	O X O X	X O X O	M M	800H-HR2B	
					S→M ❶	800H-HR4B	
					M←S	800H-HR5B	

❶ Target tables are reversed from those shown.

UL Listed

CSA® Certified

SECTION 5

Severe Duty is **Standard** with **WEG W22** motors.

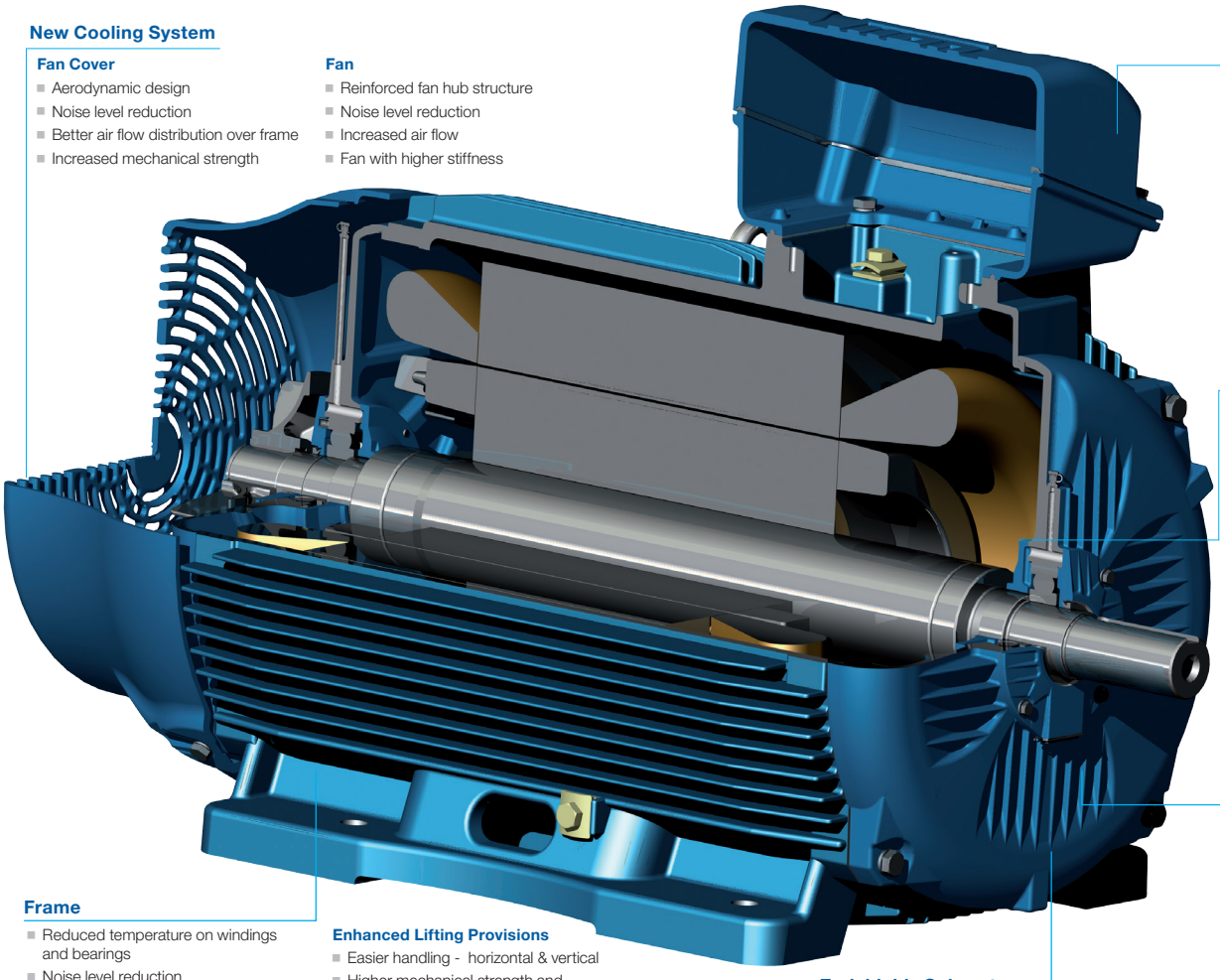
You do not need a special motor for severe duty. Severe Duty is standard with WEG W22 motors.

You do not need a special motor for severe duty. Severe Duty is standard with WEG.

Features that make a difference:

- All NEMA Premium ratings have a 1.25 service factor (up to 100 HP) resulting in cooler operation and extended life of the motor
- All Cast Iron Construction, including Terminal Box and Fan Cover (*)
- Solid feet for reduced vibration levels and impact absorption
- Optimized ventilation system for cooler operation and extended life
- High Grade FC200 cast iron provides superior mechanical strength and heat dissipation
- All WEG W22 motors are Totally Enclosed Fan Cooled with a true IP55 rating against dust and moisture. (IPW56, IPW65 and IPW66 available as optional)
- Exclusive W-Seal 364T and larger provides superior bearing protection
- Taconite Labyrinth seal 586 Frame and larger
- Exclusive WEG painting system exceed 200hrs ASTM 117 corrosion test (Exceeds IEEE841 standard)
- Balanced to 0.08 inches per second vibration limits (Meets IEEE841 standard)
- Four Bolt Conduit Cover with glued Neoprene Gasket
- Impregnation Resin and magnet wire are insulation class H
- Stainless Steel Nameplate - Laser edged with high contrast background
- Corrosion Proof Drains
- Inverter Duty per NEMA MG1, Part 31
- Certified Class I Div 2, Groups A, B, C & D; Class II, Div 2, Groups F & G

**cast iron fan cover available as an option on 143-215T frames*



New Cooling System

Fan Cover
- Aerodynamic design
- Noise level reduction
- Better air flow distribution over frame
- Increased mechanical strength

Fan
- Reinforced fan hub structure
- Noise level reduction
- Increased air flow
- Fan with higher stiffness

Terminal Box
- Better connection quality
- Easier cable handling during installation
- More space available for accessory installation
- Easier Maintenance
- Mounting F1/F2/F3
- Rotation on 90° stages

Bearing Caps

External
- Finned surface for improved bearing heat dissipation

Internal
- Change of grease path for positive lubrication
- Bearing lubrication quality improvement
- Reduced bearing temperature

Seal Subsystem
- Increased dust and moisture protection
- Increased protection to high-pressure cleaning

Frame
- Reduced temperature on windings and bearings
- Noise level reduction
- Terminal box position outlet on top

Pad for vibration sensor
- Displaced 90º from each other

Enhanced Lifting Provisions
- Easier handling - horizontal & vertical
- Higher mechanical strength and handling safety

Solid feet
- More impact resistance
- Ideal for high vibration level applications

Endshields Subsystem

DE (Drive Endshield)
- New fin design
- Bearing moved outwards for better load support
- Improved bearing heat dissipation for reduced bearing temperature
- Reinforced endshield structure

NDE (Non-Drive Endshield)
- New design with smooth exterior surface
- Improved air flow
- Noise level reduction
- Improved structural rigidity for low vibration

DATA SHEET

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11804410
		Catalog # :	04018ET3E324TF3-W22

Frame	: 324T	Locked rotor time	: 36s (cold) 20s (hot)
Output	: 40 HP (30 kW)	Temperature rise	: 80 K
Poles	: 4	Duty cycle	: Cont.(S1)
Frequency	: 60 Hz	Ambient temperature	: -20°C to +40°C
Rated voltage	: 230/460 V	Altitude	: 1000 m.a.s.l.
Rated current	: 94.2/47.1 A	Protection degree	: IP55
L. R. Amperes	: 575/287 A	Cooling method	: IC411 - TEFC
LRC	: 6.1x(Code G)	Mounting	: F-3
No load current	: 34.0/17.0 A	Rotation[1]	: Both (CW and CCW)
Rated speed	: 1770 rpm	Noise level[2]	: 66.0 dB(A)
Slip	: 1.67 %	Starting method	: Direct On Line
Rated torque	: 119 ft.lb	Approx. weight[3]	: 562 lb
Locked rotor torque	: 229 %		
Breakdown torque	: 240 %		
Insulation class	: F		
Service factor	: 1.25		
Moment of inertia (J)	: 9.16 sq.ft.lb		
Design	: B		

Output	25%	50%	75%	100%
Efficiency (%)	93.4	93.6	94.1	94.1
Power Factor	0.46	0.72	0.80	0.85

Foundation loads	
Max. traction	: 980 lb
Max. compression	: 1542 lb

		Drive end	Non drive end
Bearing type	:	6312 C3	6212 C3
Sealing	:	V'Ring	V'Ring
Lubrication interval	:	20000 h	20000 h
Lubricant amount	:	21 g	13 g
Lubricant type	:	Mobil Polyrex EM	

Notes
USABLE @208V 104A SF 1.15 SFA 120A

This revision replaces and cancel the previous one, which must be eliminated.
(1) Looking the motor from the shaft end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At 100% of full load.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.

Rev.	Changes Summary	Performed	Checked	Date

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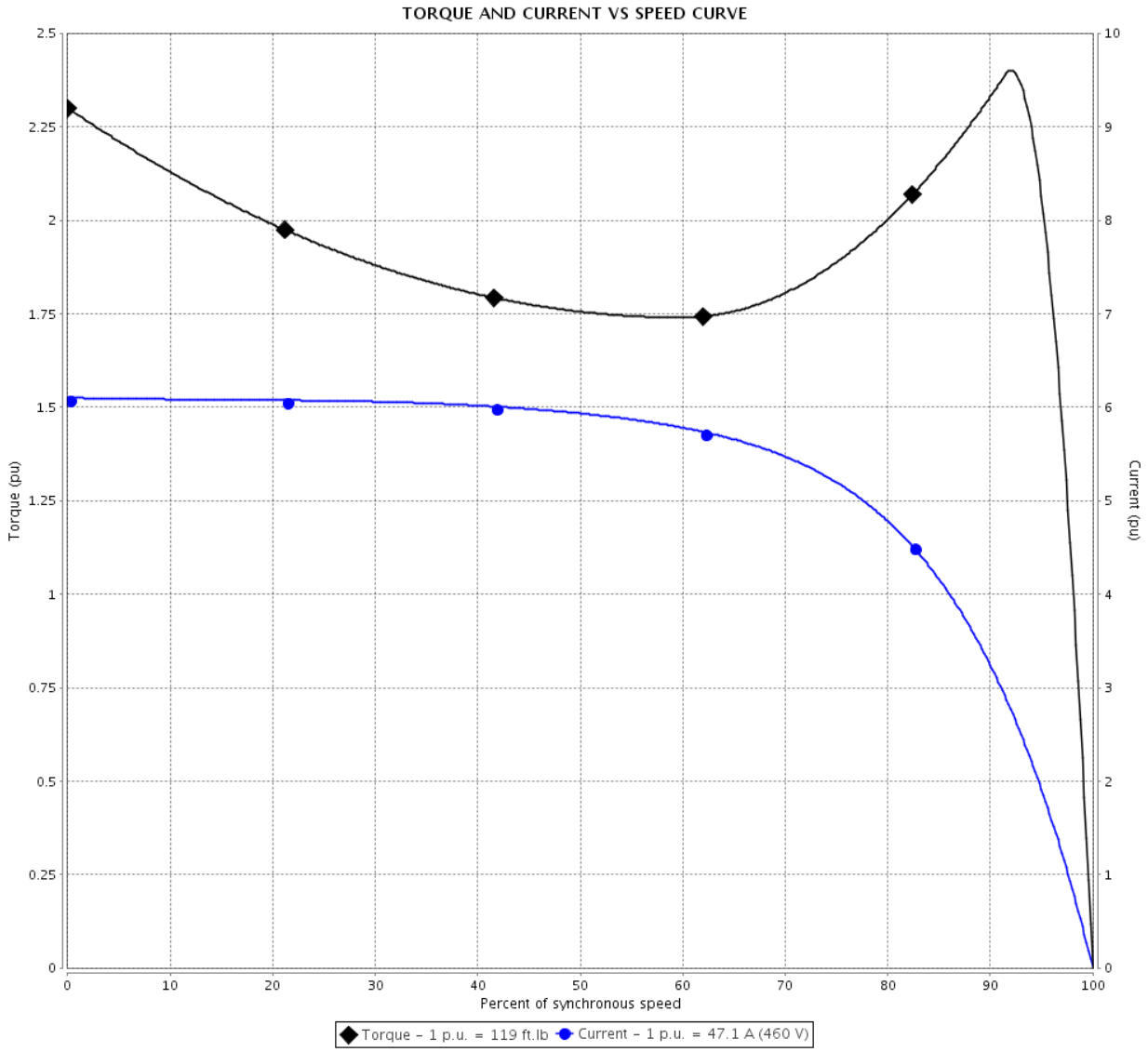
TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11804410



Performance	: 230/460 V 60 Hz 4P

Rated current	: 94.2/47.1 A	Moment of inertia (J)	: 9.16 sq.ft.lb
LRC	: 6.1	Duty cycle	: Cont.(S1)
Rated torque	: 119 ft.lb	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 240 %	Temperature rise	: 80 K
Rated speed	: 1770 rpm	Design	: B

Locked rotor time	: 36s (cold) 20s (hot)

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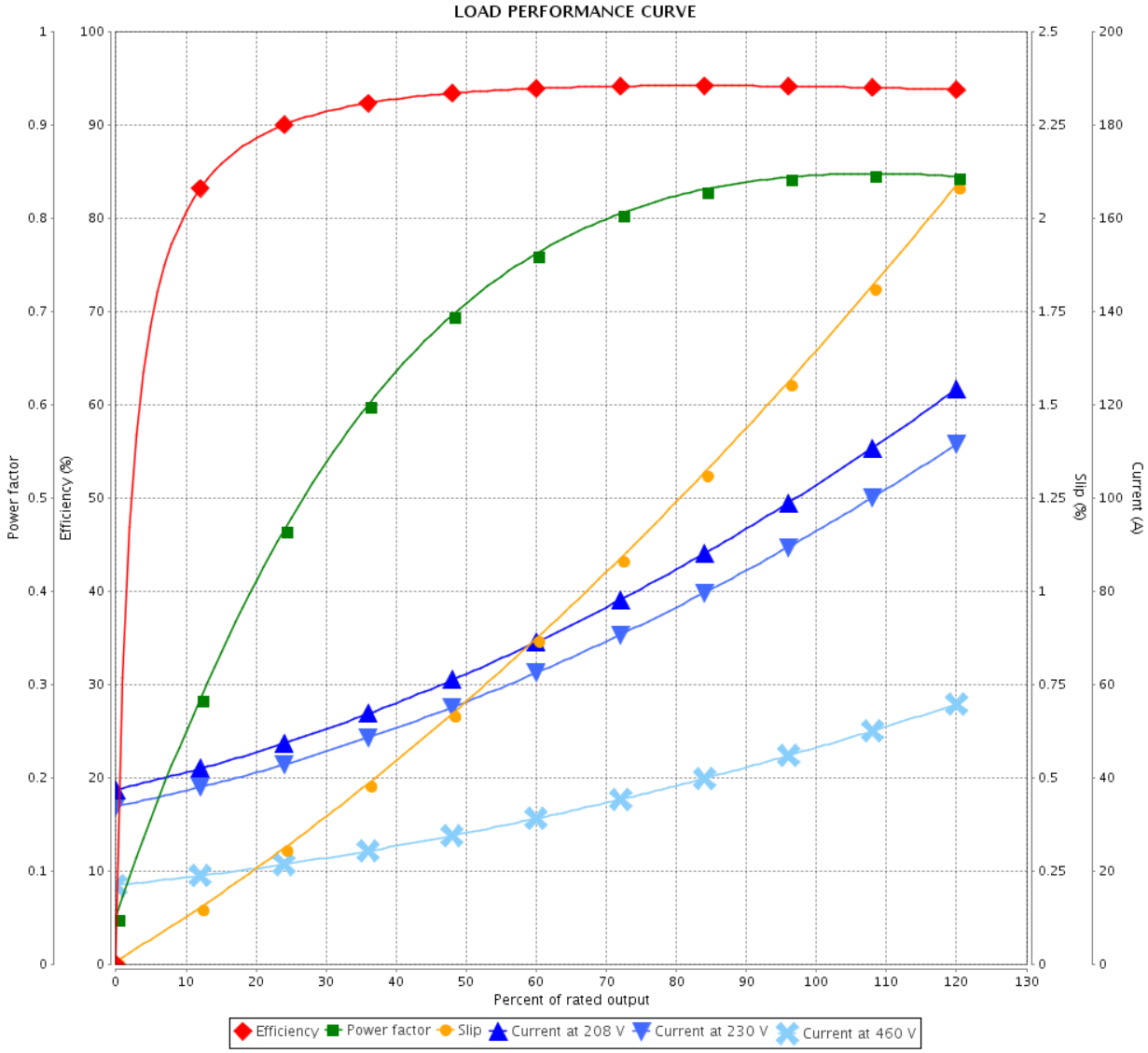
LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:
Product line	: W22 NEMA Premium Efficiency Three-Phase
Product code :	11804410



Performance	: 230/460 V 60 Hz 4P		
Rated current	: 94.2/47.1 A	Moment of inertia (J)	: 9.16 sq.ft.lb
LRC	: 6.1	Duty cycle	: Cont.(S1)
Rated torque	: 119 ft.lb	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 240 %	Temperature rise	: 80 K
Rated speed	: 1770 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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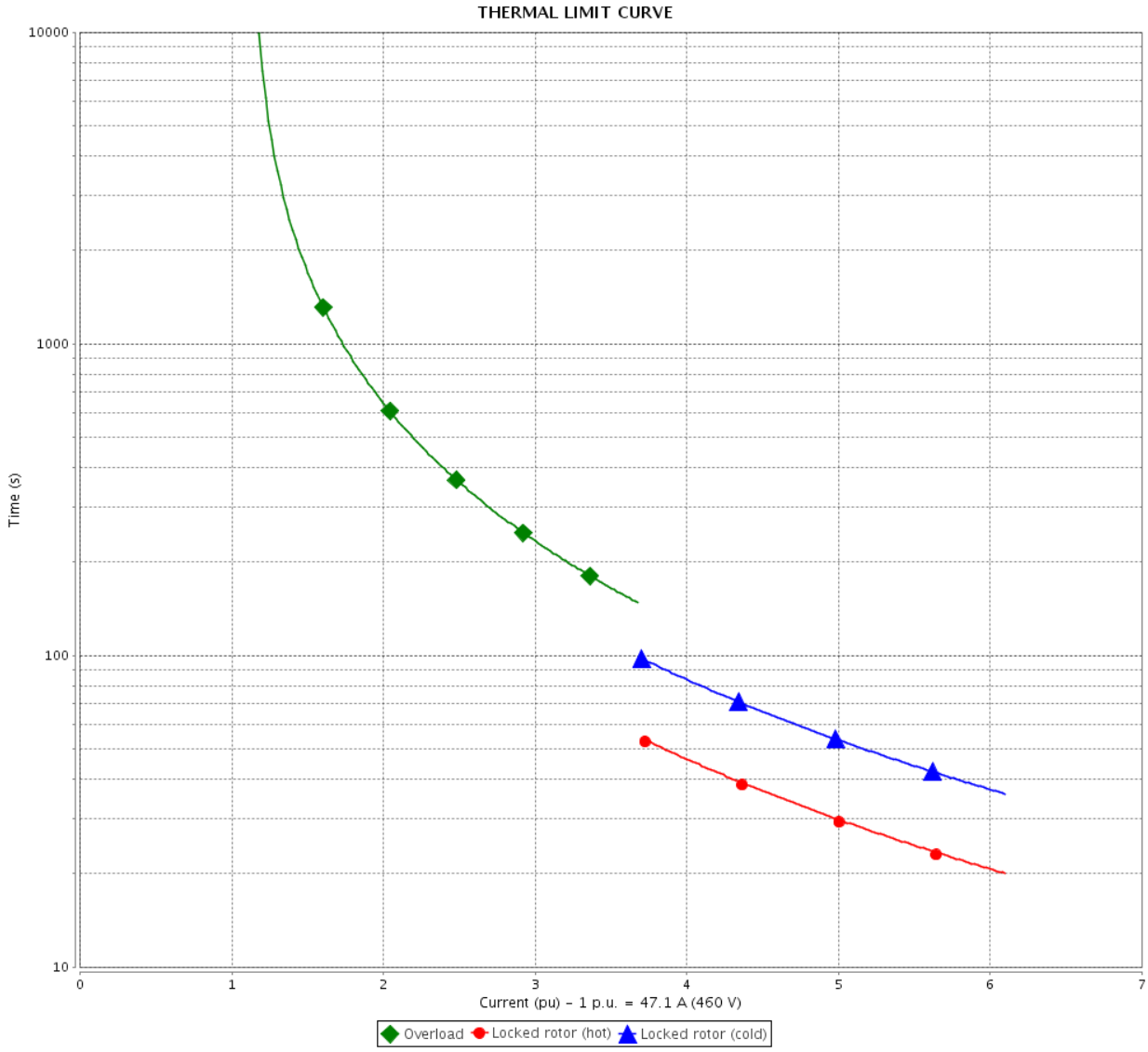
THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11804410



Performance	: 230/460 V 60 Hz 4P		
Rated current	: 94.2/47.1 A	Moment of inertia (J)	: 9.16 sq.ft.lb
LRC	: 6.1	Duty cycle	: Cont.(S1)
Rated torque	: 119 ft.lb	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 240 %	Temperature rise	: 80 K
Rated speed	: 1770 rpm	Design	: B
Heating constant			
Cooling constant			

Rev.	Changes Summary	Performed	Checked	Date

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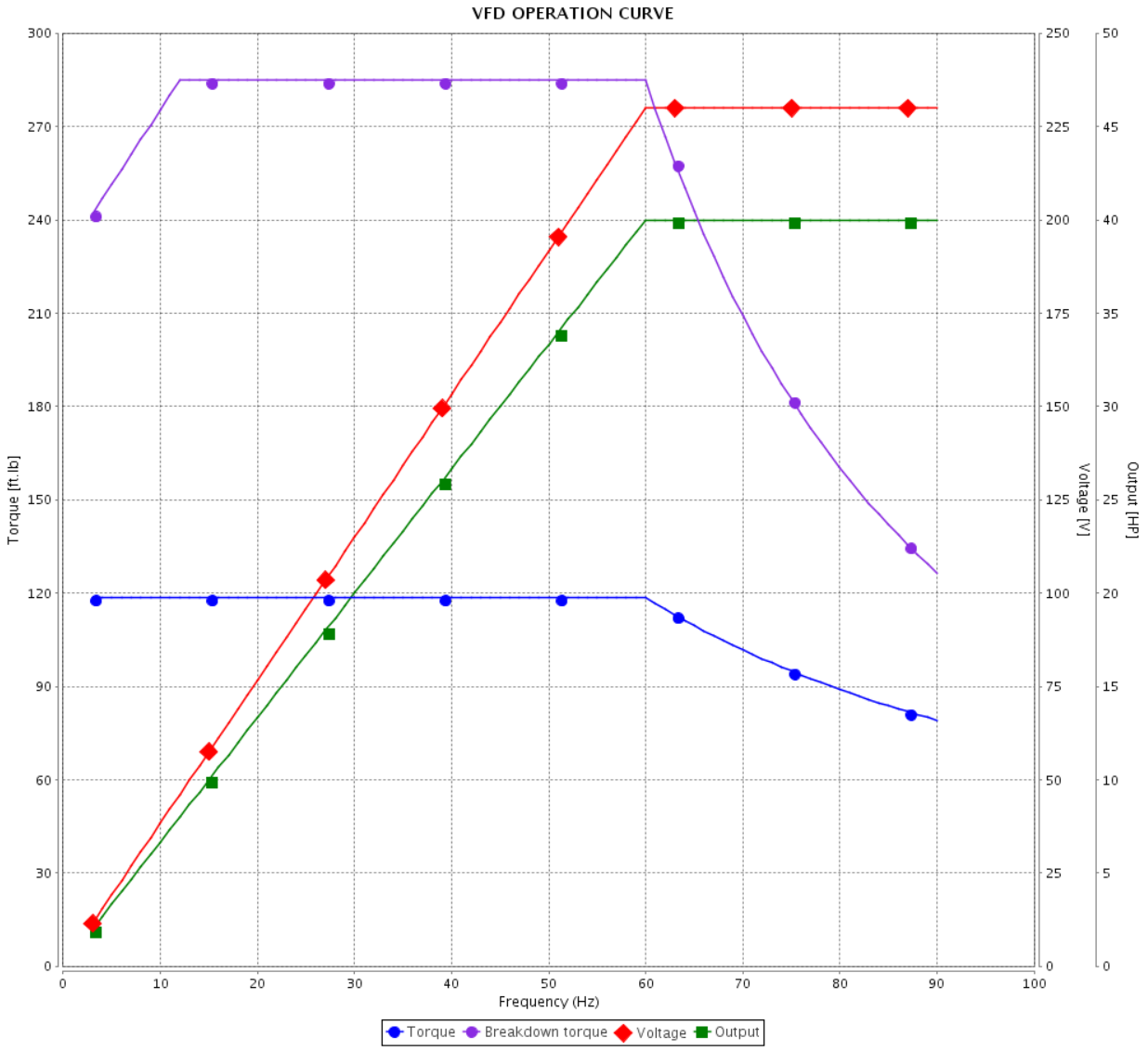
VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11804410



Performance	: 230/460 V 60 Hz 4P		
Rated current	: 94.2/47.1 A	Moment of inertia (J)	: 9.16 sq.ft.lb
LRC	: 6.1	Duty cycle	: Cont.(S1)
Rated torque	: 119 ft.lb	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 240 %	Temperature rise	: 80 K
Rated speed	: 1770 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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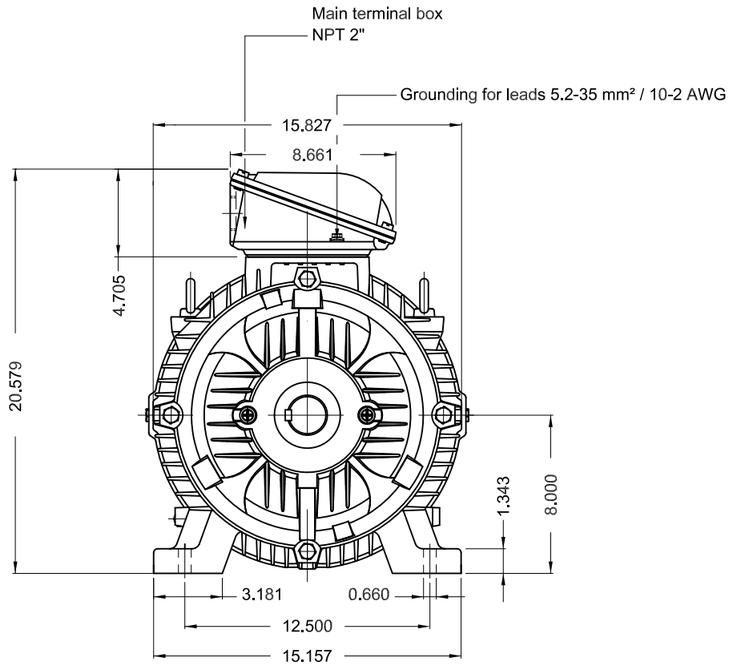

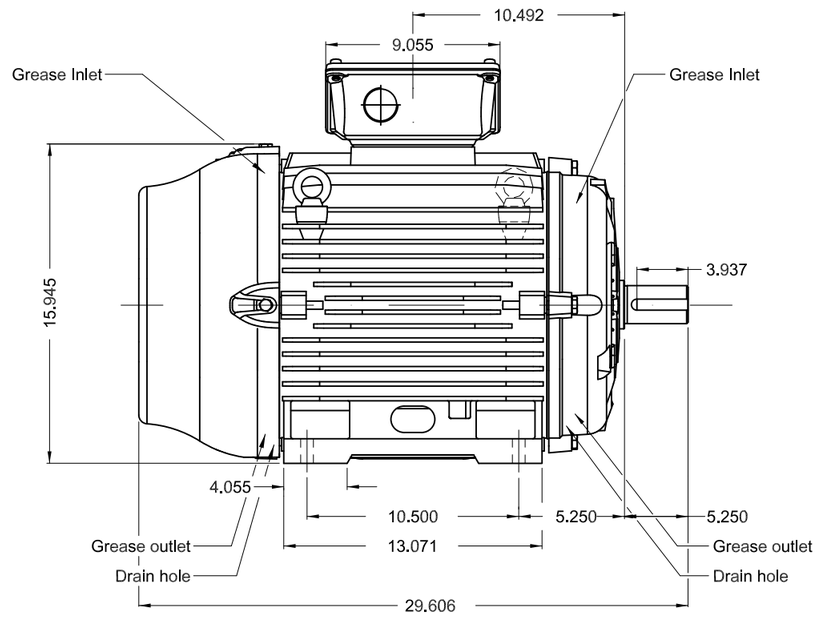

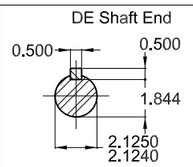

- Without vertical jackscrews
- Thermal protection to switch off - thermostat 155°C
- Color RAL 5009
- Painting plan 203A
- Mounting B3T

40 HP 04 Poles 60Hz | A

ECM	LOC	SUMMARY OF MODIFICATIONS	EXECUTED	CHECKED	RELEASED	DATE	VER

EXECUTED	PIRWBUSER	THREE PHASE W22 MOTOR - NEMA PREMIUM EFF	PREVIEW
CHECKED		FRAME 324T IP55 TEFC	WDD
RELEASED			
REL DT.		WMO Jaragua do Sul Product Engineering	SHEET 1 / 1

Dimensions in inches

XME A3

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DATA SHEET

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	12439905
		Catalog # :	05018ET3E326TF3-W22

Frame	: 326T	Locked rotor time	: 27s (cold) 15s (hot)
Output	: 50 HP (37 kW)	Temperature rise	: 80 K
Poles	: 4	Duty cycle	: Cont.(S1)
Frequency	: 60 Hz	Ambient temperature	: -20°C to +40°C
Rated voltage	: 208-230/460 V	Altitude	: 1000 m.a.s.l.
Rated current	: 131-118/59.2 A	Protection degree	: IP55
L. R. Amperes	: 812-734/367 A	Cooling method	: IC411 - TEFC
LRC	: 6.2x(Code G)	Mounting	: F-3
No load current	: 40.5-47.0/23.5 A	Rotation[1]	: Both (CW and CCW)
Rated speed	: 1775 rpm	Noise level[2]	: 66.0 dB(A)
Slip	: 1.39 %	Starting method	: Direct On Line
Rated torque	: 20.4 kgfm	Approx. weight[3]	: 269 kg
Locked rotor torque	: 229 %		
Breakdown torque	: 270 %		
Insulation class	: F		
Service factor	: 1.25		
Moment of inertia (J)	: 0.3861 kgm²		
Design	: B		

Output	25%	50%	75%	100%
Efficiency (%)	92.5	93.0	94.1	94.5
Power Factor	0.42	0.66	0.77	0.83

Foundation loads	
Max. traction	: 673 kgf
Max. compression	: 943 kgf

		Drive end	Non drive end
Bearing type	:	6312 C3	6212 C3
Sealing	:	V'Ring	V'Ring
Lubrication interval	:	20000 h	20000 h
Lubricant amount	:	21 g	13 g
Lubricant type	:	Mobil Polyrex EM	

Notes

This revision replaces and cancel the previous one, which must be eliminated.
(1) Looking the motor from the shaft end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At 100% of full load.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.

Rev.	Changes Summary	Performed	Checked	Date

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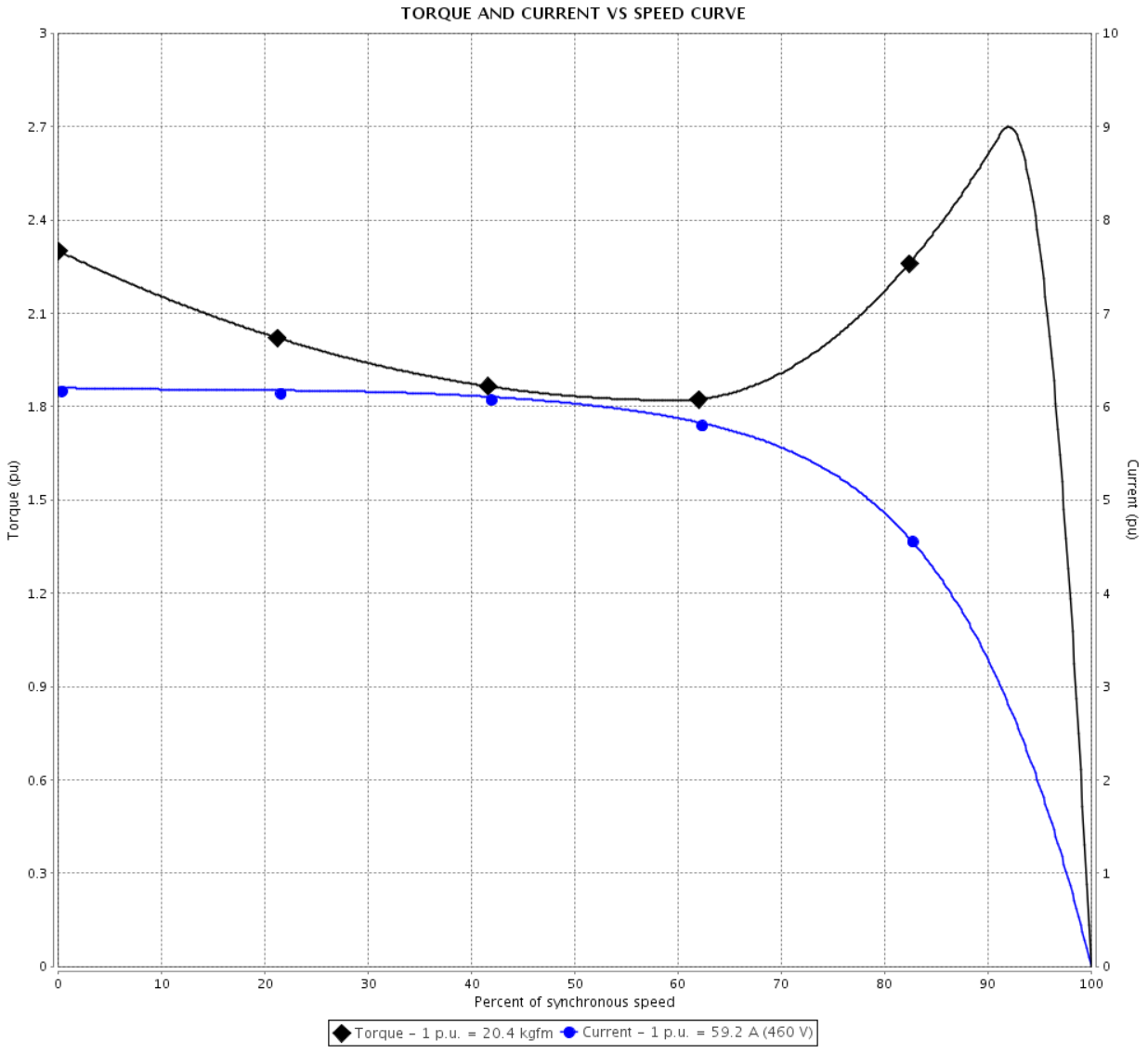
TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	12439905
		Catalog # :	05018ET3E326TF3-W22



Performance	: 208-230/460 V 60 Hz 4P		
Rated current	: 131-118/59.2 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 20.4 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1775 rpm	Design	: B
Locked rotor time	: 27s (cold) 15s (hot)		

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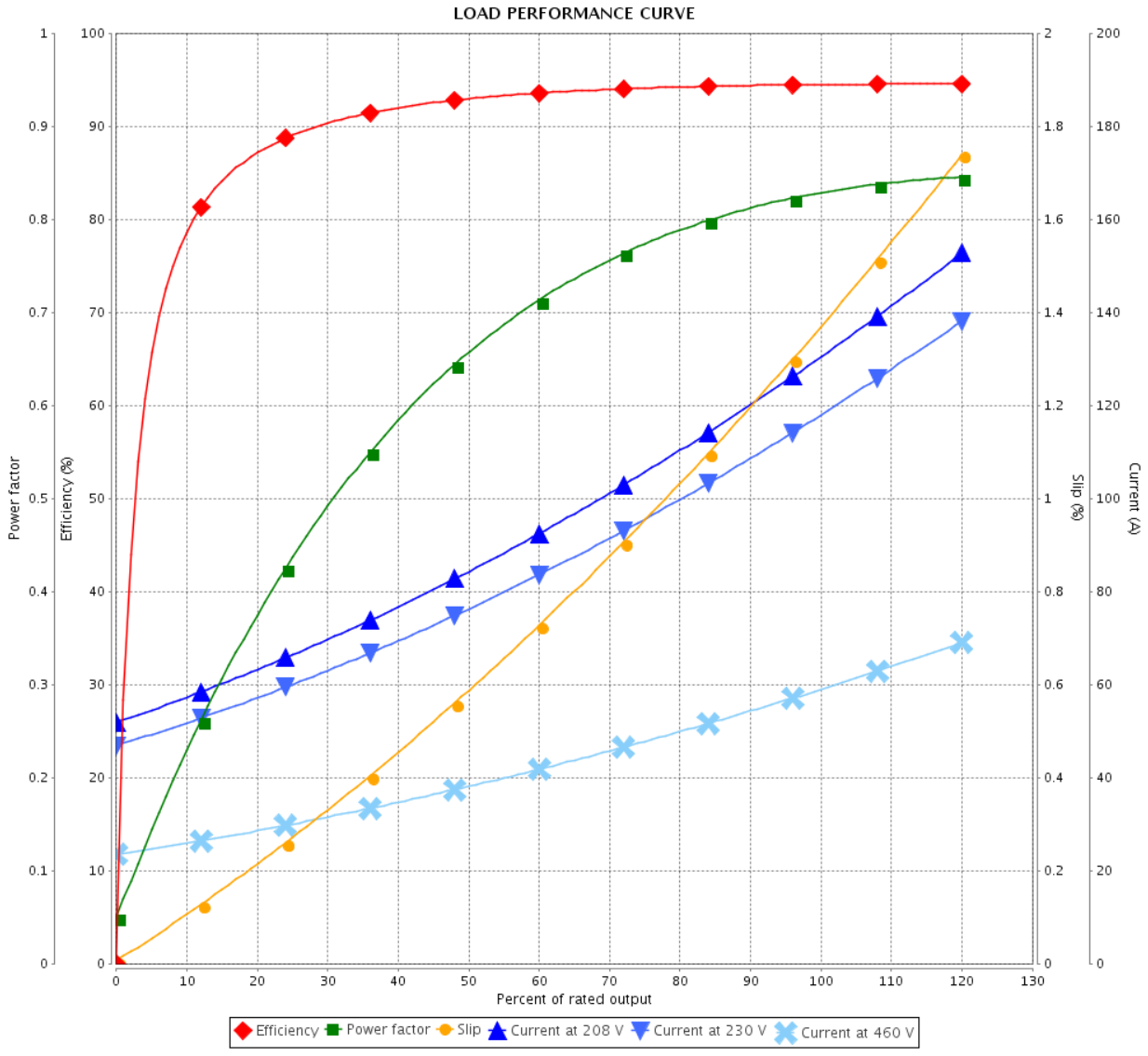
LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	12439905
		Catalog # :	05018ET3E326TF3-W22



Performance	: 208-230/460 V 60 Hz 4P		
Rated current	: 131-118/59.2 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 20.4 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1775 rpm	Design	: B

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THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	12439905
		Catalog # :	05018ET3E326TF3-W22

Performance	: 208-230/460 V 60 Hz 4P		
Rated current	: 131-118/59.2 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 20.4 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1775 rpm	Design	: B
Heating constant			
Cooling constant			

Rev.	Changes Summary	Performed	Checked	Date

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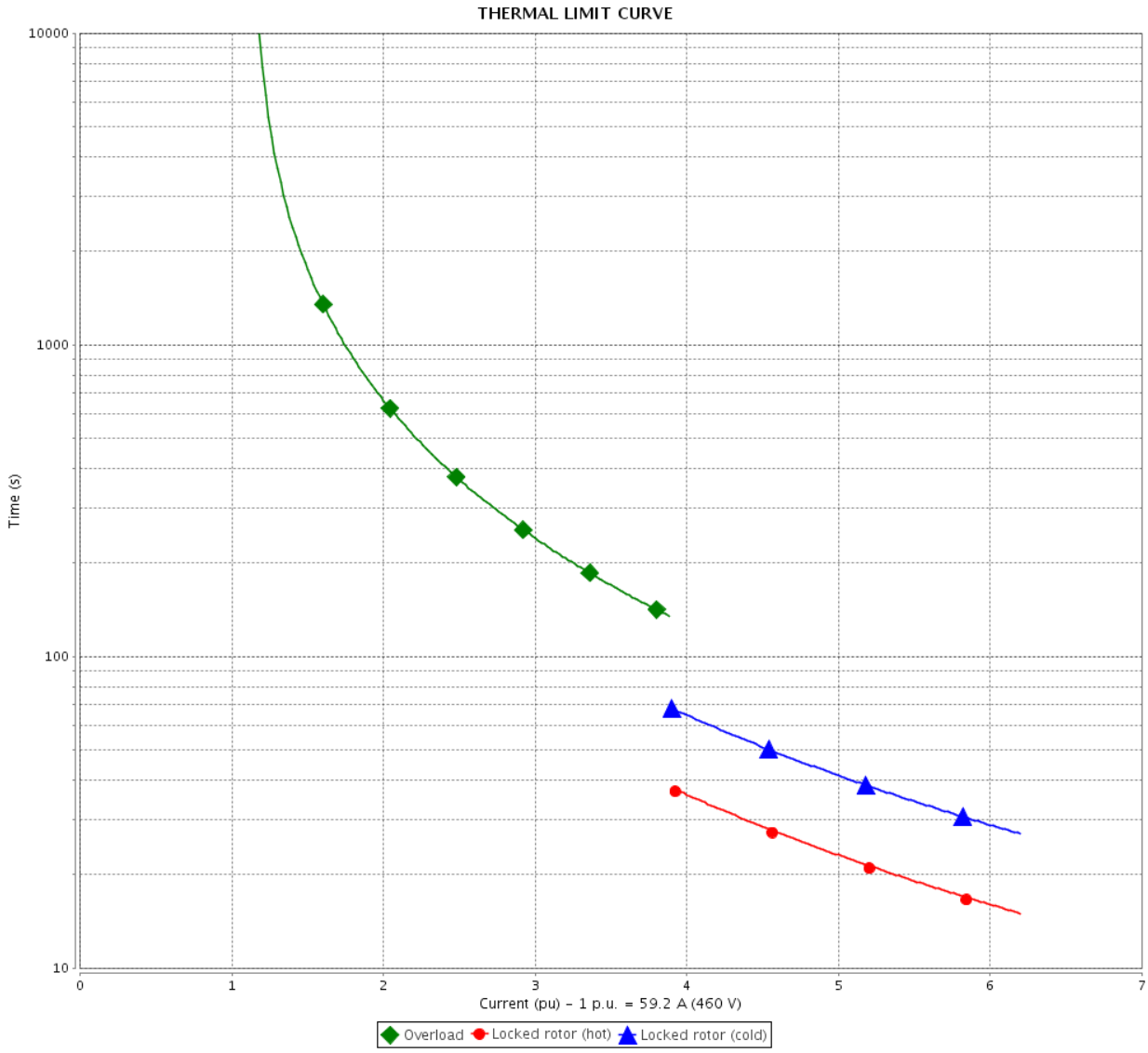
THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer :



Rev.	Changes Summary	Performed	Checked	Date

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Checked by			Page	Revision
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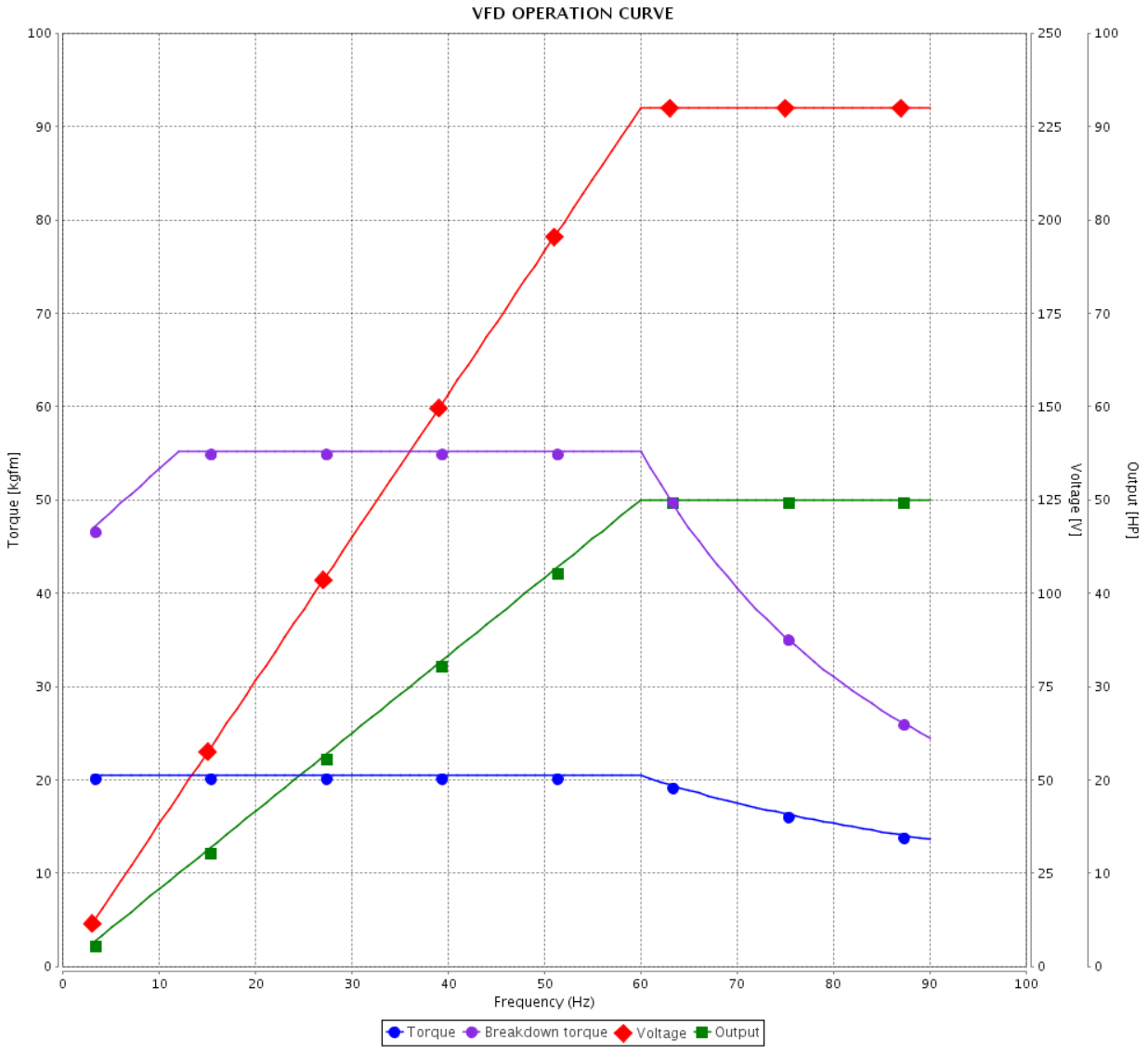
VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	12439905
		Catalog # :	05018ET3E326TF3-W22



Performance	: 208-230/460 V 60 Hz 4P		
Rated current	: 131-118/59.2 A	Moment of inertia (J)	: 0.3861 kgm²
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 20.4 kgfm	Insulation class	: F
Locked rotor torque	: 229 %	Service factor	: 1.25
Breakdown torque	: 270 %	Temperature rise	: 80 K
Rated speed	: 1775 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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Checked by			Page	Revision
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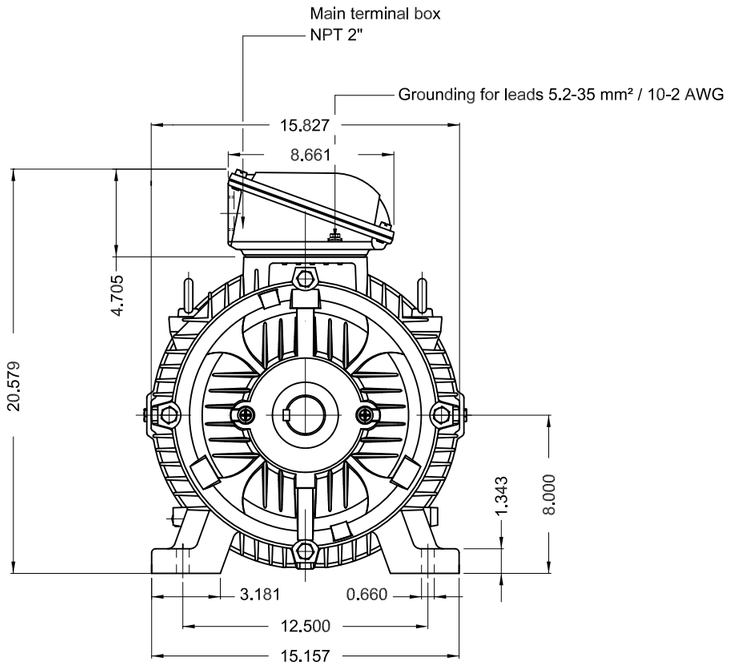

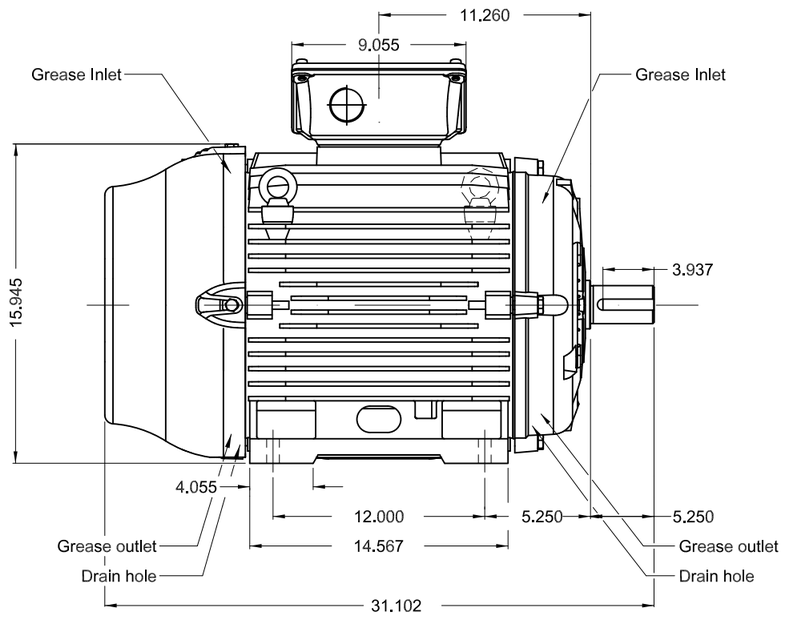

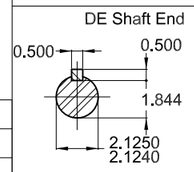

Color RAL 5009
Painting plan 203A
Mounting B3T

50 HP 04 Poles 60Hz | A

ECM	LOC	SUMMARY OF MODIFICATIONS	EXECUTED	CHECKED	RELEASED	DATE	VER

EXECUTED	PIRWBUSER	THREE PHASE W22 MOTOR - NEMA PREMIUM EFF	PREVIEW
CHECKED		FRAME 326T IP55 TEFC	WDD
RELEASED			
REL DT.		WMO Jaragua do Sul Product Engineering	SHEET 1 / 1

Dimensions in inches
XME A3

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DATA SHEET

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11166654
		Catalog # :	06018ET3E364T-W22

Frame	: 364/5T	Locked rotor time	: 27s (cold) 15s (hot)
Output	: 60 HP (45 kW)	Temperature rise	: 80 K
Poles	: 4	Duty cycle	: Cont.(S1)
Frequency	: 60 Hz	Ambient temperature	: -20°C to +40°C
Rated voltage	: 230/460 V	Altitude	: 1000 m.a.s.l.
Rated current	: 143/71.6 A	Protection degree	: IP55
L. R. Amperes	: 888/444 A	Cooling method	: IC411 - TEFC
LRC	: 6.2x(Code G)	Mounting	: F-1
No load current	: 52.0/26.0 A	Rotation[1]	: Both (CW and CCW)
Rated speed	: 1780 rpm	Noise level[2]	: 67.0 dB(A)
Slip	: 1.11 %	Starting method	: Direct On Line
Rated torque	: 177 ft.lb	Approx. weight[3]	: 880 lb
Locked rotor torque	: 220 %		
Breakdown torque	: 240 %		
Insulation class	: F		
Service factor	: 1.25		
Moment of inertia (J)	: 22.4 sq.ft.lb		
Design	: B		

Output	25%	50%	75%	100%
Efficiency (%)	93.5	94.1	94.5	95.0
Power Factor	0.46	0.71	0.80	0.83

Foundation loads	
Max. traction	: 1236 lb
Max. compression	: 2116 lb

		Drive end	Non drive end
Bearing type	:	6314 C3	6314 C3
Sealing	:	WSeal	WSeal
Lubrication interval	:	12000 h	12000 h
Lubricant amount	:	27 g	27 g
Lubricant type	:	Mobil Polyrex EM	

Notes
USABLE @208V 151A SF 1.10 SFA 166A

This revision replaces and cancel the previous one, which must be eliminated.
(1) Looking the motor from the shaft end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At 100% of full load.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.

Rev.	Changes Summary	Performed	Checked	Date

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Date	15/12/2020		1 / 6	

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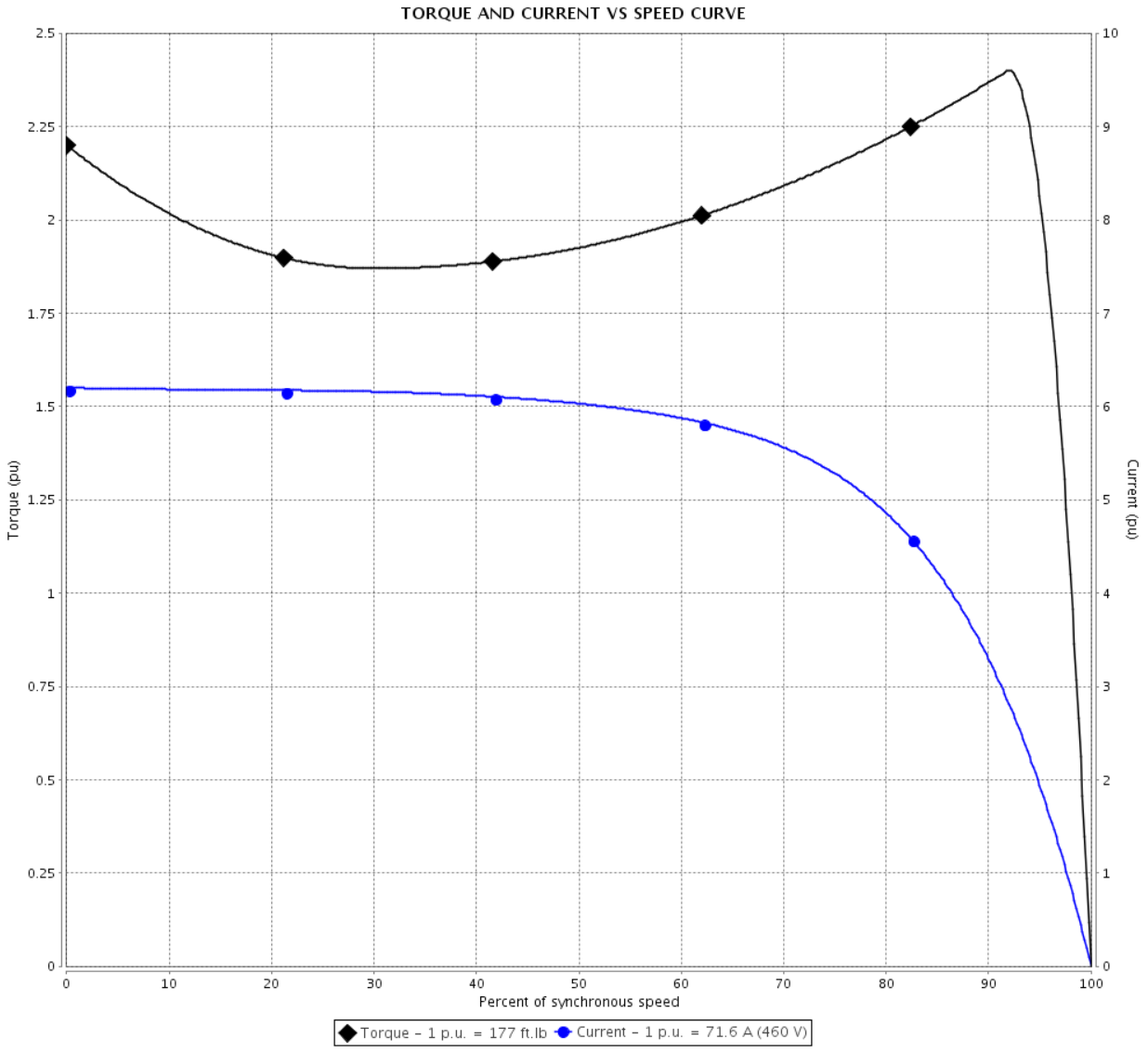
TORQUE AND CURRENT VS SPEED CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11166654
		Catalog # :	06018ET3E364T-W22



Performance	: 230/460 V 60 Hz 4P

Rated current	: 143/71.6 A	Moment of inertia (J)	: 22.4 sq.ft.lb
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 177 ft.lb	Insulation class	: F
Locked rotor torque	: 220 %	Service factor	: 1.25
Breakdown torque	: 240 %	Temperature rise	: 80 K
Rated speed	: 1780 rpm	Design	: B

Locked rotor time	: 27s (cold) 15s (hot)

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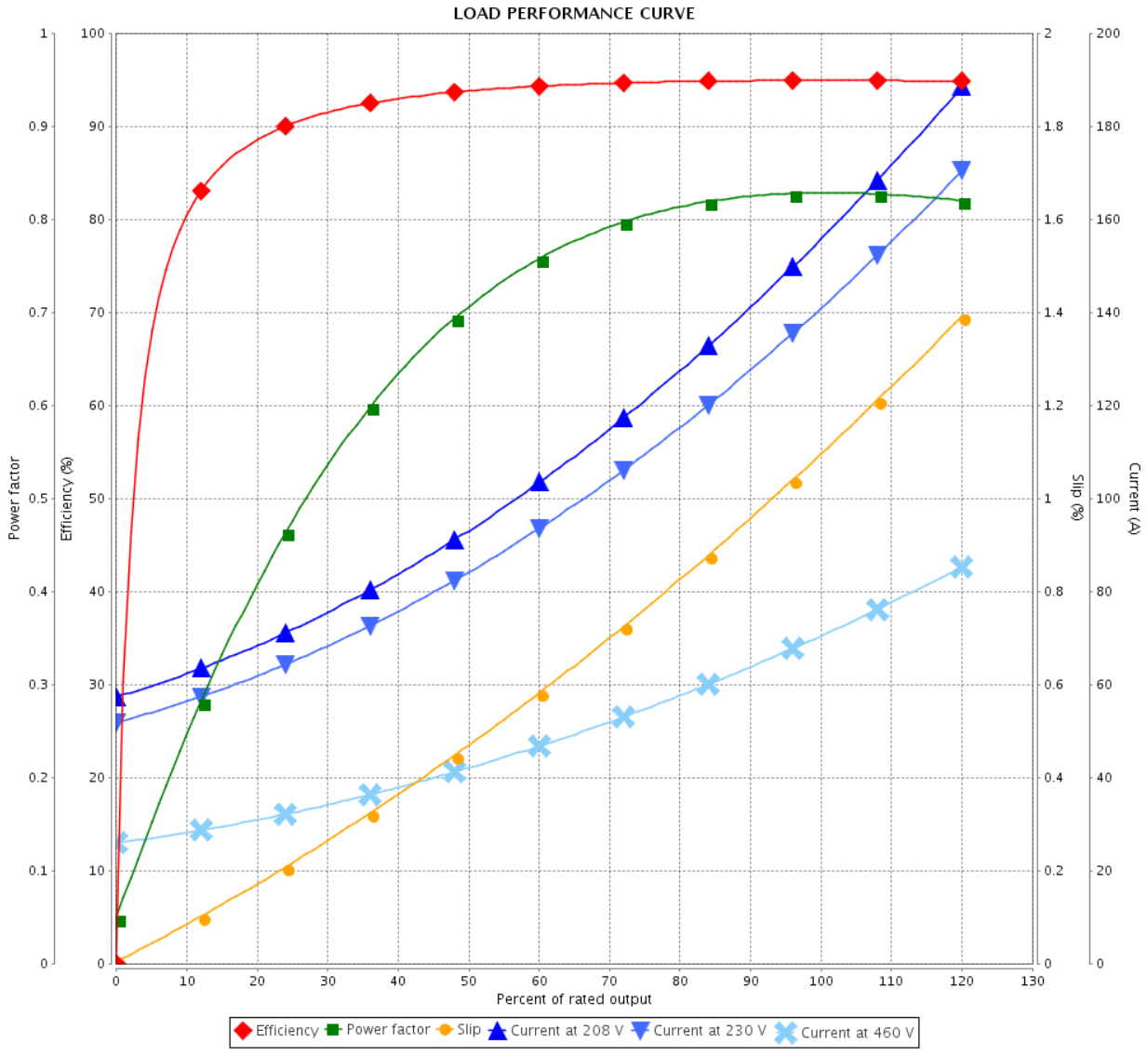
LOAD PERFORMANCE CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11166654
		Catalog # :	06018ET3E364T-W22



Performance	: 230/460 V 60 Hz 4P		
Rated current	: 143/71.6 A	Moment of inertia (J)	: 22.4 sq.ft.lb
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 177 ft.lb	Insulation class	: F
Locked rotor torque	: 220 %	Service factor	: 1.25
Breakdown torque	: 240 %	Temperature rise	: 80 K
Rated speed	: 1780 rpm	Design	: B

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THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11166654
		Catalog # :	06018ET3E364T-W22

Performance	: 230/460 V 60 Hz 4P

Rated current	: 143/71.6 A	Moment of inertia (J)	: 22.4 sq.ft.lb
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 177 ft.lb	Insulation class	: F
Locked rotor torque	: 220 %	Service factor	: 1.25
Breakdown torque	: 240 %	Temperature rise	: 80 K
Rated speed	: 1780 rpm	Design	: B

Heating constant	
Cooling constant	

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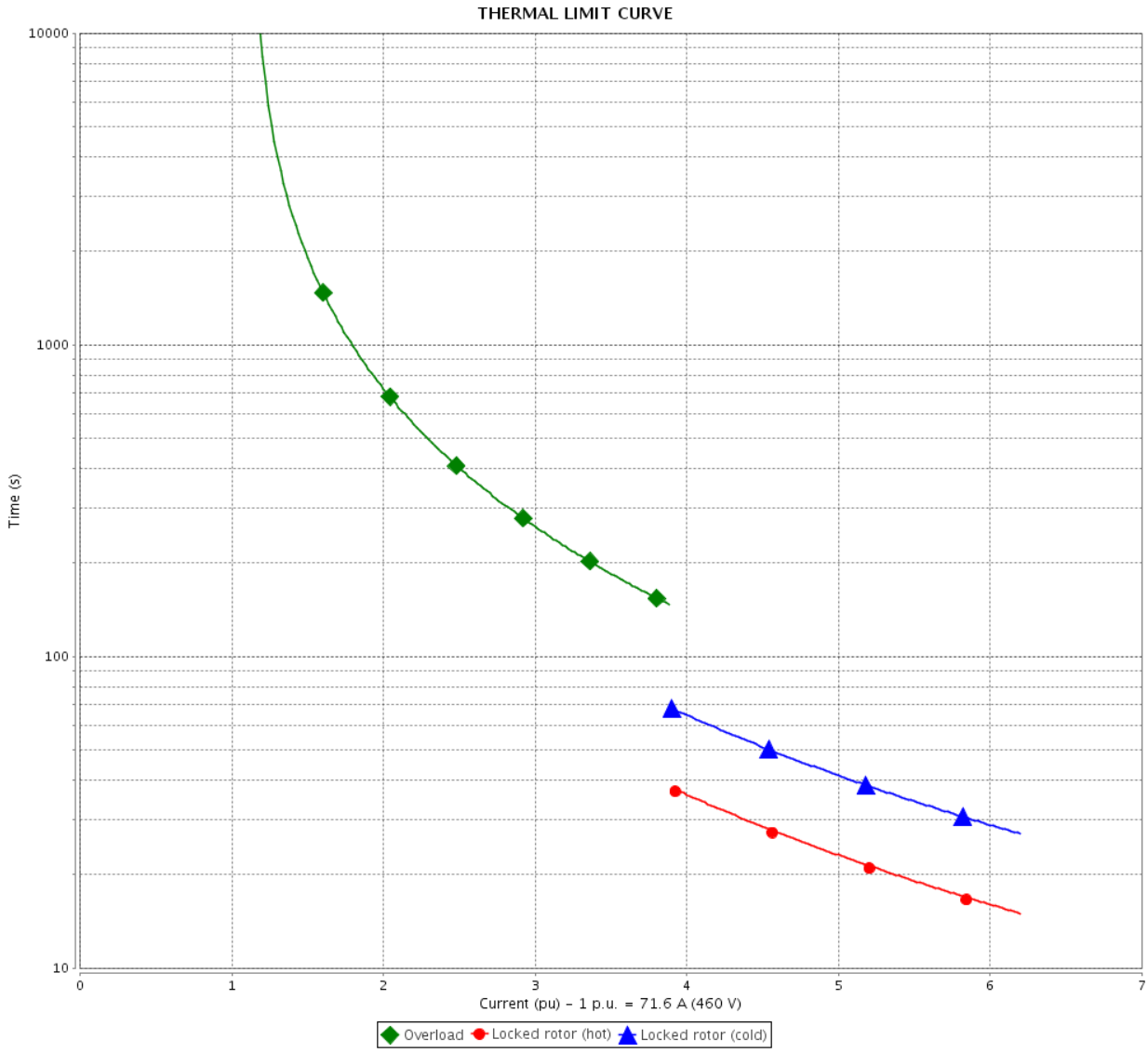
THERMAL LIMIT CURVE

Three Phase Induction Motor - Squirrel Cage

Customer :



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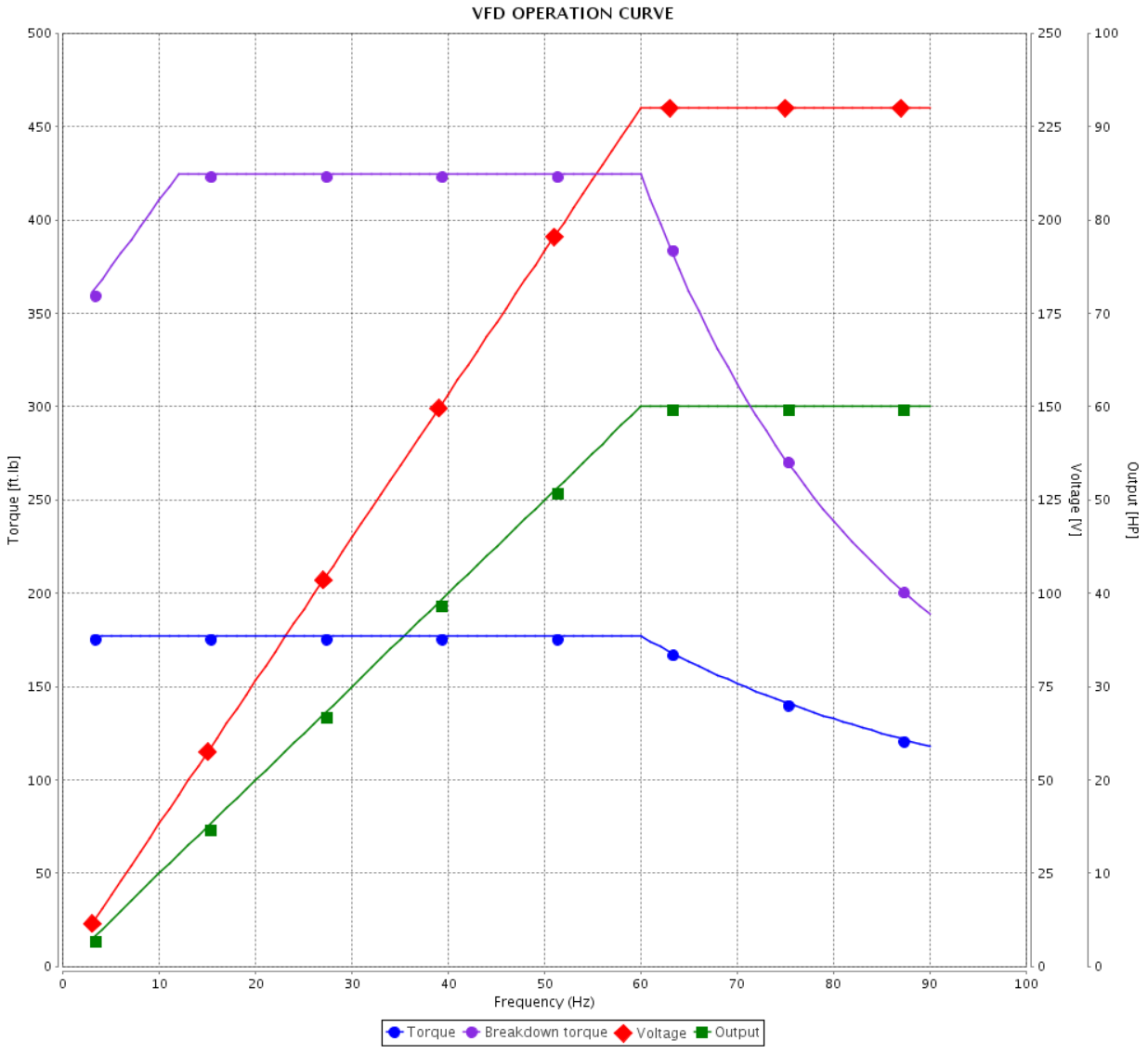
VFD OPERATION CURVE

Three Phase Induction Motor - Squirrel Cage

Customer	:		
Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	11166654
		Catalog # :	06018ET3E364T-W22



Performance	: 230/460 V 60 Hz 4P		
Rated current	: 143/71.6 A	Moment of inertia (J)	: 22.4 sq.ft.lb
LRC	: 6.2	Duty cycle	: Cont.(S1)
Rated torque	: 177 ft.lb	Insulation class	: F
Locked rotor torque	: 220 %	Service factor	: 1.25
Breakdown torque	: 240 %	Temperature rise	: 80 K
Rated speed	: 1780 rpm	Design	: B

Rev.	Changes Summary	Performed	Checked	Date

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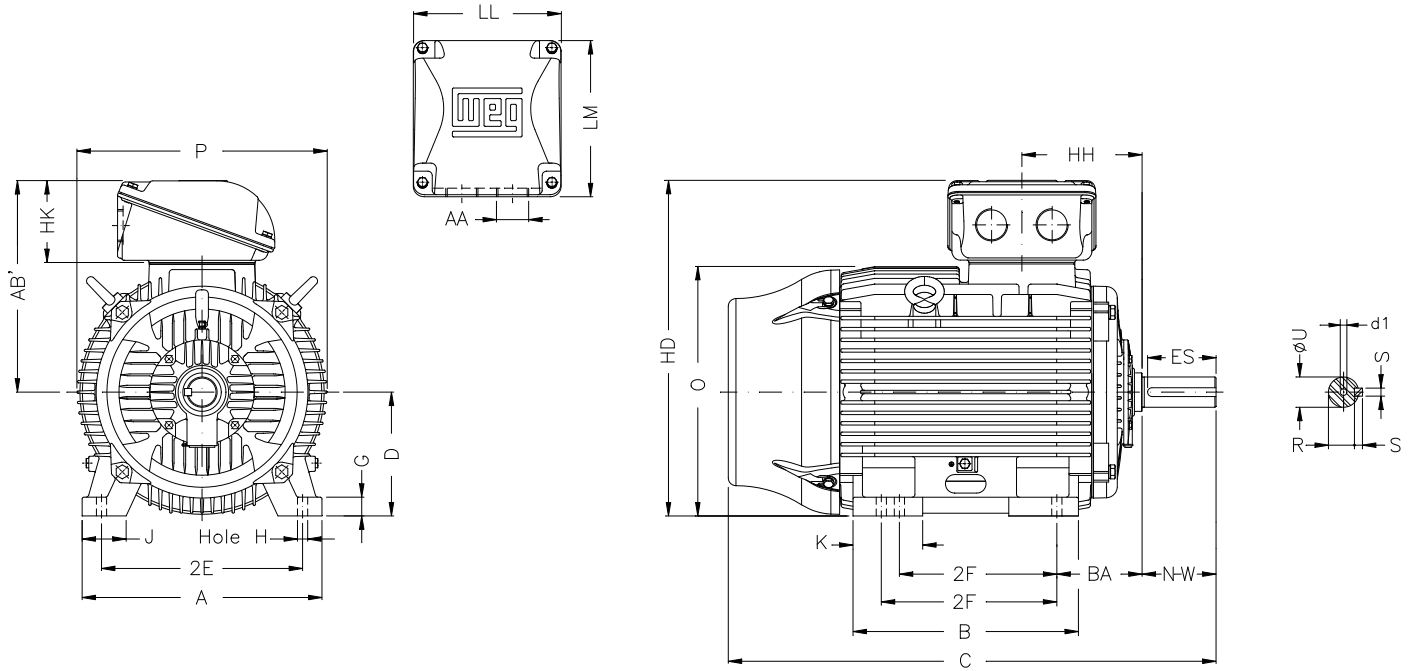


Notes: DRAWING SHOWING F3

Performed by:

Checked:

Customer:

W22 NEMA Premium - Ball Bearings

2E 14.016	J 3.150	A 17.165	P 17.914	AB' 15.177
2F 11.250/12.250	K 4.138	B 15.512	BA 5.875	U 2.375
N-W 5.874	ES 4.331	S 0.625	R 2.019	depth 0.625
D 9.000	G 1.480	HB 4.252	O 17.957	HH 11.988
HK 6.024	EV 1.634	H 0.660	C 34.409	FC 39.331
LL 10.591	LM 11.220	AA NPT 3"	d1 DUNC 3/4"-10	

Three-phase induction motor

Frame 364/5T - IP55

15-DEC-2020

AEGIS SGR™

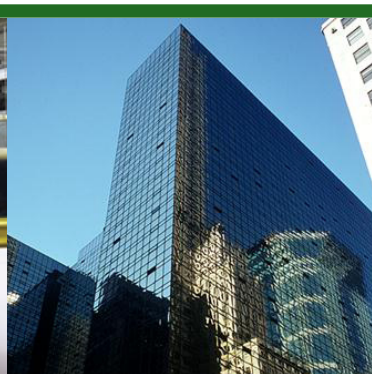
BEARING PROTECTION RING

Sustainable Technology for True Inverter Duty Motors

WEG uses the standard SGR from the AEGIS catalog that is sized based on the motor min/max shaft diameter. They use the type with the mounting brackets which are designed to fit over the shaft shoulder on the motor end-shield.

Bearing Protection For Life!

2009



BEARING PROTECTION RING™

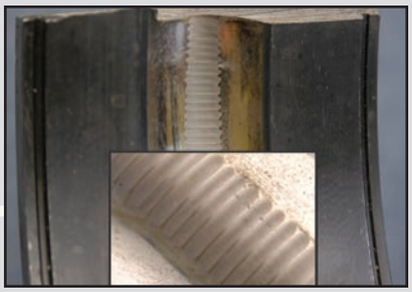
"The only bearing protection system guaranteed to eliminate harmful shaft currents preventing premature motor failure - for life."

Guarantee

Electro Static Technology guarantees any new motor up to 100hp/75kW will not fail from electrical bearing fluting damage for the life of the motor when the AEGIS SGR™ Bearing Protection Ring™ is installed in accordance with manufacturer's installation instructions. If electrically induced fluting damage occurs, Electro Static Technology will replace motor bearings. Guarantee is subject to the terms and conditions of the AEGIS SGR™ Guarantee Program.

For program details, visit: www.est-aegis.com

Don't let this happen to your bearings!



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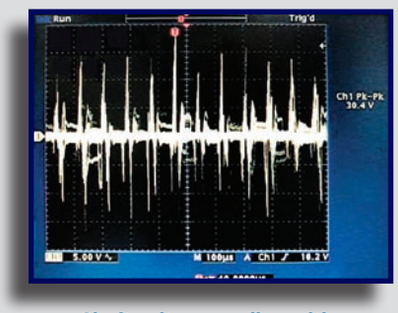
Sustainable Motor Design - Prevent Bearing Failure

AEGIS Bearing Protection Ring™- **protects motor bearings for life. Variable frequency drives (VFD) induce electrical voltages onto the shaft of AC and DC motors. With AEGIS SGR Bearing Protection Ring installed on the motor, you benefit from sustainability, system up-time, production improvement, and higher reliability.**

PROBLEM:

VFD Induced Shaft Voltages Damage Bearings



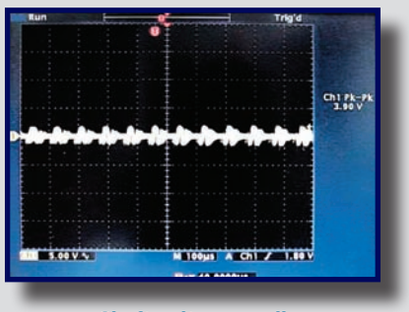
Shaft voltage reading with no protection

Variable frequency drives (VFD) on AC and DC motors induce harmful electrical voltages on the motor shaft. Once these voltages exceed the resistance of the bearing lubricant, they discharge through the motor's bearings causing fusion craters, severe pitting, fluting damage, excessive bearing noise and eventually bearing failure.

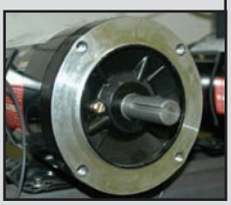
SOLUTION:

AEGIS SGR™ - Electrical Bearing Damage Protection

The new AEGIS SGR™ Bearing Protection Ring™ prevents electrical bearing damage by safely channeling harmful shaft voltages away from the bearings to ground. Using proprietary Electron Transport Technology™, the conductive micro fibers inside the AEGIS SGR™ provide the path of least resistance and dramatically extend motor life.

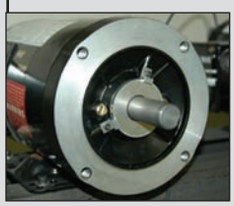


Shaft voltage reading with AEGIS SGR



No bearing protection

VFD

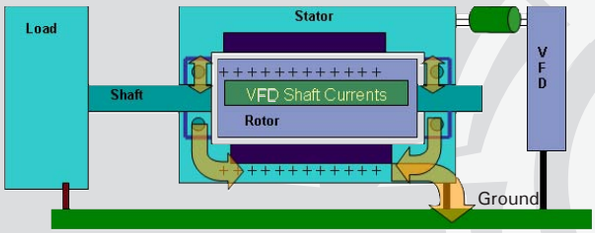


AEGIS SGR™ Bearing Protection Ring™

About Shaft Voltages and Bearing Currents

VFD Induced Shaft Voltages - All Motors

Damaging voltages are induced on the shafts of AC and DC motors controlled by variable frequency drives (VFD). The extremely high on/off switching speeds of the pulse width modulation (PWM), generated by the insulated gate bipolar transistors (IGBT), induce damaging voltages onto the motor shaft through parasitic capacitive coupling between the stator and rotor. This common mode shaft voltage seeks a path to ground, usually through the motor's bearings.



EDM Currents Damage Bearings

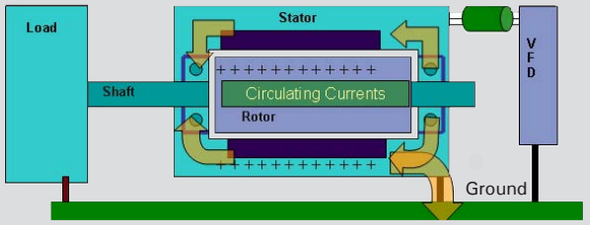
Bearing fluting, "washboard" pattern on bearing race

Electrical Damage in the Bearings (EDM) - Pitting, Fluting, Failure

Damaging currents arc through the dielectric oil film between the rolling elements and the bearing race. This is known as electrical discharge machining (EDM) effect. EDM causes fusion craters, severe pitting, and eventually bearing fluting (a washboard-like pattern in the bearing race) which results in premature bearing failure.

High Frequency Circulating Currents in Large AC and DC Motors

In addition to potential bearing failures in motors from VFD induced EDM currents, AC and DC motors above 100 hp (75 kW) may also experience bearing failures caused by high frequency circulating currents. VFD induced high frequency circulating currents are in the kilohertz or even megahertz range and circulate through the motor's bearings because of magnetic flux imbalances in the stator. This type of VFD induced current becomes the more dominant destructive current in higher hp/kW motors.



High Frequency Currents Damage Bearings

AEGIS SGR™ Bearing Protection Ring™ is the most effective solution to protect bearings in motors and attached equipment from EDM currents and VFD induced shaft voltages.

Technology Comparison

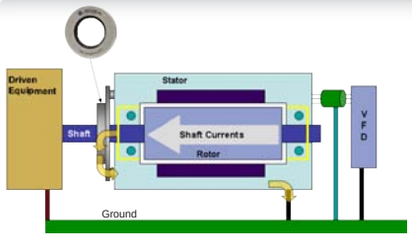
	AEGIS SGR™	Insulating sleeve	Ceramic/ Hybrid Bearing	Copper or Bronze Metal Brush	Carbon Block Brush	Conductive Grease
Protects Motor and Attached Equipment	Yes	No	No	No	No	No
Long-term Effectiveness	Yes	No	No	No	No	No
Easy to install	Yes	No	No	No	No	No
Contamination Proof	Yes	N/A	N/A	No	No	N/A
Low Lifetime Cost High return on Investment	Yes	No	No	No	No	No
Effective at any RPM	Yes	Yes	Yes	No	No	No
Maintenance Free Operation	Yes	Yes	Yes	No	No	No

Application Notes for AEGIS Bearing Protection Ring™

Improve System Reliability and Production with Sustainable Motor Design

Motors up to 100 HP (75 kW)

Any motor controlled by a variable frequency drive (VFD) requires bearing protection. Motors of 100 hp down to fractional hp motors will experience bearing failures when operated on a PWM drive. AEGIS SGR™ Bearing Protection Ring™ guarantees that bearings will not fail in these motors from fluting damage for the service life of the motor.



Install one AEGIS SGR™ Bearing Protection Ring™ on either the drive end or the non-drive end of the motor. The simplest installation is to slide the AEGIS SGR™ over the drive end and fasten it to the motor end bell with the easy to install mounting hardware included with each AEGIS SGR™

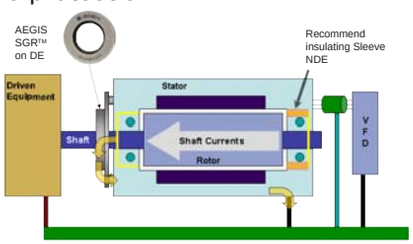
★ Recommend Colloidal Silver Shaft Coating PN CS015

Motors 100 HP to 1000 HP (75 kW to 750 kW)

Large motors above 100 hp may have VFD induced EDM currents as well as high frequency circulating currents when they are controlled by VFDs. To protect the bearings, insulate the bearing on one end and install an AEGIS SGR™ on the other end.

Insulation on one end (usually NDE) and AEGIS SGR™ on opposite end

- This method offers the most reliable protection
- Motor frame must be well grounded
- Non-Drive End: Bearing journal should be insulated or Insulated/ Ceramic Bearing installed to disrupt circulating currents
- Install AEGIS SGR™ Bearing Protection Ring™ on opposite end of insulation and Insulated/Ceramic Bearing (usually DE)
- Protects bearings in attached equipment (gear box, pillow block, encoder etc.)



★ Recommend Colloidal Silver Shaft Coating PN CS015

BEARING PROTECTION FACTS:

Bearing protection for motors and attached equipment: Only AEGIS SGR™ will protect both motor bearings and the bearings in attached equipment. VFD induced currents on the shaft can discharge through motor bearings or coupled equipment like gear boxes, pumps, fan bearings, pillow blocks, encoders, brake motors, etc. AEGIS SGR™ addresses the root of the problem and channels harmful currents to ground.

Maintenance free bearing protection for life: Hundreds of thousands of conductive micro fibers have virtually zero wear during operation, even at high RPM and high surface rates. Unlike carbon block brushes, there is no spring pressure on fibers. AEGIS SGR™ Bearing Protection Ring™ will last for the service life of the motor.

AEGIS SGR™ is effective in grease, oil, dirt or dust: Lab and field tested. The conductive micro fibers "sweep" away contaminants from the shaft surface and maintain a conductive path even when oil, grease, dirt or dust get on the shaft.

Operation in harsh environments where fibers are exposed to excessive debris: To prevent particles from damaging the fibers, install a slinger or O-ring against the AEGIS SGR™.

★ COLLOIDAL SILVER SHAFT COATING: NEW TECHNOLOGY

Improving the conductivity of the steel shaft surface enhances the shaft voltage discharge capability in AEGIS shaft grounding applications. Maintaining a highly conductive shaft surface is especially important in critical applications or in applications where the conductive shaft surface of steel could become compromised. Environmental elements could create a potential for decreased conductivity on the shaft of the motor.

Apply AEGIS CS015 Colloidal Silver Shaft Coating to any VFD driven motor shaft prior to installing AEGIS Bearing Protection Ring™.

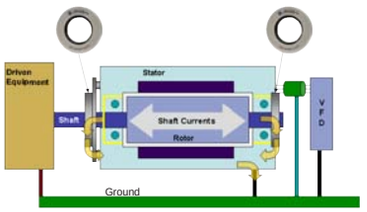
BEARING PROTECTION FACTS:

AEGIS SGR™ Bearing Protection Ring™ current handling capability: AEGIS SGR™ is rated to discharge high frequency current. Variable frequency drives (VFD) induce high frequency EDM currents of up to 2 amps in 50 billionths of a second. AEGIS SGR™ protects the bearing by safely channeling the energy away from the motor bearings to ground.

AEGIS Bearing Protection Ring™ - the most reliable bearing protection: Production up-time and reliability improve when AEGIS SGR™ is installed. The patented ring of hundreds of thousands of conductive micro fibers provide protection for the service life of the motor. The fibers will always surround the shaft with a conductive path for destructive shaft currents while the motor is running.

Vertical Motors: Insulate top bearing or shaft with non conductive coating. For bottom bearing, coat shaft with Colloidal Silver Shaft Coating and install AEGIS Bearing Protection Ring.

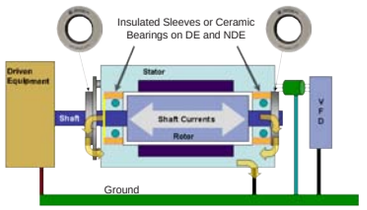
If insulation is not possible, the next best protection is to install AEGIS SGR™ on both ends of the motor



- Motor frame must be well grounded
- Install AEGIS SGR™ Bearing Protection Ring™ on drive and non-drive end to provide path of least resistance for circulating currents and to channel VFD currents to ground.
- Protects bearings in attached equipment
- **NOT SUITABLE FOR CYLINDRICAL ROLLER BEARING**

★ Coat shaft with Colloidal Silver Shaft Coating

Critical Applications: Insulate both ends and add AEGIS SGR™ Bearing Protection Ring™ on both ends



- Motor frame must be well grounded
- Drive and Non-Drive end: Bearing journals should be insulated or Insulated/Ceramic Bearing installed to disrupt circulating currents
- Install AEGIS SGR™ Bearing Protection Ring™ on drive and non-drive end to provide path of least resistance for shaft voltages and to channel VFD induced currents to ground.
- AEGIS SGR™ required to protect bearings in attached equipment (gear box, pillow block, encoder, etc.)

★ Coat shaft with Colloidal Silver Shaft Coating

Medium Voltage Motors
Large Motors and Generators over 1000 HP (750 kW)
Power Generators over 750kW

AEGIS iPRO™ Bearing Protection Ring™

Large motors and generators often have much higher induced shaft voltages and bearing currents which require a high current capable Bearing Protection Ring™. High frequency circulating currents induced by variable frequency drives (VFD) will cause bearing fluting and catastrophic failure in these motors. Generators experience current surges which can cause electrical arcing in bearings and equipment.

AEGIS iPRO™ High Current Bearing Protection Ring™

- One end of the motor should be insulated. Install AEGIS iPRO™ on opposite end of insulation to protect the non-insulated bearing.
- Install AEGIS iPRO™ on both ends of motor or generator if bearing cannot be insulated.

★ Coat shaft with Colloidal Silver Shaft Coating

MOTORS WITH CERAMIC BEARINGS

Insulating both bearing journals or using ceramic coated bearings in the motor **does not prevent VFD induced currents** from discharging through the bearings on attached equipment and may present a voltage hazard.

Whenever ceramic bearings are used in a motor, *AEGIS SGR™ is required* to protect attached equipment and reduce potentially dangerous shaft voltages.

Purpose of Application Notes: Application notes are intended as general guidance to assist with proper application of AEGIS SGR™ Bearing Protection Ring™ to protect motor bearings. All statements and technical information contained in the application notes are rendered in good faith. User must assume responsibility to determine suitability of the product for its intended use.

AEGIS SVP™ Shaft Voltage Probe

Conductive Microfiber Probe for use with Fluke 199C ScopeMeter

Measuring VFD Induced Shaft Voltages

For the first time you can easily and more accurately measure the voltage on a rotating shaft. The AEGIS SVP™ Shaft Voltage Probe's unique design of high density conductive microfibers ensures continuous contact with the rotating shaft. Used with the Fluke 199C ScopeMeter, you can determine if your motor is subject to potentially damaging bearing currents.

Catalog Number	Includes:
SVP-KIT-F199C	3 SVP tips, probe holder with two piece extension rod (fits 3/8" magnetic base)
SVP-TIP-F199C	3 SVP tips

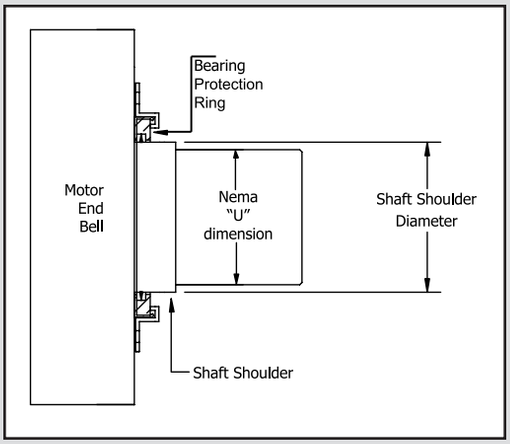
Selecting The Right Size Bearing Protection Ring For Your Motor

Front View

Side View

Back View

Mounting Options shown on page 8

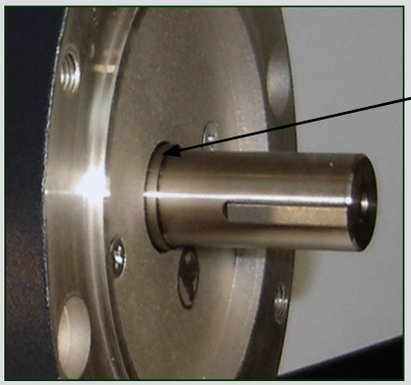


1. Measure shaft diameter at a point 0.125" from motor end bell.
2. Refer to the part lists to locate the correct SGR part number.

Note: If you have a slinger or a shaft shoulder that is less than 0.375", you will need the NEMA/IEC kit. See page 13 for more information.

Example shaft measurement
0.425"

Catalog Number	Min.shaft diameter	Max.shaft diameter	Outside diameter	Thickness Max
SGR-6.9-1	0.311	0.355	1.60	0.295
SGR-8.0-1	0.356	0.395	1.60	0.295
SGR-9.0-1	0.396	0.435	1.60	0.295
SGR-10.1-1	0.436	0.480	1.60	0.295
SGR-11.2-1	0.481	0.520	1.60	0.295



Shaft shoulder: The SGR can be mounted to the shaft shoulder but the shoulder should be at least 0.375" in length so that all of the fibers are in contact with the rotating shaft. Measure the diameter of the shaft shoulder then locate the correct SGR on the part lists.

AEGIS SGR™ Bearing Protection Ring™ Options

pg. 9

NEW PRODUCT!

Conductive Epoxy Mounting
Shaft diameters: 0.311" to 6.02"
Solid and Split Ring
Quick and easy installation to metal motor frame
Conductive Epoxy Included

pg.10-11

Standard Mounting Brackets
Shaft diameters: 0.311" to 6.02"
Ships with mounting brackets, 6-32 screws and washers
Quick and easy installation to most surfaces

pg. 10-11

Split Ring
Shaft diameter: 0.311" to 6.02"
4 to 6 mounting brackets, M3 screws and washers
Installs without decoupling motor

pg. 10-11

Bolt Through Mounting
Shaft diameters: 0.311" to 6.02"
M3 x 14 socket head cap screws and lock washers
2 mounting holes up to shaft size 3.895"
4 mounting holes for larger sizes

pg. 12

Press Fit Mounting
Shaft diameters: 0.311" to 6.02"
Clean dry 0.004" press fit
Custom sizes available

pg. 13

NEMA-IEC Mounting Kits
Shaft diameter: see chart for standard kits
Custom kits available for other shaft diameters
Clears any slinger, shaft shoulder or protrusion

pg. 14

WTG
Long term reliable performance
Maintenance free system
Solid and Split Ring configurations

pg. 14

iPRO
Long term reliable performance
Maintenance free system
Solid and Split Ring configurations
Available in sizes up to 30" shaft diameter

Standard SGR™ - Conductive Epoxy Mounting

NEW PRODUCT!

Dimensions in inches

Solid SGR Catalog Number	Split SGR Catalog Number	Min.shaft diameter	Max.shaft diameter	Outside diameter	Thickness Max
SGR-6.9-0AW	SGR-6.9-0A4W	0.311	0.355	1.60	0.295
SGR-8.0-0AW	SGR-8.0-0A4W	0.356	0.395	1.60	0.295
SGR-9.0-0AW	SGR-9.0-0A4W	0.396	0.435	1.60	0.295
SGR-10.1-0AW	SGR-10.1-0A4W	0.436	0.480	1.60	0.295
SGR-11.2-0AW	SGR-11.2-0A4W	0.481	0.520	1.60	0.295
SGR-12.2-0AW	SGR-12.2-0A4W	0.521	0.560	1.60	0.295
SGR-13.2-0AW	SGR-13.2-0A4W	0.561	0.605	1.60	0.295
SGR-14.4-0AW	SGR-14.4-0A4W	0.606	0.645	1.60	0.295
SGR-15.4-0AW	SGR-15.4-0A4W	0.646	0.685	2.10	0.295
SGR-16.4-0AW	SGR-16.4-0A4W	0.686	0.730	2.10	0.295
SGR-17.6-0AW	SGR-17.6-0A4W	0.731	0.774	2.10	0.295
SGR-18.7-0AW	SGR-18.7-0A4W	0.775	0.815	2.10	0.295
SGR-19.7-0AW	SGR-19.7-0A4W	0.816	0.855	2.10	0.295
SGR-20.7-0AW	SGR-20.7-0A4W	0.856	0.895	2.10	0.295
SGR-21.7-0AW	SGR-21.7-0A4W	0.896	0.935	2.10	0.295
SGR-22.8-0AW	SGR-22.8-0A4W	0.936	0.980	2.10	0.295
SGR-23.9-0AW	SGR-23.9-0A4W	0.981	1.020	2.10	0.295
SGR-24.9-0AW	SGR-24.9-0A4W	1.021	1.060	2.10	0.295
SGR-25.9-0AW	SGR-25.9-0A4W	1.061	1.105	2.10	0.295
SGR-27.1-0AW	SGR-27.1-0A4W	1.106	1.145	2.10	0.295
SGR-28.1-0AW	SGR-28.1-0A4W	1.146	1.185	2.10	0.295
SGR-29.1-0AW	SGR-29.1-0A4W	1.186	1.230	2.10	0.295
SGR-30.3-0AW	SGR-30.3-0A4W	1.231	1.270	2.10	0.295
SGR-31.3-0AW	SGR-31.3-0A4W	1.271	1.310	2.10	0.295
SGR-32.3-0AW	SGR-32.3-0A4W	1.311	1.355	2.10	0.295
SGR-33.4-0AW	SGR-33.4-0A4W	1.356	1.395	2.10	0.295
SGR-34.4-0AW	SGR-34.4-0A4W	1.396	1.435	2.68	0.295
SGR-35.5-0AW	SGR-35.5-0A4W	1.436	1.480	2.68	0.295
SGR-36.6-0AW	SGR-36.6-0A4W	1.481	1.520	2.68	0.295
SGR-37.6-0AW	SGR-37.6-0A4W	1.521	1.560	2.68	0.295
SGR-38.6-0AW	SGR-38.6-0A4W	1.561	1.605	2.68	0.295
SGR-39.8-0AW	SGR-39.8-0A4W	1.606	1.645	2.68	0.295
SGR-40.8-0AW	SGR-40.8-0A4W	1.646	1.685	2.68	0.295
SGR-41.8-0AW	SGR-41.8-0A4W	1.686	1.730	2.68	0.295
SGR-43.0-0AW	SGR-43.0-0A4W	1.731	1.770	2.68	0.295
SGR-44.0-0AW	SGR-44.0-0A4W	1.771	1.810	2.68	0.295
SGR-45.0-0AW	SGR-45.0-0A4W	1.811	1.855	2.68	0.295
SGR-46.1-0AW	SGR-46.1-0A4W	1.856	1.895	2.68	0.295
SGR-47.1-0AW	SGR-47.1-0A4W	1.896	1.935	2.68	0.295
SGR-48.2-0AW	SGR-48.2-0A4W	1.936	1.980	2.68	0.295
SGR-49.3-0AW	SGR-49.3-0A4W	1.981	2.020	2.68	0.295
SGR-50.3-0AW	SGR-50.3-0A4W	2.021	2.060	3.10	0.295
SGR-51.3-0AW	SGR-51.3-0A4W	2.061	2.105	3.10	0.295
SGR-52.5-0AW	SGR-52.5-0A4W	2.106	2.145	3.10	0.295
SGR-53.5-0AW	SGR-53.5-0A4W	2.146	2.185	3.10	0.295
SGR-54.5-0AW	SGR-54.5-0A4W	2.186	2.230	3.10	0.295
SGR-55.7-0AW	SGR-55.7-0A4W	2.231	2.270	3.10	0.295
SGR-56.7-0AW	SGR-56.7-0A4W	2.271	2.310	3.10	0.295
SGR-57.7-0AW	SGR-57.7-0A4W	2.311	2.355	3.10	0.295
SGR-58.8-0AW	SGR-58.8-0A4W	2.356	2.395	3.10	0.295
SGR-59.8-0AW	SGR-59.8-0A4W	2.396	2.435	3.60	0.295
SGR-60.9-0AW	SGR-60.9-0A4W	2.436	2.480	3.60	0.295
SGR-62.0-0AW	SGR-62.0-0A4W	2.481	2.520	3.60	0.295
SGR-63.0-0AW	SGR-63.0-0A4W	2.521	2.560	3.60	0.295
SGR-64.0-0AW	SGR-64.0-0A4W	2.561	2.605	3.60	0.295
SGR-65.2-0AW	SGR-65.2-0A4W	2.606	2.645	3.60	0.295
SGR-66.2-0AW	SGR-66.2-0A4W	2.646	2.685	3.60	0.295
SGR-67.2-0AW	SGR-67.2-0A4W	2.686	2.730	3.60	0.295
SGR-68.4-0AW	SGR-68.4-0A4W	2.731	2.770	3.60	0.295
SGR-69.4-0AW	SGR-69.4-0A4W	2.771	2.810	3.60	0.295
SGR-70.4-0AW	SGR-70.4-0A4W	2.811	2.855	3.60	0.295
SGR-71.5-0AW	SGR-71.5-0A4W	2.856	2.895	3.60	0.295
SGR-72.5-0AW	SGR-72.5-0A4W	2.896	2.935	4.10	0.295
SGR-73.6-0AW	SGR-73.6-0A4W	2.936	2.980	4.10	0.295
SGR-74.7-0AW	SGR-74.7-0A4W	2.981	3.020	4.10	0.295
SGR-75.7-0AW	SGR-75.7-0A4W	3.021	3.060	4.10	0.295
SGR-76.7-0AW	SGR-76.7-0A4W	3.061	3.105	4.10	0.295
SGR-77.9-0AW	SGR-77.9-0A4W	3.106	3.145	4.10	0.295
SGR-78.9-0AW	SGR-78.9-0A4W	3.146	3.185	4.10	0.295
SGR-79.9-0AW	SGR-79.9-0A4W	3.186	3.230	4.10	0.295
SGR-81.1-0AW	SGR-81.1-0A4W	3.231	3.270	4.10	0.295
SGR-82.1-0AW	SGR-82.1-0A4W	3.271	3.310	4.10	0.295
SGR-83.1-0AW	SGR-83.1-0A4W	3.311	3.355	4.10	0.295
SGR-84.2-0AW	SGR-84.2-0A4W	3.356	3.395	4.10	0.295
SGR-85.2-0AW	SGR-85.2-0A4W	3.396	3.435	4.60	0.295
SGR-86.3-0AW	SGR-86.3-0A4W	3.436	3.480	4.60	0.295
SGR-87.4-0AW	SGR-87.4-0A4W	3.481	3.520	4.60	0.295
SGR-88.4-0AW	SGR-88.4-0A4W	3.521	3.560	4.60	0.295
SGR-89.4-0AW	SGR-89.4-0A4W	3.561	3.605	4.60	0.295
SGR-90.6-0AW	SGR-90.6-0A4W	3.606	3.645	4.60	0.295
SGR-91.6-0AW	SGR-91.6-0A4W	3.646	3.685	4.60	0.295
SGR-92.6-0AW	SGR-92.6-0A4W	3.686	3.730	4.60	0.295
SGR-93.8-0AW	SGR-93.8-0A4W	3.731	3.770	4.60	0.295
SGR-94.8-0AW	SGR-94.8-0A4W	3.771	3.810	4.60	0.295
SGR-95.8-0AW	SGR-95.8-0A4W	3.811	3.855	4.60	0.295
SGR-96.9-0AW	SGR-96.9-0A4W	3.856	3.895	4.60	0.295
SGR-97.9-0AW	SGR-97.9-0A4W	3.896	3.935	5.10	0.295
SGR-99.0-0AW	SGR-99.0-0A4W	3.936	3.980	5.10	0.295
SGR-100.1-0AW	SGR-100.1-0A4W	3.981	4.020	5.10	0.295
SGR-101.1-0AW	SGR-101.1-0A4W	4.021	4.060	5.10	0.295
SGR-102.1-0AW	SGR-102.1-0A4W	4.061	4.105	5.10	0.295
SGR-103.3-0AW	SGR-103.3-0A4W	4.106	4.145	5.10	0.295
SGR-104.3-0AW	SGR-104.3-0A4W	4.146	4.185	5.10	0.295
SGR-105.3-0AW	SGR-105.3-0A4W	4.186	4.230	5.10	0.295
SGR-106.5-0AW	SGR-106.5-0A4W	4.231	4.270	5.10	0.295
SGR-107.5-0AW	SGR-107.5-0A4W	4.271	4.310	5.10	0.295
SGR-108.5-0AW	SGR-108.5-0A4W	4.311	4.355	5.10	0.295
SGR-109.6-0AW	SGR-109.6-0A4W	4.356	4.395	5.10	0.295
SGR-110.6-0AW	SGR-110.6-0A4W	4.396	4.435	5.60	0.295
SGR-111.7-0AW	SGR-111.7-0A4W	4.436	4.480	5.60	0.295
SGR-112.8-0AW	SGR-112.8-0A4W	4.481	4.520	5.60	0.295
SGR-113.8-0AW	SGR-113.8-0A4W	4.521	4.560	5.60	0.295
SGR-114.8-0AW	SGR-114.8-0A4W	4.561	4.605	5.60	0.295
SGR-116.0-0AW	SGR-116.0-0A4W	4.606	4.645	5.60	0.295
SGR-117.0-0AW	SGR-117.0-0A4W	4.646	4.685	5.60	0.295
SGR-118.0-0AW	SGR-118.0-0A4W	4.686	4.730	5.60	0.295
SGR-119.2-0AW	SGR-119.2-0A4W	4.731	4.770	5.60	0.295
SGR-120.2-0AW	SGR-120.2-0A4W	4.771	4.810	5.60	0.295
SGR-121.2-0AW	SGR-121.2-0A4W	4.811	4.855	5.60	0.295
SGR-122.3-0AW	SGR-122.3-0A4W	4.856	4.895	5.60	0.295
SGR-123.3-0AW	SGR-123.3-0A4W	4.896	4.935	6.10	0.295
SGR-124.4-0AW	SGR-124.4-0A4W	4.936	4.980	6.10	0.295
SGR-125.5-0AW	SGR-125.5-0A4W	4.981	5.020	6.10	0.295
SGR-126.5-0AW	SGR-126.5-0A4W	5.021	5.060	6.10	0.295
SGR-127.5-0AW	SGR-127.5-0A4W	5.061	5.105	6.10	0.295
SGR-128.7-0AW	SGR-128.7-0A4W	5.106	5.145	6.10	0.295
SGR-129.7-0AW	SGR-129.7-0A4W	5.146	5.185	6.10	0.295
SGR-130.7-0AW	SGR-130.7-0A4W	5.186	5.230	6.10	0.295
SGR-131.9-0AW	SGR-131.9-0A4W	5.231	5.270	6.10	0.295
SGR-132.9-0AW	SGR-132.9-0A4W	5.271	5.310	6.10	0.295
SGR-133.9-0AW	SGR-133.9-0A4W	5.311	5.355	6.10	0.295
SGR-135.0-0AW	SGR-135.0-0A4W	5.356	5.395	6.10	0.295
SGR-136.0-0AW	SGR-136.0-0A4W	5.396	5.435	6.60	0.295
SGR-137.1-0AW	SGR-137.1-0A4W	5.436	5.480	6.60	0.295
SGR-138.2-0AW	SGR-138.2-0A4W	5.481	5.520	6.60	0.295
SGR-139.2-0AW	SGR-139.2-0A4W	5.521	5.560	6.60	0.295
SGR-140.2-0AW	SGR-140.2-0A4W	5.561	5.605	6.60	0.295
SGR-141.4-0AW	SGR-141.4-0A4W	5.606	5.645	6.60	0.295
SGR-142.4-0AW	SGR-142.4-0A4W	5.646	5.685	6.60	0.295
SGR-143.4-0AW	SGR-143.4-0A4W	5.686	5.730	6.60	0.295
SGR-144.6-0AW	SGR-144.6-0A4W	5.731	5.770	6.60	0.295
SGR-145.6-0AW	SGR-145.6-0A4W	5.771	5.810	6.60	0.295
SGR-146.6-0AW	SGR-146.6-0A4W	5.811	5.855	6.60	0.295
SGR-147.7-0AW	SGR-147.7-0A4W	5.856	5.895	6.60	0.295
SGR-148.7-0AW	SGR-148.7-0A4W	5.896	5.935	7.10	0.295
SGR-149.8-0AW	SGR-149.8-0A4W	5.936	5.980	7.10	0.295
SGR-150.9-0AW	SGR-150.9-0A4W	5.981	6.020	7.10	0.295

Conductive Epoxy Included

Parts List

Dimensions in inches

Standard SGR Catalog Number	Split Ring* Catalog Number	Bolt Through* Catalog Number	Min. shaft diameter	Max. shaft diameter	Outside diameter	Thickness Max
SGR-6.9-1	SGR-6.9-2A4	SGR-6.9-3	0.311	0.355	1.60	0.295
SGR-8.0-1	SGR-8.0-2A4	SGR-8.0-3	0.356	0.395	1.60	0.295
SGR-9.0-1	SGR-9.0-2A4	SGR-9.0-3	0.396	0.435	1.60	0.295
SGR-10.1-1	SGR-10.1-2A4	SGR-10.1-3	0.436	0.480	1.60	0.295
SGR-11.2-1	SGR-11.2-2A4	SGR-11.2-3	0.481	0.520	1.60	0.295
SGR-12.2-1	SGR-12.2-2A4	SGR-12.2-3	0.521	0.560	1.60	0.295
SGR-13.2-1	SGR-13.2-2A4	SGR-13.2-3	0.561	0.605	1.60	0.295
SGR-14.4-1	SGR-14.4-2A4	SGR-14.4-3	0.606	0.645	1.60	0.295
SGR-15.4-1	SGR-15.4-2A4	SGR-15.4-3	0.646	0.685	2.10	0.295
SGR-16.4-1	SGR-16.4-2A4	SGR-16.4-3	0.686	0.730	2.10	0.295
SGR-17.6-1	SGR-17.6-2A4	SGR-17.6-3	0.731	0.774	2.10	0.295
SGR-18.7-1	SGR-18.7-2A4	SGR-18.7-3	0.775	0.815	2.10	0.295
SGR-19.7-1	SGR-19.7-2A4	SGR-19.7-3	0.816	0.855	2.10	0.295
SGR-20.7-1	SGR-20.7-2A4	SGR-20.7-3	0.856	0.895	2.10	0.295
SGR-21.7-1	SGR-21.7-2A4	SGR-21.7-3	0.896	0.935	2.10	0.295
SGR-22.8-1	SGR-22.8-2A4	SGR-22.8-3	0.936	0.980	2.10	0.295
SGR-23.9-1	SGR-23.9-2A4	SGR-23.9-3	0.981	1.020	2.10	0.295
SGR-24.9-1	SGR-24.9-2A4	SGR-24.9-3	1.021	1.060	2.10	0.295
SGR-25.9-1	SGR-25.9-2A4	SGR-25.9-3	1.061	1.105	2.10	0.295
SGR-27.1-1	SGR-27.1-2A4	SGR-27.1-3	1.106	1.145	2.10	0.295
SGR-28.1-1	SGR-28.1-2A4	SGR-28.1-3	1.146	1.185	2.10	0.295
SGR-29.1-1	SGR-29.1-2A4	SGR-29.1-3	1.186	1.230	2.10	0.295
SGR-30.3-1	SGR-30.3-2A4	SGR-30.3-3	1.231	1.270	2.10	0.295
SGR-31.3-1	SGR-31.3-2A4	SGR-31.3-3	1.271	1.310	2.10	0.295
SGR-32.3-1	SGR-32.3-2A4	SGR-32.3-3	1.311	1.355	2.10	0.295
SGR-33.4-1	SGR-33.4-2A4	SGR-33.4-3	1.356	1.395	2.10	0.295
SGR-34.4-1	SGR-34.4-2A4	SGR-34.4-3	1.396	1.435	2.68	0.295
SGR-35.5-1	SGR-35.5-2A4	SGR-35.5-3	1.436	1.480	2.68	0.295
SGR-36.6-1	SGR-36.6-2A4	SGR-36.6-3	1.481	1.520	2.68	0.295
SGR-37.6-1	SGR-37.6-2A4	SGR-37.6-3	1.521	1.560	2.68	0.295
SGR-38.6-1	SGR-38.6-2A4	SGR-38.6-3	1.561	1.605	2.68	0.295
SGR-39.8-1	SGR-39.8-2A4	SGR-39.8-3	1.606	1.645	2.68	0.295
SGR-40.8-1	SGR-40.8-2A4	SGR-40.8-3	1.646	1.685	2.68	0.295
SGR-41.8-1	SGR-41.8-2A4	SGR-41.8-3	1.686	1.730	2.68	0.295
SGR-43.0-1	SGR-43.0-2A4	SGR-43.0-3	1.731	1.770	2.68	0.295
SGR-44.0-1	SGR-44.0-2A4	SGR-44.0-3	1.771	1.810	2.68	0.295
SGR-45.0-1	SGR-45.0-2A4	SGR-45.0-3	1.811	1.855	2.68	0.295
SGR-46.1-1	SGR-46.1-2A4	SGR-46.1-3	1.856	1.895	2.68	0.295
SGR-47.1-1	SGR-47.1-2A4	SGR-47.1-3	1.896	1.935	2.68	0.295
SGR-48.2-1	SGR-48.2-2A4	SGR-48.2-3	1.936	1.980	2.68	0.295
SGR-49.3-1	SGR-49.3-2A4	SGR-49.3-3	1.981	2.020	2.68	0.295
SGR-50.3-1	SGR-50.3-2A4	SGR-50.3-3	2.021	2.060	3.10	0.295
SGR-51.3-1	SGR-51.3-2A4	SGR-51.3-3	2.061	2.105	3.10	0.295
SGR-52.5-1	SGR-52.5-2A4	SGR-52.5-3	2.106	2.145	3.10	0.295
SGR-53.5-1	SGR-53.5-2A4	SGR-53.5-3	2.146	2.185	3.10	0.295
SGR-54.5-1	SGR-54.5-2A4	SGR-54.5-3	2.186	2.230	3.10	0.295
SGR-55.7-1	SGR-55.7-2A4	SGR-55.7-3	2.231	2.270	3.10	0.295
SGR-56.7-1	SGR-56.7-2A4	SGR-56.7-3	2.271	2.310	3.10	0.295
SGR-57.7-1	SGR-57.7-2A4	SGR-57.7-3	2.311	2.355	3.10	0.295
SGR-58.8-1	SGR-58.8-2A4	SGR-58.8-3	2.356	2.395	3.10	0.295
SGR-59.8-1	SGR-59.8-2A4	SGR-59.8-3	2.396	2.435	3.60	0.295
SGR-60.9-1	SGR-60.9-2A4	SGR-60.9-3	2.436	2.480	3.60	0.295
SGR-62.0-1	SGR-62.0-2A4	SGR-62.0-3	2.481	2.520	3.60	0.295
SGR-63.0-1	SGR-63.0-2A4	SGR-63.0-3	2.521	2.560	3.60	0.295
SGR-64.0-1	SGR-64.0-2A4	SGR-64.0-3	2.561	2.605	3.60	0.295
SGR-65.2-1	SGR-65.2-2A4	SGR-65.2-3	2.606	2.645	3.60	0.295
SGR-66.2-1	SGR-66.2-2A4	SGR-66.2-3	2.646	2.685	3.60	0.295
SGR-67.2-1	SGR-67.2-2A4	SGR-67.2-3	2.686	2.730	3.60	0.295
SGR-68.4-1	SGR-68.4-2A4	SGR-68.4-3	2.731	2.770	3.60	0.295
SGR-69.4-1	SGR-69.4-2A4	SGR-69.4-3	2.771	2.810	3.60	0.295
SGR-70.4-1	SGR-70.4-2A4	SGR-70.4-3	2.811	2.855	3.60	0.295
SGR-71.5-1	SGR-71.5-2A4	SGR-71.5-3	2.856	2.895	3.60	0.295
SGR-72.5-1	SGR-72.5-2A4	SGR-72.5-3	2.896	2.935	4.10	0.295
SGR-73.6-1	SGR-73.6-2A4	SGR-73.6-3	2.936	2.980	4.10	0.295
SGR-74.7-1	SGR-74.7-2A4	SGR-74.7-3	2.981	3.020	4.10	0.295
SGR-75.7-1	SGR-75.7-2A4	SGR-75.7-3	3.021	3.060	4.10	0.295
SGR-76.7-1	SGR-76.7-2A4	SGR-76.7-3	3.061	3.105	4.10	0.295
SGR-77.9-1	SGR-77.9-2A4	SGR-77.9-3	3.106	3.145	4.10	0.295
SGR-78.9-1	SGR-78.9-2A4	SGR-78.9-3	3.146	3.185	4.10	0.295

*Custom Part - No Returns

Parts List

Dimensions in inches

Standard SGR Catalog Number	Split Ring* Catalog Number	Bolt Through* Catalog Number	Min. shaft diameter	Max. shaft diameter	Outside diameter	Thickness Max
SGR-79.9-1	SGR-79.9-2A4	SGR-79.9-3	3.186	3.230	4.10	0.295
SGR-81.1-1	SGR-81.1-2A4	SGR-81.1-3	3.231	3.270	4.10	0.295
SGR-82.1-1	SGR-82.1-2A4	SGR-82.1-3	3.271	3.310	4.10	0.295
SGR-83.1-1	SGR-83.1-2A4	SGR-83.1-3	3.311	3.355	4.10	0.295
SGR-84.2-1	SGR-84.2-2A4	SGR-84.2-3	3.356	3.395	4.10	0.295
SGR-85.2-1	SGR-85.2-2A4	SGR-85.2-3	3.396	3.435	4.60	0.295
SGR-86.3-1	SGR-86.3-2A4	SGR-86.3-3	3.436	3.480	4.60	0.295
SGR-87.4-1	SGR-87.4-2A4	SGR-87.4-3	3.481	3.520	4.60	0.295
SGR-88.4-1	SGR-88.4-2A4	SGR-88.4-3	3.521	3.560	4.60	0.295
SGR-89.4-1	SGR-89.4-2A4	SGR-89.4-3	3.561	3.605	4.60	0.295
SGR-90.6-1	SGR-90.6-2A4	SGR-90.6-3	3.606	3.645	4.60	0.295
SGR-91.6-1	SGR-91.6-2A4	SGR-91.6-3	3.646	3.685	4.60	0.295
SGR-92.6-1	SGR-92.6-2A4	SGR-92.6-3	3.686	3.730	4.60	0.295
SGR-93.8-1	SGR-93.8-2A4	SGR-93.8-3	3.731	3.770	4.60	0.295
SGR-94.8-1	SGR-94.8-2A4	SGR-94.8-3	3.771	3.810	4.60	0.295
SGR-95.8-1	SGR-95.8-2A4	SGR-95.8-3	3.811	3.855	4.60	0.295
SGR-96.9-1	SGR-96.9-2A4	SGR-96.9-3	3.856	3.895	4.60	0.295
SGR-97.9-1	SGR-97.9-2A4	SGR-97.9-3	3.896	3.935	5.10	0.295
SGR-99.0-1	SGR-99.0-2A4	SGR-99.0-3	3.936	3.980	5.10	0.295
SGR-100.1-1	SGR-100.1-2A4	SGR-100.1-3	3.981	4.020	5.10	0.295
SGR-101.1-1	SGR-101.1-2A4	SGR-101.1-3	4.021	4.060	5.10	0.295
SGR-102.1-1	SGR-102.1-2A4	SGR-102.1-3	4.061	4.105	5.10	0.295
SGR-103.3-1	SGR-103.3-2A4	SGR-103.3-3	4.106	4.145	5.10	0.295
SGR-104.3-1	SGR-104.3-2A4	SGR-104.3-3	4.146	4.185	5.10	0.295
SGR-105.3-1	SGR-105.3-2A4	SGR-105.3-3	4.186	4.230	5.10	0.295
SGR-106.5-1	SGR-106.5-2A4	SGR-106.5-3	4.231	4.270	5.10	0.295
SGR-107.5-1	SGR-107.5-2A4	SGR-107.5-3	4.271	4.310	5.10	0.295
SGR-108.5-1	SGR-108.5-2A4	SGR-108.5-3	4.311	4.355	5.10	0.295
SGR-109.6-1	SGR-109.6-2A4	SGR-109.6-3	4.356	4.395	5.10	0.295
SGR-110.6-1	SGR-110.6-2A4	SGR-110.6-3	4.396	4.435	5.60	0.295
SGR-111.7-1	SGR-111.7-2A4	SGR-111.7-3	4.436	4.480	5.60	0.295
SGR-112.8-1	SGR-112.8-2A4	SGR-112.8-3	4.481	4.520	5.60	0.295
SGR-113.8-1	SGR-113.8-2A4	SGR-113.8-3	4.521	4.560	5.60	0.295
SGR-114.8-1	SGR-114.8-2A4	SGR-114.8-3	4.561	4.605	5.60	0.295
SGR-116.0-1	SGR-116.0-2A4	SGR-116.0-3	4.606	4.645	5.60	0.295
SGR-117.0-1	SGR-117.0-2A4	SGR-117.0-3	4.646	4.685	5.60	0.295
SGR-118.0-1	SGR-118.0-2A4	SGR-118.0-3	4.686	4.730	5.60	0.295
SGR-119.2-1	SGR-119.2-2A4	SGR-119.2-3	4.731	4.770	5.60	0.295
SGR-120.2-1	SGR-120.2-2A4	SGR-120.2-3	4.771	4.810	5.60	0.295
SGR-121.2-1	SGR-121.2-2A4	SGR-121.2-3	4.811	4.855	5.60	0.295
SGR-122.3-1	SGR-122.3-2A4	SGR-122.3-3	4.856	4.895	5.60	0.295
SGR-123.3-1	SGR-123.3-2A4	SGR-123.3-3	4.896	4.935	6.10	0.295
SGR-124.4-1	SGR-124.4-2A4	SGR-124.4-3	4.936	4.980	6.10	0.295
SGR-125.5-1	SGR-125.5-2A4	SGR-125.5-3	4.981	5.020	6.10	0.295
SGR-126.5-1	SGR-126.5-2A4	SGR-126.5-3	5.021	5.060	6.10	0.295
SGR-127.5-1	SGR-127.5-2A4	SGR-127.5-3	5.061	5.105	6.10	0.295
SGR-128.7-1	SGR-128.7-2A4	SGR-128.7-3	5.106	5.145	6.10	0.295
SGR-129.7-1	SGR-129.7-2A4	SGR-129.7-3	5.146	5.185	6.10	0.295
SGR-130.7-1	SGR-130.7-2A4	SGR-130.7-3	5.186	5.230	6.10	0.295
SGR-131.9-1	SGR-131.9-2A4	SGR-131.9-3	5.231	5.270	6.10	0.295
SGR-132.9-1	SGR-132.9-2A4	SGR-132.9-3	5.271	5.310	6.10	0.295
SGR-133.9-1	SGR-133.9-2A4	SGR-133.9-3	5.311	5.355	6.10	0.295
SGR-135.0-1	SGR-135.0-2A4	SGR-135.0-3	5.356	5.395	6.10	0.295
SGR-136.0-1	SGR-136.0-2A4	SGR-136.0-3	5.396	5.435	6.60	0.295
SGR-137.1-1	SGR-137.1-2A4	SGR-137.1-3	5.436	5.480	6.60	0.295
SGR-138.2-1	SGR-138.2-2A4	SGR-138.2-3	5.481	5.520	6.60	0.295
SGR-139.2-1	SGR-139.2-2A4	SGR-139.2-3	5.521	5.560	6.60	0.295
SGR-140.2-1	SGR-140.2-2A4	SGR-140.2-3	5.561	5.605	6.60	0.295
SGR-141.4-1	SGR-141.4-2A4	SGR-141.4-3	5.606	5.645	6.60	0.295
SGR-142.4-1	SGR-142.4-2A4	SGR-142.4-3	5.646	5.685	6.60	0.295
SGR-143.4-1	SGR-143.4-2A4	SGR-143.4-3	5.686	5.730	6.60	0.295
SGR-144.6-1	SGR-144.6-2A4	SGR-144.6-3	5.731	5.770	6.60	0.295
SGR-145.6-1	SGR-145.6-2A4	SGR-145.6-3	5.771	5.810	6.60	0.295
SGR-146.6-1	SGR-146.6-2A4	SGR-146.6-3	5.811	5.855	6.60	0.295
SGR-147.7-1	SGR-147.7-2A4	SGR-147.7-3	5.856	5.895	6.60	0.295
SGR-148.7-1	SGR-148.7-2A4	SGR-148.7-3	5.896	5.935	7.10	0.295
SGR-149.8-1	SGR-149.8-2A4	SGR-149.8-3	5.936	5.980	7.10	0.295
SGR-150.9-1	SGR-150.9-2A4	SGR-150.9-3	5.981	6.020	7.10	0.295

*Custom Part - No Returns

Standard SGR™ - Press Fit Mounting*

Dimensions in inches

Catalog Number	Min.shaft diameter	Max.shaft diameter	SGR OD Tolerance +0/-0.001	Thickness Max	Bore Tolerance +0.001/-0
SGR-6.9-0A6	0.311	0.355	1.580	0.295	1.576
SGR-8.0-0A6	0.356	0.395	1.580	0.295	1.576
SGR-9.0-0A6	0.396	0.435	1.580	0.295	1.576
SGR-10.1-0A6	0.436	0.480	1.580	0.295	1.576
SGR-11.2-0A6	0.481	0.520	1.580	0.295	1.576
SGR-12.2-0A6	0.521	0.560	1.580	0.295	1.576
SGR-13.2-0A6	0.561	0.605	1.580	0.295	1.576
SGR-14.4-0A6	0.606	0.645	1.580	0.295	1.576
SGR-15.4-0A6	0.646	0.685	2.080	0.295	2.076
SGR-16.4-0A6	0.686	0.730	2.080	0.295	2.076
SGR-17.6-0A6	0.731	0.774	2.080	0.295	2.076
SGR-18.7-0A6	0.775	0.815	2.080	0.295	2.076
SGR-19.7-0A6	0.816	0.855	2.080	0.295	2.076
SGR-20.7-0A6	0.856	0.895	2.080	0.295	2.076
SGR-21.7-0A6	0.896	0.935	2.080	0.295	2.076
SGR-22.8-0A6	0.936	0.980	2.080	0.295	2.076
SGR-23.9-0A6	0.981	1.020	2.080	0.295	2.076
SGR-24.9-0A6	1.021	1.060	2.080	0.295	2.076
SGR-25.9-0A6	1.061	1.105	2.080	0.295	2.076
SGR-27.1-0A6	1.106	1.145	2.080	0.295	2.076
SGR-28.1-0A6	1.146	1.185	2.080	0.295	2.076
SGR-29.1-0A6	1.186	1.230	2.080	0.295	2.076
SGR-30.3-0A6	1.231	1.270	2.080	0.295	2.076
SGR-31.3-0A6	1.271	1.310	2.080	0.295	2.076
SGR-32.3-0A6	1.311	1.355	2.080	0.295	2.076
SGR-33.4-0A6	1.356	1.395	2.080	0.295	2.076
SGR-34.4-0A6	1.396	1.435	2.660	0.295	2.656
SGR-35.5-0A6	1.436	1.480	2.660	0.295	2.656
SGR-36.6-0A6	1.481	1.520	2.660	0.295	2.656
SGR-37.6-0A6	1.521	1.560	2.660	0.295	2.656
SGR-38.6-0A6	1.561	1.605	2.660	0.295	2.656
SGR-39.8-0A6	1.606	1.645	2.660	0.295	2.656
SGR-40.8-0A6	1.646	1.685	2.660	0.295	2.656
SGR-41.8-0A6	1.686	1.730	2.660	0.295	2.656
SGR-43.0-0A6	1.731	1.770	2.660	0.295	2.656
SGR-44.0-0A6	1.771	1.810	2.660	0.295	2.656
SGR-45.0-0A6	1.811	1.855	2.660	0.295	2.656
SGR-46.1-0A6	1.856	1.895	2.660	0.295	2.656
SGR-47.1-0A6	1.896	1.935	2.660	0.295	2.656
SGR-48.2-0A6	1.936	1.980	2.660	0.295	2.656
SGR-49.3-0A6	1.981	2.020	2.660	0.295	2.656
SGR-50.3-0A6	2.021	2.060	3.080	0.295	3.076
SGR-51.3-0A6	2.061	2.105	3.080	0.295	3.076
SGR-52.5-0A6	2.106	2.145	3.080	0.295	3.076
SGR-53.5-0A6	2.146	2.185	3.080	0.295	3.076
SGR-54.5-0A6	2.186	2.230	3.080	0.295	3.076
SGR-55.7-0A6	2.231	2.270	3.080	0.295	3.076
SGR-56.7-0A6	2.271	2.310	3.080	0.295	3.076
SGR-57.7-0A6	2.311	2.355	3.080	0.295	3.076
SGR-58.8-0A6	2.356	2.395	3.080	0.295	3.076
SGR-59.8-0A6	2.396	2.435	3.580	0.295	3.576
SGR-60.9-0A6	2.436	2.480	3.580	0.295	3.576
SGR-62.0-0A6	2.481	2.520	3.580	0.295	3.576
SGR-63.0-0A6	2.521	2.560	3.580	0.295	3.576
SGR-64.0-0A6	2.561	2.605	3.580	0.295	3.576
SGR-65.2-0A6	2.606	2.645	3.580	0.295	3.576
SGR-66.2-0A6	2.646	2.685	3.580	0.295	3.576
SGR-67.2-0A6	2.686	2.730	3.580	0.295	3.576
SGR-68.4-0A6	2.731	2.770	3.580	0.295	3.576
SGR-69.4-0A6	2.771	2.810	3.580	0.295	3.576
SGR-70.4-0A6	2.811	2.855	3.580	0.295	3.576
SGR-71.5-0A6	2.856	2.895	3.580	0.295	3.576
SGR-72.5-0A6	2.896	2.935	4.080	0.295	4.076
SGR-73.6-0A6	2.936	2.980	4.080	0.295	4.076
SGR-74.7-0A6	2.981	3.020	4.080	0.295	4.076
SGR-75.7-0A6	3.021	3.060	4.080	0.295	4.076
SGR-76.7-0A6	3.061	3.105	4.080	0.295	4.076
SGR-77.9-0A6	3.106	3.145	4.080	0.295	4.076
SGR-78.9-0A6	3.146	3.185	4.080	0.295	4.076

Catalog Number	Min.shaft diameter	Max.shaft diameter	SGR OD Tolerance +0/-0.001	Thickness Max	Bore Tolerance +0.001/-0
SGR-79.9-0A6	3.186	3.230	4.080	0.295	4.076
SGR-81.1-0A6	3.231	3.270	4.080	0.295	4.076
SGR-82.1-0A6	3.271	3.310	4.080	0.295	4.076
SGR-83.1-0A6	3.311	3.355	4.080	0.295	4.076
SGR-84.2-0A6	3.356	3.395	4.080	0.295	4.076
SGR-85.2-0A6	3.396	3.435	4.580	0.295	4.576
SGR-86.3-0A6	3.436	3.480	4.580	0.295	4.576
SGR-87.4-0A6	3.481	3.520	4.580	0.295	4.576
SGR-88.4-0A6	3.521	3.560	4.580	0.295	4.576
SGR-89.4-0A6	3.561	3.605	4.580	0.295	4.576
SGR-90.6-0A6	3.606	3.645	4.580	0.295	4.576
SGR-91.6-0A6	3.646	3.685	4.580	0.295	4.576
SGR-92.6-0A6	3.686	3.730	4.580	0.295	4.576
SGR-93.8-0A6	3.731	3.770	4.580	0.295	4.576
SGR-94.8-0A6	3.771	3.810	4.580	0.295	4.576
SGR-95.8-0A6	3.811	3.855	4.580	0.295	4.576
SGR-96.9-0A6	3.856	3.895	4.580	0.295	4.576
SGR-97.9-0A6	3.896	3.935	5.080	0.295	5.076
SGR-99.0-0A6	3.936	3.980	5.080	0.295	5.076
SGR-100.1-0A6	3.981	4.020	5.080	0.295	5.076
SGR-101.1-0A6	4.021	4.060	5.080	0.295	5.076
SGR-102.1-0A6	4.061	4.105	5.080	0.295	5.076
SGR-103.3-0A6	4.106	4.145	5.080	0.295	5.076
SGR-104.3-0A6	4.146	4.185	5.080	0.295	5.076
SGR-105.3-0A6	4.186	4.230	5.080	0.295	5.076
SGR-106.5-0A6	4.231	4.270	5.080	0.295	5.076
SGR-107.5-0A6	4.271	4.310	5.080	0.295	5.076
SGR-108.5-0A6	4.311	4.355	5.080	0.295	5.076
SGR-109.6-0A6	4.356	4.395	5.080	0.295	5.076
SGR-110.6-0A6	4.396	4.435	5.580	0.295	5.576
SGR-111.7-0A6	4.436	4.480	5.580	0.295	5.576
SGR-112.8-0A6	4.481	4.520	5.580	0.295	5.576
SGR-113.8-0A6	4.521	4.560	5.580	0.295	5.576
SGR-114.8-0A6	4.561	4.605	5.580	0.295	5.576
SGR-116.0-0A6	4.606	4.645	5.580	0.295	5.576
SGR-117.0-0A6	4.646	4.685	5.580	0.295	5.576
SGR-118.0-0A6	4.686	4.730	5.580	0.295	5.576
SGR-119.2-0A6	4.731	4.770	5.580	0.295	5.576
SGR-120.2-0A6	4.771	4.810	5.580	0.295	5.576
SGR-121.2-0A6	4.811	4.855	5.580	0.295	5.576
SGR-122.3-0A6	4.856	4.895	5.580	0.295	5.576
SGR-123.3-0A6	4.896	4.935	6.080	0.295	6.076
SGR-124.4-0A6	4.936	4.980	6.080	0.295	6.076
SGR-125.5-0A6	4.981	5.020	6.080	0.295	6.076
SGR-126.5-0A6	5.021	5.060	6.080	0.295	6.076
SGR-127.5-0A6	5.061	5.105	6.080	0.295	6.076
SGR-128.7-0A6	5.106	5.145	6.080	0.295	6.076
SGR-129.7-0A6	5.146	5.185	6.080	0.295	6.076
SGR-130.7-0A6	5.186	5.230	6.080	0.295	6.076
SGR-131.9-0A6	5.231	5.270	6.080	0.295	6.076
SGR-132.9-0A6	5.271	5.310	6.080	0.295	6.076
SGR-133.9-0A6	5.311	5.355	6.080	0.295	6.076
SGR-135.0-0A6	5.356	5.395	6.080	0.295	6.076
SGR-136.0-0A6	5.396	5.435	6.580	0.295	6.576
SGR-137.1-0A6	5.436	5.480	6.580	0.295	6.576
SGR-138.2-0A6	5.481	5.520	6.580	0.295	6.576
SGR-139.2-0A6	5.521	5.560	6.580	0.295	6.576
SGR-140.2-0A6	5.561	5.605	6.580	0.295	6.576
SGR-141.4-0A6	5.606	5.645	6.580	0.295	6.576
SGR-142.4-0A6	5.646	5.685	6.580	0.295	6.576
SGR-143.4-0A6	5.686	5.730	6.580	0.295	6.576
SGR-144.6-0A6	5.731	5.770	6.580	0.295	6.576
SGR-145.6-0A6	5.771	5.810	6.580	0.295	6.576
SGR-146.6-0A6	5.811	5.855	6.580	0.295	6.576
SGR-147.7-0A6	5.856	5.895	6.580	0.295	6.576
SGR-148.7-0A6	5.896	5.935	7.080	0.295	7.076
SGR-149.8-0A6	5.936	5.980	7.080	0.295	7.076
SGR-150.9-0A6	5.981	6.020	7.080	0.295	7.076

*Custom Part - No Returns

Bearing Protection Ring Kit for NEMA & IEC Motors

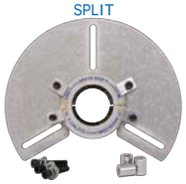
Kits include AEGIS SGR™ Bearing Protection Ring and all mounting hardware

NEMA/IEC Bearing Protection Ring™ Kit

SOLID

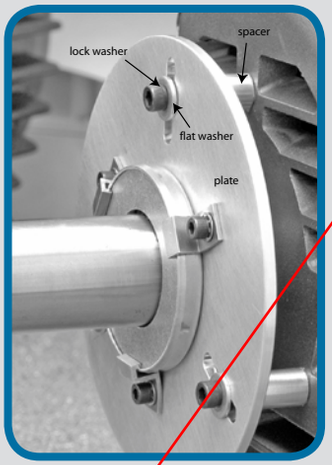
1 AEGIS SGR™
1 mounting plate
3 screws (inches or metric)
3 washers
3 lock washers
3 spacers*

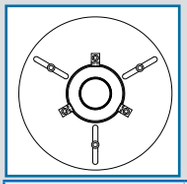
SPLIT

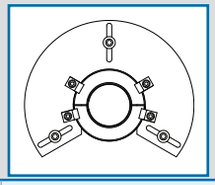


1 AEGIS Split Ring SGR™
1 split mounting plate
3 screws (inches or metric)
3 washers
3 lock washers
3 spacers*

* each kit includes 3 spacer lengths: 1/4", 1/2", and 1" for NEMA kits and 7mm, 17mm, and 27mm for IEC kits.







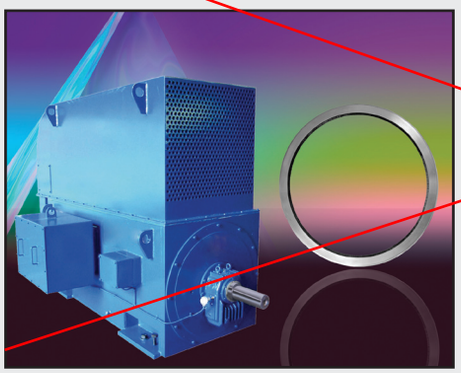
NEMA Motors Solid	NEMA Motors Split			
Catalog Number	**Catalog Number**	Motor shaft diameter "u"	NEMA Frame	Plate OD
SGR-0.625-NEMA	SGR-0.625-NEMA-1A4	0.625"	56	3.75"
SGR-0.875-NEMA	SGR-0.875-NEMA-1A4	0.875"	143T, 145T	5.60"
SGR-1.125-NEMA	SGR-1.125-NEMA-1A4	1.125"	182T, 184T	5.60"
SGR-1.375-NEMA	SGR-1.375-NEMA-1A4	1.375"	213T, 215T	5.60"
SGR-1.625-NEMA	SGR-1.625-NEMA-1A4	1.625"	254T, 256T	6.30"
SGR-1.875-NEMA	SGR-1.875-NEMA-1A4	1.875"	284T, 286T, 324TS, 326TS, 364TS, 365TS	6.30"
SGR-2.125-NEMA	SGR-2.125-NEMA-1A4	2.125"	324T, 326T, 404TS, 405TS	6.60"
SGR-2.375-NEMA	SGR-2.375-NEMA-1A4	2.375"	364T, 365T, 444TS, 445TS, 447TS, 449TS	6.60"
SGR-2.875-NEMA	SGR-2.875-NEMA-1A4	2.875"	404T, 405T,	7.30"
SGR-3.375-NEMA	SGR-3.375-NEMA-1A4	3.375"	444T, 445T, 447T, 449T	7.60"

IEC Motors Solid	IEC Motors Split			
Catalog Number	**Catalog Number**	IEC shaft diameter	IEC Frame	Plate OD
SGR-19-IEC	SGR-19-IEC-2A4	19mm	IEC 80 (2, 4, 6, 8 pole)	142mm
SGR-24-IEC	SGR-24-IEC-2A4	24mm	IEC 90S, 90L (2, 4, 6, 8 pole)	142mm
SGR-28-IEC	SGR-28-IEC-2A4	28mm	IEC 100L, 112M (2, 4, 6, 8 pole)	142mm
SGR-38-IEC	SGR-38-IEC-2A4	38mm	IEC 132S, 132M (2, 4, 6, 8 pole)	160mm
SGR-42-IEC	SGR-42-IEC-2A4	42mm	IEC 160M, 160L (2, 4, 6, 8 pole)	160mm
SGR-48-IEC	SGR-48-IEC-2A4	48mm	IEC 180M, 180L (2, 4, 6, 8 pole)	160mm
SGR-55-IEC	SGR-55-IEC-2A4	55mm	IEC 200L (2, 4, 6, 8 pole); IEC 225S, 225M (2 pole)	168mm
SGR-60-IEC	SGR-60-IEC-2A4	60mm	IEC 225S, 225M (4, 6, 8 pole) ; IEC 250M (2 pole)	168mm
SGR-65-IEC	SGR-65-IEC-2A4	65mm	IEC 250M (4, 6, 8 pole); IEC 280M, 280S, 315S, 315M, 315L (2 pole)	185mm
SGR-75-IEC	SGR-75-IEC-2A4	75mm	IEC 280S, 280M (4, 6, 8 pole); IEC 355M, 355L (2 pole)	193mm
SGR-80-IEC	SGR-80-IEC-2A4	80mm	IEC 315S, 315M, 315L (4, 6, 8 pole)	193mm
SGR-95-IEC	SGR-95-IEC-2A4	95mm	IEC 335L, 335M, 355L, 355M (4, 6, 8, 10 pole)	211mm

Custom Kits available for shaft diameters not shown above

- Easy to order and install for any NEMA or IEC frame size
- Clears any slinger, shaft shoulder or protrusion
- Adjustable slots adapt to most end bells
- Rigid mounting plate ensures alignment
- Split Ring kit allows for installation without decoupling equipment

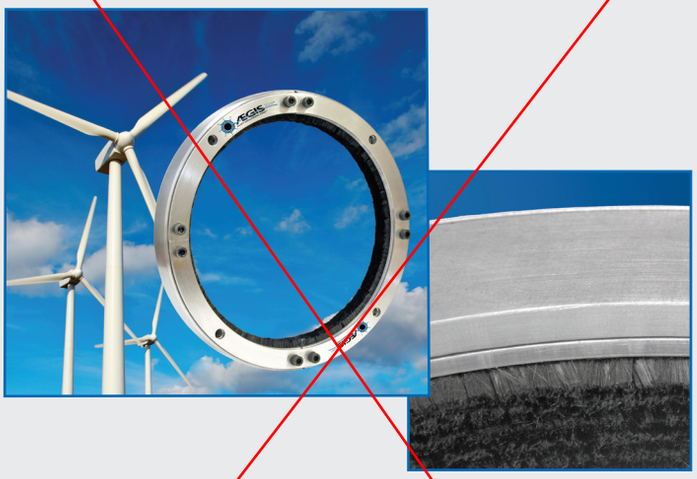
Custom Applications



AEGIS SGR™ Bearing Protection Ring™ for Large Shaft Diameters

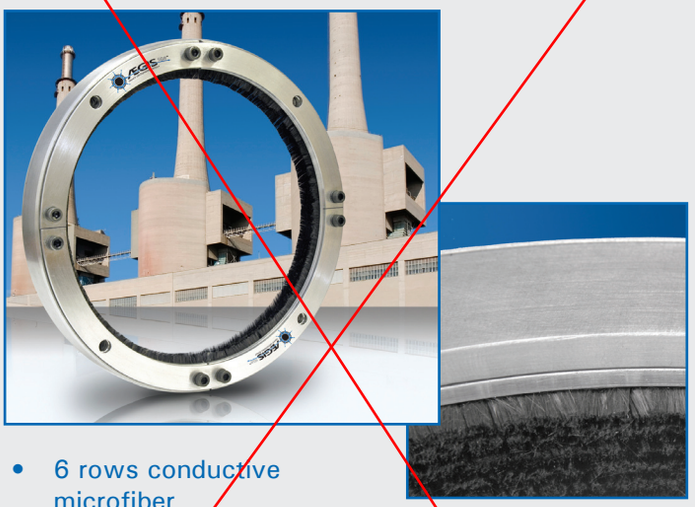
- For shaft diameters greater than 6" (152.4mm)
- Long term reliable performance
- Maintenance free system
- Available in solid or split ring design

AEGIS WTG™ Wind Turbine Bearing Protection



- 6 rows conductive microfiber
- High current capable
- AEGIS WTG™ shaft current monitoring compatible
- Long term reliable performance
- Maintenance free system
- Up-tower retrofit capable split ring configuration

AEGIS iPRO™ High Current Bearing Protection for Large Motors and Generators



- 6 rows conductive microfiber
- High current capable
- AEGIS iPRO shaft current monitoring compatible
- Long term reliable performance
- Maintenance free system
- Available in sizes up to 30" (762mm) shaft diameter

WARRANTY: Units are guaranteed for one year from date of purchase against defective materials and workmanship. Replacement will be made except for defects caused by abnormal use or mishandling. All statements and technical information contained herein, or presented by the manufacturer or his representative are rendered in good faith. User must assume responsibility to determine suitability of the product for intended use. The manufacturer shall not be liable for any injury, loss or damage, direct or consequential arising out of the use, or attempt to use the product.

Patent Numbers: 7,136,271: 7,193,836: and other patents pending

Engineering Specification:

All motors driven by a variable frequency PWM drive shall include a maintenance free, circumferential, conductive micro fiber shaft grounding ring (AEGIS SGR) to discharge shaft currents to ground.
Recommended part: AEGIS SGR™ Bearing Protection Ring

AEGIS SGR™

BEARING PROTECTION RING™

CONSULTING - SPECIFYING engineer 2009 PRODUCT OF THE YEAR Finalist

Plant Engineering PRODUCT of the YEAR 2007 Winner

2007 FROST & SULLIVAN
North American Motors & Drives Product Value Leadership of the Year Award

2007 design news GOLDEN MOUSETRAP Finalist

CONSULTING - SPECIFYING engineer A Perfect 10 2006 Product of the Year Silver Winner

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Electro Static Technology™
An ITW Company

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Tel.: 866-738-1857
Fax: 207-998-5143
www.est-aegis.com

Electrically insulated bearings from SKF

Virtually eliminate the dama

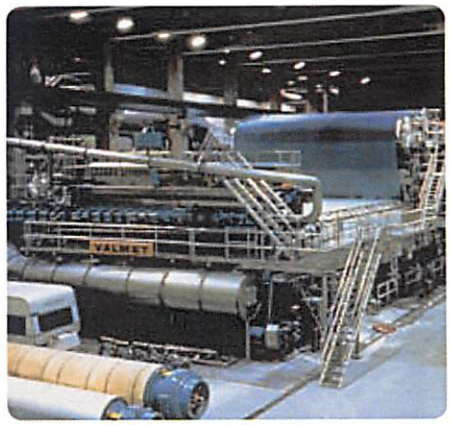
The problem of stray electric current bearing damage

When a stray current in an electric motor uses a bearing as its path to ground, bearing damage can occur. The most common causes of stray electric currents are: asymmetry in the motor's magnetic circuit, unshielded power cables, and fast switching pulse width modulated (PWM) frequency converters used in modern variable frequency drives (VFDs). The increasing popularity of VFDs is directly linked to the increase in electric current related bearing damage.

When an electric current passes through the bearing it can cause micro-cratering in the raceways of inner and outer rings and on the rolling element surfaces (→ **fig. 1**). The heat, which is generated by the discharges, causes local melting that creates small craters and changes in the structure of the metal. As a result of this initial damage, a "washboard pattern" may be found on the raceways and rolling elements (for roller bearings) (→ **fig. 2**). This secondary damage is wear caused by the dynamic effect of the rolling elements when they roll over the smaller craters. Current discharges also cause the lubricant in the bearing to change its composition, degrade rapidly and fail prematurely (→ **fig. 3**).

Once bearing damage from electric erosion has begun, increased noise levels, reduced effectiveness of the lubricant, increased heat and finally excessive vibration, all contribute to drastically decrease bearing service life.

Stray electric currents can occur almost anywhere from windmills to papermills



ging effects of stray electric currents

A cost-effective solution

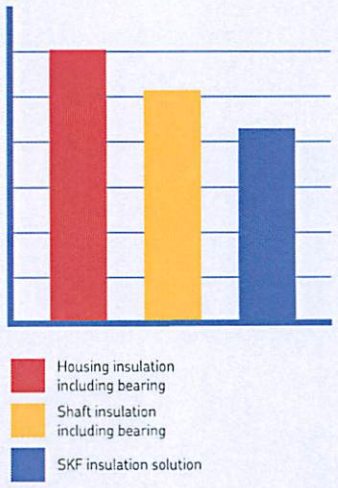
To overcome this problem, SKF has developed two electrically insulating rolling bearing solutions: SKF® hybrid bearings and INSOCOAT® bearings. The solution one chooses depends on the severity and cause of the stray electric current and size of the bearing. In either case, SKF hybrid bearings and INSOCOAT bearings provide a number of benefits

- two functions in one solution:
  - a bearing function
  - electrical insulation
- virtually eliminates premature bearing failures caused by stray electric currents
- increases machine uptime
- reduces maintenance costs
- provides an economical solution when compared with other insulation solutions
- global availability.

Recommended range

SKF has defined a recommended range of INSOCOAT and hybrid bearings specifically for electric motors and generators. This range enables fast and secure delivery around the globe.

Total cost of SKF insulated bearing solution relative to other insulation approaches



Micro-cratering
Micro-cratering is the result of electric current passage in bearings. The damaged surface appears dull and is characterized by small craters of a few microns in diameter.

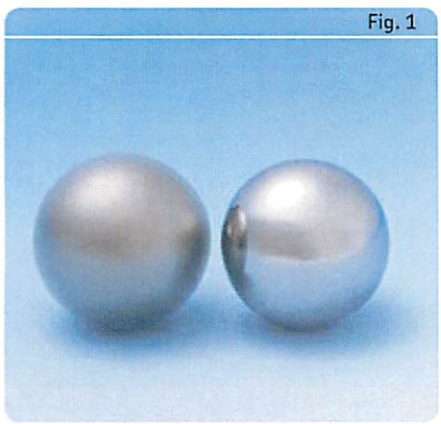


Fig. 1

Fluting or washboard pattern
A pattern of lines (fluting) across the raceways can be a sign that current has passed through the bearing. Fluting is not primary damage resulting from stray electric currents but is secondary damage that becomes visible over time.

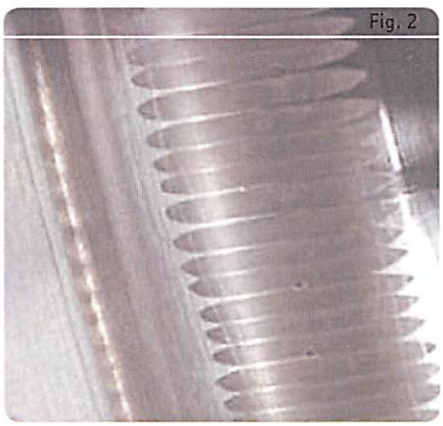


Fig. 2

Grease-blackening
Electric discharges cause the base oil in the lubricant to burn and harden to create a poor lubrication condition.

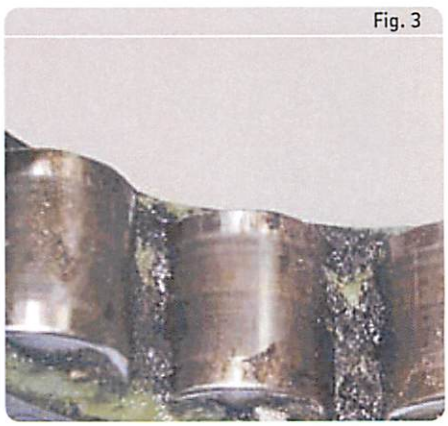


Fig. 3

SKF 6215/C3

INSOCOAT

An INSOCOAT bearing is a very economical solution when compared with other insulation methods that protect a bearing against electric current passage. By integrating the electrical insulation function into the bearing, SKF has been able to increase reliability and machine uptime by virtually eliminating the damaging effects of stray electric currents.

INSOCOAT bearing designs

The standard range of INSOCOAT bearings in the most frequently used sizes and variants are available from stock as

- single row deep groove ball bearings
- single row cylindrical roller bearings.

The performance data as well as the dimensional and running accuracy of INSOCOAT bearings are identical to standard non-insulated bearings.

INSOCOAT bearings with coated outer ring

Bearings with an electrically insulating coating on the external surfaces of the outer ring are the most common INSOCOAT bearings. They are identified by the suffix VL0241.

Outer ring coated INSOCOAT bearings are recommended for medium size motors, that use 6215, 6313 size bearings and larger. For applications where smaller bearings are used, SKF recommends hybrid deep groove ball bearings.

INSOCOAT bearings with coated inner ring

Bearings with an electrically insulating coating on the external surfaces of the inner ring provide enhanced protection against electric current damage. The enhanced protection results from the increased impedance due to the smaller coated surface area. Bearings with a coated inner ring are identified by the suffix VL2071 and are recommended for larger size motors (typically from bearing sizes 6226, 6324 sizes and larger), or other applications where the bearings risk being subjected to high shaft voltages.

Technical features and benefits

- The coating is applied using a plasma-spray technique. Sophisticated pre- and post- application processes yield an outstanding coating quality.
- INSOCOAT bearings are treated with a unique sealant to guard against humidity and water from penetrating the coating and reducing its effectiveness.
- Due to the quality of the application and finishing processes, INSOCOAT bearings provide reliable and consistent insulation, that is virtually insensitive to heat, moisture and chemicals.
- SKF can supply values for relevant electric parameters for the bearings (capacitance, impedance) to optimize the insulating solution for any application.
- INSOCOAT bearings are environmentally friendly.
- INSOCOAT bearings with an outer ring coating are suitable for all types of housings. No additional mounting precautions are necessary.

Dimensions

The boundary dimensions of INSOCOAT deep groove ball bearings and cylindrical roller bearings are in accordance with ISO 15:1998.

Tolerances and fits

INSOCOAT bearings are produced to Normal tolerances. Some deep groove ball bearings are also available with higher accuracy to tolerance class P5.

The aluminium-oxide layer applied either to the external outer ring surfaces or the external inner ring surfaces does not influence running accuracy.

INSOCOAT bearings can be mounted with the same fit as a standard bearing in an electric motor or generator, without risk of damaging the coating. Fits up to and including p6 for inner ring coated variants and P6 for outer ring coated variants can be applied.

Internal clearance

Standard INSOCOAT deep groove ball bearings and cylindrical roller bearings are manufactured with the radial internal clearance to the class shown in the bearing designation. Before ordering, check the availability of bearings with clearances other than standard.

Cages

Depending on the bearing type and size, INSOCOAT bearings are equipped with one of the following cages

- a riveted cage of pressed steel, no designation suffix, or
- a two-piece machined brass cage, rolling element centred, designation suffix M.

Electrical properties

INSOCOAT bearings provide effective protection against AC and DC currents. The specifications for different variants are:

VL0241 Electrical resistance: min. 50 MΩ, breakdown voltage: max. operating voltage 1 000 V DC.

VL0246 Electrical resistance: > 150 MΩ, breakdown voltage: max. operating voltage 3 000 V DC.

VL2071 Electrical resistance: min. 50 MΩ, breakdown voltage: max. operating voltage 1 000 V DC.

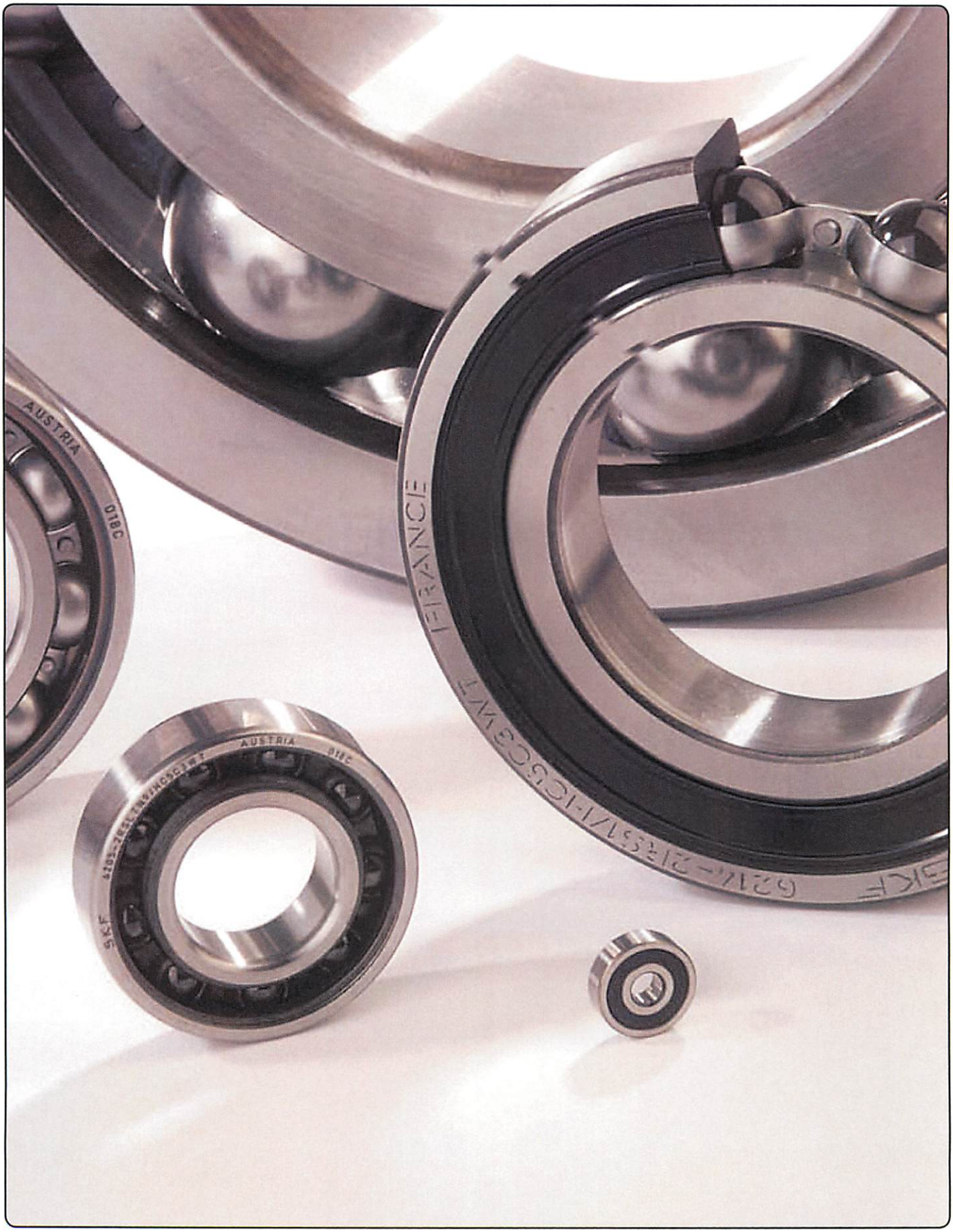
VL2074 Electrical resistance: > 150 MΩ, breakdown voltage: max. operating voltage 2 000 V DC.

Design of associated components

To maximize the effects of the insulating properties of INSOCOAT bearings, SKF recommends the following:

- For bearings with a coated outer ring designation suffix VL0241, the housing shoulder or spacer sleeve should not have a diameter smaller than the abutment dimension D_a min listed in the assortment tables. For VL0246 abutment dimensions, contact SKF.
- For bearings with a coated inner ring designation suffix VL2071, the shaft shoulder or spacer sleeve should not have a diameter larger than the abutment dimension d_a max listed in the assortment tables. For VL2074 abutment dimensions, contact SKF.

The coating can be applied to either the outer or inner ring to provide protection against electric current damage in bearings. Designation suffix VL0241 or VL2071 respectively.


AUSTRIA
0810
AUSTRIA
0815
SKF
E-BEARING

Hybrid bearings – more than an insulator

Hybrid bearings have rings made of bearing steel and rolling elements made of bearing grade silicon nitride (Si_3N_4). Because silicon nitride is such an excellent insulator, hybrid bearings can be used effectively to insulate the housing from the shaft in both AC and DC motors, as well as in generators.

In addition to being an excellent insulator, hybrid bearings have higher speed capabilities and will provide longer bearing service life under the same operating conditions than a similarly sized all-steel bearing.

Features and benefits

Lower density

The density of a bearing grade silicon nitride rolling element is 60 % lower than a similarly sized rolling element made from bearing steel. Less weight means lower inertia – and that translates into superior behaviour during rapid starts and stops as well as higher speeds.

Lower friction

The lower density of a silicon nitride rolling element combined with its low coefficient of friction, significantly reduces bearing temperatures at high speeds. Cooler running increases the service life of both the bearing and the lubricant.

High hardness and high modulus of elasticity

The high degree of hardness of a silicon nitride rolling element means high wear-resistance, increased bearing stiffness and longer bearing service life in contaminated environments.

Low coefficient of thermal expansion

A silicon nitride rolling element has a lower coefficient of thermal expansion than a similarly sized rolling element made from bearing steel. This means less sensitivity to temperature gradients at high temperatures for better, more accurate preload control.

Runs faster, lasts longer

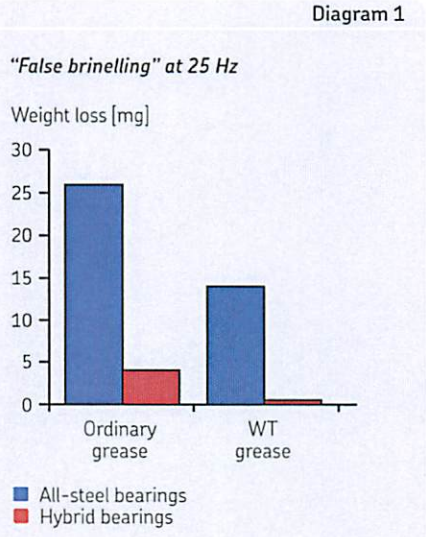
Combine the lower density of silicon nitride with its lower coefficient of friction, high hardness and the fact that silicon nitride will not smear the raceways under poor lubrication conditions, and the result is a bearing that will run faster and longer even under the most difficult operating conditions.

Resists false brinelling

If a stationary bearing is subjected to vibrations there is a risk that "false brinelling" will occur. False brinelling is the formation of small indentations in the raceways that will eventually lead to spalling and premature bearing failure. In cases where steel balls were replaced by ceramic balls the bearings were found to be much less susceptible to false brinelling.

Hybrid bearings supplied with SKF wide temperature grease (WT) were found to sustain less false brinelling damage than bearings containing other types of greases (→ **diagram 1**).

Diagram 1



Cages

Depending on their size, standard SKF hybrid deep groove ball bearings are fitted with

- an injection moulded snap-type cage of glass fibre reinforced polyamide 6,6 or
- a riveted pressed steel cage.

Hybrid bearings with a polyamide 6,6 cage can be operated at temperatures up to + 120 °C (+250 °F).

Polyetheretherketone (PEEK)

The use of glass fibre reinforced PEEK cages is becoming more common for applications where there are high speeds or high temperatures. PEEK provides a superior combination of strength and flexibility and does not show signs of ageing due to high temperatures or oil additives. The maximum temperature for high-speed use is limited to +150 °C (+300 °F) as this is the softening temperature of the polymer. For additional information about PEEK cages, contact the SKF application engineering service.

Seals

The SKF standard range of hybrid bearings for electric motors consists primarily of single row deep groove ball bearings. Sealed and greased-for-life SKF hybrid deep groove ball bearings are protected on both sides by

- a low-friction RSL seal, fitted to bearings with an outside diameter ≤ 52 mm, designation suffix 2RSL
- a low-friction RZ seal, fitted to bearings with an outside diameter > 52 mm, designation suffix 2RZ
- an RS1 contact seal, fitted to bearings with an outside diameter ≥ 90 mm, designation suffix 2RS1.

All seals are made of acrylonitrile-butadiene rubber (NBR) with sheet steel reinforcement. The permissible operating temperature range for these seals is –40 to +100 °C (–40 to +210 °F) and up to +120 °C (+250 °F) for brief periods. For operating temperatures up to +180 °C (+355 °F), seals made from fluoro rubber are available. For additional information about these seals, contact the SKF application engineering service.

Lubrication

The standard sealed hybrid bearing is filled with a premium quality synthetic ester oil based grease, containing a polyurea thickener (designation suffix WT). This grease, which has an operating temperature range from about +70 to +120 °C (+160 to +250 °F), has excellent lubrication properties and provides extremely long service life.

Hybrid bearings perform extremely well under vibrating or oscillating conditions. It is therefore not usually necessary to use special greases for these conditions.

Comparison of the material properties of bearing steel and bearing grade silicon nitride

Material properties	Bearing steel	Bearing grade silicon nitride
Mechanical properties		
Density (g/cm^3)	7,9	3,2
Hardness, HV 10 (kg/mm^2)	700	1 600
Modulus of elasticity (GPa)	210	310
Thermal expansion ($10^{-6}/K$)	12	3
Electrical properties (at 1 MHz)		
Electrical resistivity (Ωm)	$0,4 \times 10^{-6}$ (conductor)	10^{12} (insulator)
Dielectric strength (kV/mm)	–	15
Relative dielectric constant	–	8

Grease life in hybrid bearings

Tests have shown that when used with sealed hybrid bearings, the wide temperature grease (WT) from SKF has a very long service life even at high speeds and high temperatures. One example (→ **diagram 2**) shows where the life of WT grease in hybrid bearings was four times longer than in all-steel bearings. The shaft diameter was 20 mm, the speed 20 000 r/min and the operating temperature +120 °C (+250 °F).

Most SKF hybrid deep groove ball bearings are sealed and greased-for-life.

SKF recommends relubrication of open bearings with SKF grease LGHP 2. In general, the relubrication interval is 3 to 5 times longer than for an all-steel bearing.

For very high-speed applications at temperatures below +70 °C (+160 °F) the use of either SKF grease LGLC 2 or SKF grease LGLT 2 is recommended.

The recommended bearing operating temperature range for maximum grease life is +70 to +120 °C (+160 to +250 °F).

Equivalent bearing loads

The equivalent dynamic and static bearing loads of hybrid deep groove ball bearings are calculated using the equations for all-steel deep groove ball bearings.

Typical hybrid bearing designations suffixes

The designation suffixes used to identify certain features of SKF hybrid deep groove ball bearings are explained in the following.

C3	Radial internal clearance greater than Normal
HC5	Rolling elements of silicon nitride
TNH	Injection moulded snap-type cage of polyetheretherketone (PEEK)
TN9	Injection moulded snap-type cage of glass fibre reinforced polyamide 6,6
WT	Grease with a polyurea thickener of consistency 2–3 to the NLGI Scale for a temperature range –40 to +160 °C (–40 to +320 °F) (normal filling grade)
2RS1	Sheet steel reinforced contact seal of acrylonitrile-butadiene rubber (NBR) on both sides of the bearing
2RSH2	Sheet steel reinforced contact seal of fluoro rubber (FKM) on both sides of the bearing
2RSL	Sheet steel reinforced low-friction seal of acrylonitrile-butadiene rubber (NBR) on both sides of the bearing
2RZ	Sheet steel reinforced low-friction seal of acrylonitrile-butadiene rubber (NBR) on both sides of the bearing

Dimensions, tolerances, internal clearance

Standard SKF hybrid deep groove ball bearings are manufactured as standard with

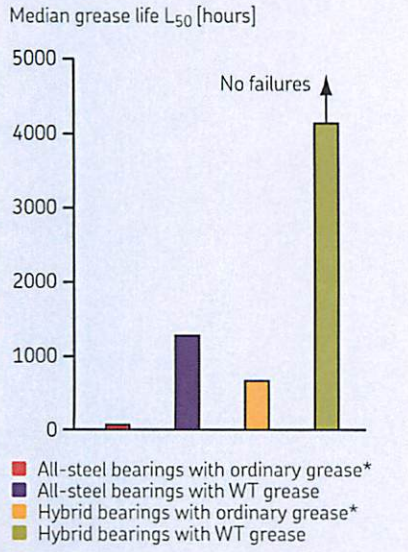
- boundary dimensions to ISO 15:1998
- Normal tolerances to ISO 492:2002
- C3 radial internal clearance to ISO 5753:1991.

Recommendations for installation

Hybrid bearings should be handled and mounted in the same manner as conventional all-steel bearings. Always use the right tools and correct methods for mounting and dismounting.

Diagram 2

Long grease life with WT grease in hybrid bearings



* At +120 °C (max temperature for ordinary grease)

Grease alternatives offering long service life in hybrid bearings

SKF grease	Temperature range*
WT	– 40 to +160 °C – 40 to +320 °F
LGHP 2	– 40 to +150 °C – 40 to +300 °F

* For additional information about safe operating temperatures, refer to the chapter "Lubrication" in the SKF General Catalogue

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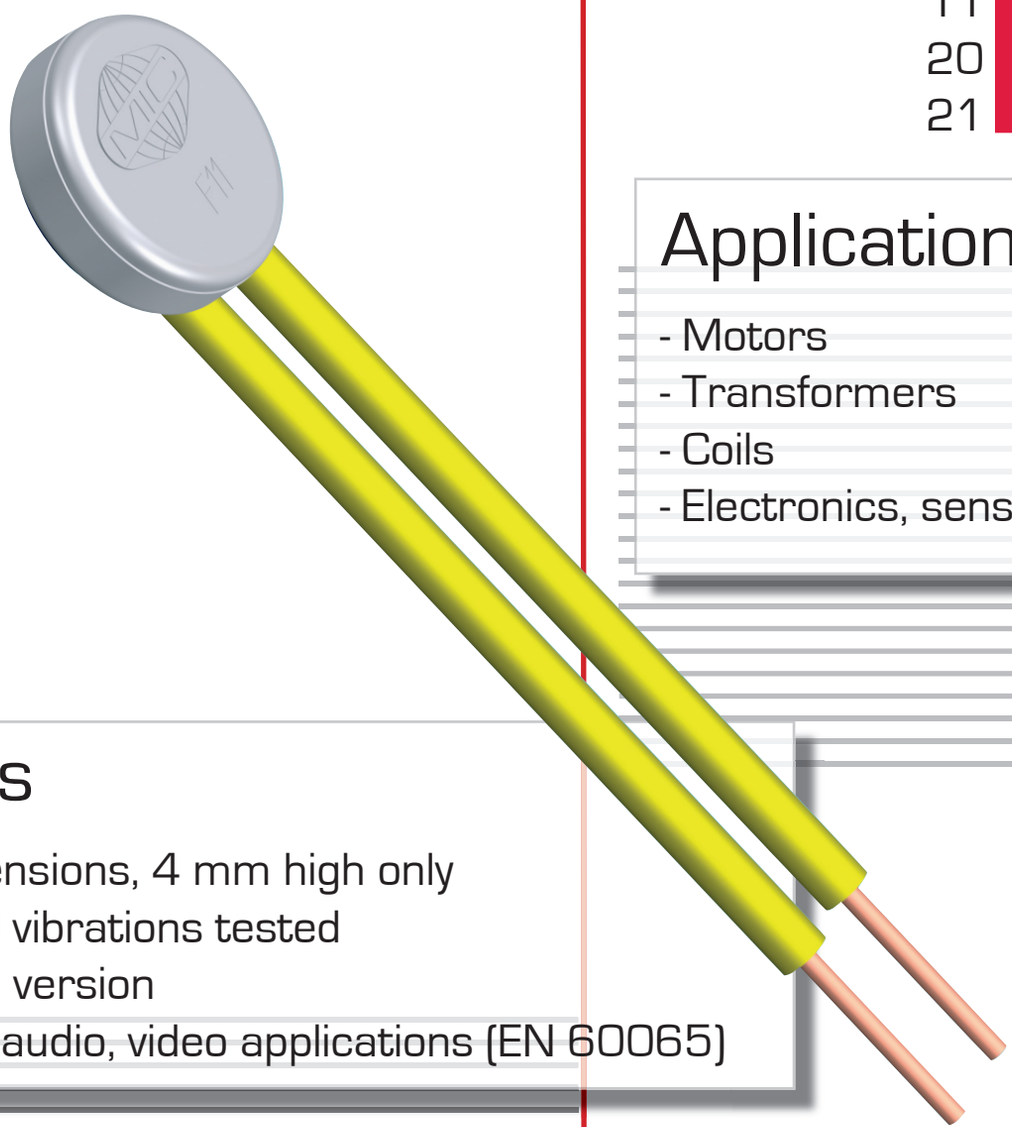
This publication supersedes publications 5128 E and 5225 E.

Printed in Sweden on environmentally friendly paper.

Thermal motor protector
Temperature limiter
Thermal cut-out

F

11
20
21

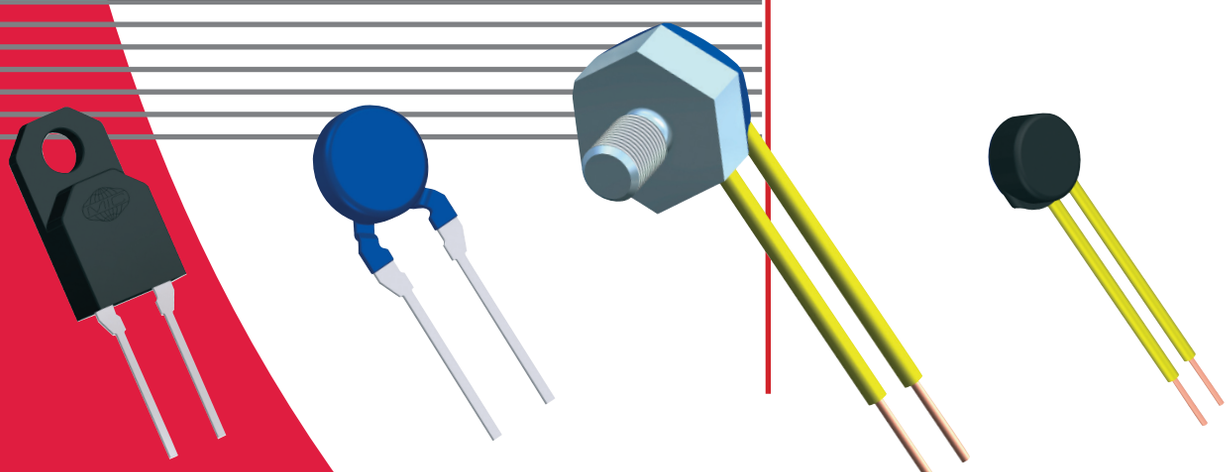


Applications

- Motors
- Transformers
- Coils
- Electronics, sensors

Benefits

- Small dimensions, 4 mm high only
- Shock- and vibrations tested
- Leadframe version
- Tested for audio, video applications (EN 60065)



MICROTHERM

MIC®
Microtherm International Cooperation

Technical data

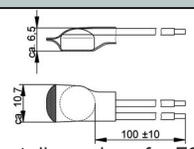
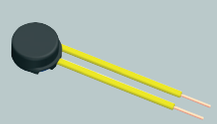
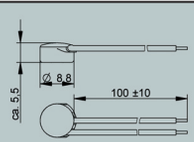
ratings \ control type		F11A / E F20A / E	F20B / G	F21A / E	
version		normally closed	normally open	normally closed	
rated current at 250 V 50/60 Hz (power factor 0.95 / 0.6)		2.0 A / 1.6 A	2.0 A / 1.6 A	3.0 A / 3.0 A	6.3 A / 1.0 A
switching cycles		10,000		10,000	700
max. current at 250 V 50/60 Hz (power factor 0.95)		6.3 A		8.0 A	
switching cycles under max. current		100			
temperature rating Ta (steps in 5 K)		70 °C ... 160 °C	70 °C ... 155 °C	70 °C ... 160 °C	
tolerances		Standard: ± 5 K			
feature of automatic action		1.B, 2.B.M, 1.C, 3.C		2.B, 1.C	
contact resistance (incl. wire of 100 mm)		< 50 mΩ			
hysteresis		30 K ± 15 K			
dielectric strength (standard insulation)		2 kV			
shock- / vibration testing (similar to EN 50155)		400 m/s² sine half wave / 100 m/s² 5 Hz ... 2,000 Hz sine			
resistances to impregnation		tight against ordinary resins and lacquers			
degrees of protection provided by enclosures (EN 60529)		IP00			
suitable for use in protection category		I, II			
approvals	**VDE / ENEC**	EN 60730-1 / -2-2 / -2-3 [1] /-2-9			
	UL	UL 2111 / UL 873			
	CSA	C22.2 No. 77 / C22.2 No. 24 [2]			

[1] different power rating
[2] on demand

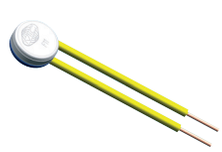
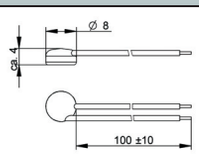
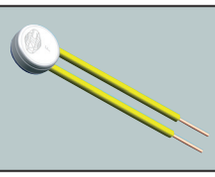
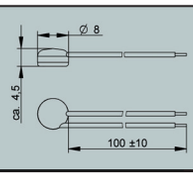
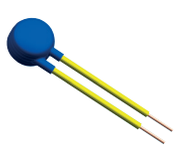
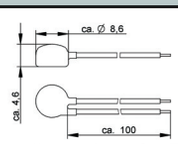
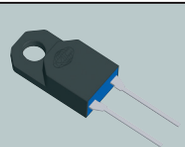
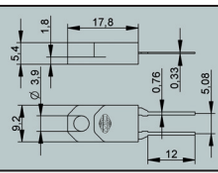
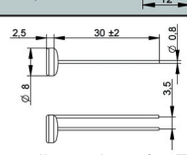
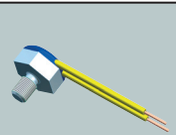
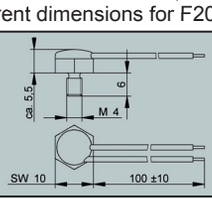
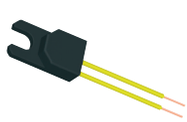
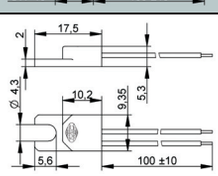
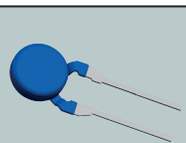
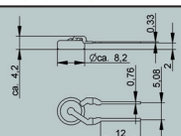
Standard wire (length 100 ± 10 mm, stripped 6 ± 1 mm)

lead	code	temperature max.	operating voltage max.	diameter insulation	cross section diameter	UL style
stranded white	L300	150 °C	300 V	1.57 mm	AWG24 / 0.21 mm²	3398
	L310			1.80 mm	AWG20 / 0.48 mm²	
	L330	200 °C	600 V	0.90 mm	AWG24 / 0.24 mm²	3557
solid yellow	L400	150 °C	300 V	1.40 mm	AWG24 / 0.51 mm	3398
	L410			1.65 mm	AWG20 / 0.81 mm	
	L430	200 °C	300 V	1.21 mm	AWG24 / 0.51 mm	1332
	L440			1.71 mm	AWG20 / 0.81 mm	

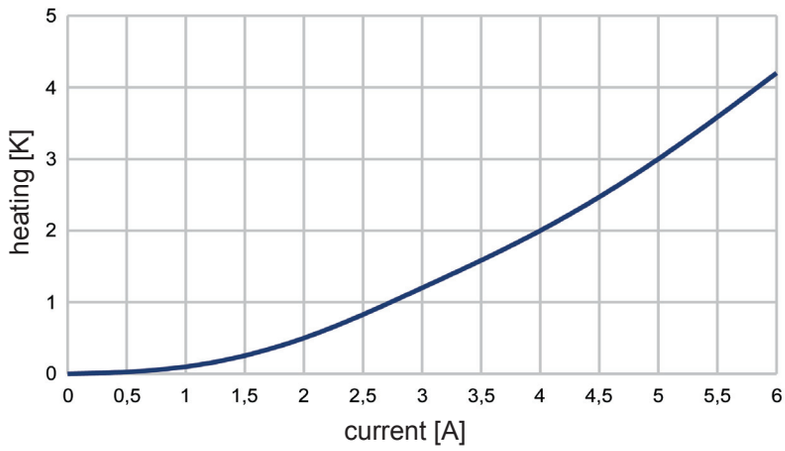
Standard insulation

control type	nc	no	code	illustration	drawing dimensions (mm)	technical specification	approvals
F11, F21 F20	A A	B	U254		 different dimensions for F20, F21	shrink cap potted Ta max. 155°C	VDE, UL
F11	A		U198		 different dimensions for F20, F21	cap of PPS potted	VDE, UL
F20 F21	A A	B	U185				

Specific variations

control type	nc	no	code	illustration	drawing dimensions (mm)	technical specification	approvals
F11	A					not insulated potted	VDE, UL, CSA
F20 F21	A A	B				not insulated potted	VDE, UL, CSA
F11, F21 F20	A A	B	U112		 different dimensions for F20, F21	coated	VDE, UL
F20 F21	A A	B	A150 U280			housing of PPS leadframe leads grid dimension 5.08 potted	VDE, UL
F11, F21 F20	A A	B	A800		 different dimensions for F20, F21	not insulated potted	VDE, UL
F20 F21	E E	G	G700			aluminium housing thread M4x6 potted Attention: Ta max. 150 °C	VDE, UL
F11	A		U281			housing of PPS potted	VDE, UL
F11, F21 F20	A A	B	A150 U112		 different dimensions for F20, F21	leadframe leads grid dimension 5.08 coated	VDE, UL

Heating by current

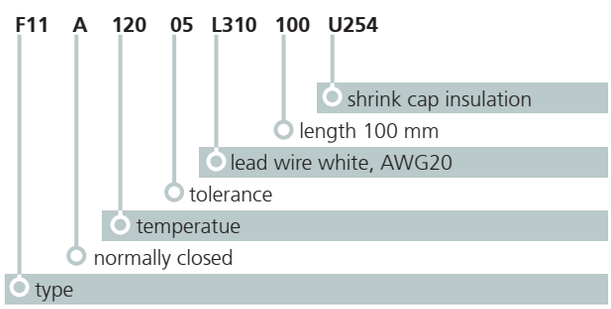


The diagram is measured with a thermal control without any insulation in an oil bath.

Attention:
The heating depends on the thermal conduction of the control to the equipment or part which should be protected.

Ordering and marking example

Ordering example



Deviations from standard controls on request.

Marking

F11A	type (F11 nc)
12005	response temperature (120°C), tolerance (± 5K)
026D	date of manufacture (Feb.2006), country (D=Germany)

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D-75112 Pforzheim

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E-Mail: mic-pforzheim@microtherm.de
Internet: www.microtherm.de

BEST PRACTICES FOR VARIABLE FREQUENCY DRIVE (VFD) APPLICATIONS

VFD-induced shaft voltage can exist in every VFD driven motor application. It is not specific to the air movement industry, nor is it specific to any particular manufacturer's motors, drives or equipment. However, shaft voltage only becomes a problem when it leads to bearing current and consequential damage to the motor bearings.

NOTICE!

Risk of serious machine damage!
Appropriate measures must be implemented by the installation contractor to limit the shaft induced voltage to 1V – 2V as per IEEE 112.

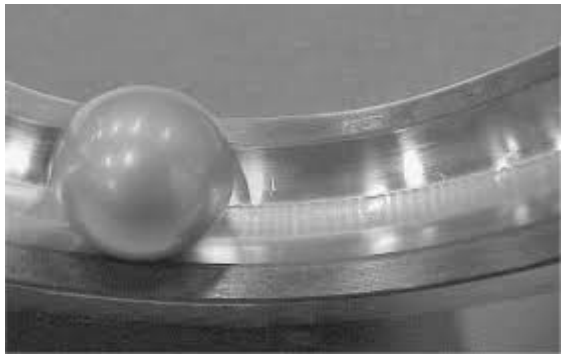

Figure 1 Bearing damage caused by EDM

Frequency converters (also known as variable frequency drives or VFD's) can induce a voltage on the shafts of drive motors and stages due to the high switching frequencies used in these drives. Shaft voltage can become a problem when it reaches a high enough level to discharge across the bearings, causing electrical discharge machining (EDM) and creating small grooves called fluting which can lead to premature bearing failure. The potential for this induced shaft voltage exists in every VFD driven motor application and must be addressed on an installation specific basis.

VFD induced voltage is a phenomenon that is somewhat rare and unpredictable. As additional protection, Aerzen USA offers options for mitigating induced shaft currents such as grounding rings and isolated motor non drive end bearings. Even with these options installed, there is no guarantee that this phenomenon will be entirely eliminated. Damage to the motor bearings from shaft / bearing currents is not covered by warranty from Aerzen, the motor manufacturer or VFD manufacturer.

GENERAL RECOMMENDATIONS:

Motors up to and including 100HP (75kW) – Low Voltage

For induction motors either foot mounted, c-face or d-flange mounted motors with single row radial ball bearings on both ends of the motors

- Install one AEGIS SGR Bearing Protection Ring on either the drive end or the non-drive end of the motor to discharge capacitive induced shaft voltage.

Motors Greater than 100HP (75kW)

For horizontally mounted motors with single row radial ball bearings on both ends of the motor:

- Non-Drive End (Opposite Drive End): Bearing housing must be isolated with insulated sleeve or coating or use insulated ceramic or hybrid bearing to disrupt circulating currents.
- Drive End: Install one AEGIS Bearing Protection Ring.

Motors in Hazardous Areas

Grounding rings are not permitted. Consult Aerzen USA or your motor supplier for specific recommendations.

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website www.aerzen.com/en-us

VFD SETTINGS

Date	Revision #
17-Mar-21	-

REFERENCE INFORMATION

Document No. BC-6-0239 rev "O"

Sales Order No.	SO-20-00311	Equip. No.	MIX.BLW-1, 2	VFD Manufacturer	-
Wiring Diagram	-	Machine	GM35S	VFD Model No.	-

GENERAL DESIGN REQUIREMENTS

1. Parameter Settings and Nos. will be included only in the case of the VFD being provided by AERZEN USA, otherwise this area can be used by customer for reference information regarding settings & parameter nos.
2. The highest voltage increase rate is 1200 V / micro second.
3. Install filter, output reactor if e.g. the cabling exceeds i.e. >200', etc.
4. Minimum Frequency is set to protect the blower from insufficient gear lubrication. Additional safety features (i.e. motor over-temp. or high discharge temp.) may trigger a shutdown before minimum speed is reached.
5. When starting VFD, motor speed must reach Min. Frequency with in 3-5 seconds
6. Rate Ramp (Acceleration Time) between Min Frequency and Max. Frequency should be set to 1 Hz/s. Also, the Deceleration Time between Max. and Min. should be set to 1 Hz/s
7. When the a stop command is supplied, the Motor should be set to "Coast-to-Stop", and must not restart until the motor has come to a completed stop. A stop command could also be an emergency stop, fault, or power failure.
8. VFD should be set to a Constant Torque Mode (Note: All motors have a 1.0 service factor when used with a VFD)

PROJECT SPECIFIC PARAMETERS	SETTING	PARAMETER No.[1]
Horsepower (kilowatt)	60 HP (45 kW)	
Voltage	460	
Full Load Amps (Motor Over Current)	71.6	
Maximum Frequency	60	
Minimum Frequency	20	
Time to Minimum Speed	3 - 5 sec.	
Ramp Rate	1 Hz / sec.	

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VFD SETTINGS

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	17-Mar-21	-

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VFD SETTINGS

Date	Revision #
17-Mar-21	-

REFERENCE INFORMATION

Document No. BC-6-0239 rev "O"

Sales Order No.	SO-20-00311	Equip. No.	MIX.BLW-4	VFD Manufacturer	-
Wiring Diagram	-	Machine	GM35S	VFD Model No.	-

GENERAL DESIGN REQUIREMENTS

1. Parameter Settings and Nos. will be included only in the case of the VFD being provided by AERZEN USA, otherwise this area can be used by customer for reference information regarding settings & parameter nos.
2. The highest voltage increase rate is 1200 V / micro second.
3. Install filter, output reactor if e.g. the cabling exceeds i.e. >200', etc.
4. Minimum Frequency is set to protect the blower from insufficient gear lubrication. Additional safety features (i.e. motor over-temp. or high discharge temp.) may trigger a shutdown before minimum speed is reached.
5. When starting VFD, motor speed must reach Min. Frequency with in 3-5 seconds
6. Rate Ramp (Acceleration Time) between Min Frequency and Max. Frequency should be set to 1 Hz/s. Also, the Deceleration Time between Max. and Min. should be set to 1 Hz/s
7. When the a stop command is supplied, the Motor should be set to "Coast-to-Stop", and must not restart until the motor has come to a completed stop. A stop command could also be an emergency stop, fault, or power failure.
8. VFD should be set to a Constant Torque Mode (Note: All motors have a 1.0 service factor when used with a VFD)

PROJECT SPECIFIC PARAMETERS	SETTING	PARAMETER No.[1]
Horsepower (kilowatt)	50 HP (37 kW)	
Voltage	460	
Full Load Amps (Motor Over Current)	59.2	
Maximum Frequency	60	
Minimum Frequency	24	
Time to Minimum Speed	3 - 5 sec.	
Ramp Rate	1 Hz / sec.	

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VFD SETTINGS

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	17-Mar-21	-

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VFD SETTINGS

Date	Revision #
17-Mar-21	-

REFERENCE INFORMATION

Document No. BC-6-0239 rev "O"

Sales Order No.	SO-20-00311	Equip. No.	MIX.BLW-3	VFD Manufacturer	-
Wiring Diagram	-	Machine	GM25S	VFD Model No.	-

GENERAL DESIGN REQUIREMENTS

1. Parameter Settings and Nos. will be included only in the case of the VFD being provided by AERZEN USA, otherwise this area can be used by customer for reference information regarding settings & parameter nos.
2. The highest voltage increase rate is 1200 V / micro second.
3. Install filter, output reactor if e.g. the cabling exceeds i.e. >200', etc.
4. Minimum Frequency is set to protect the blower from insufficient gear lubrication. Additional safety features (i.e. motor over-temp. or high discharge temp.) may trigger a shutdown before minimum speed is reached.
5. When starting VFD, motor speed must reach Min. Frequency with in 3-5 seconds
6. Rate Ramp (Acceleration Time) between Min Frequency and Max. Frequency should be set to 1 Hz/s. Also, the Deceleration Time between Max. and Min. should be set to 1 Hz/s
7. When the a stop command is supplied, the Motor should be set to "Coast-to-Stop", and must not restart until the motor has come to a completed stop. A stop command could also be an emergency stop, fault, or power failure.
8. VFD should be set to a Constant Torque Mode (Note: All motors have a 1.0 service factor when used with a VFD)

PROJECT SPECIFIC PARAMETERS	SETTING	PARAMETER No.[1]
Horsepower (kilowatt)	40 HP (30 kW)	
Voltage	460	
Full Load Amps (Motor Over Current)	47.1	
Maximum Frequency	60	
Minimum Frequency	20	
Time to Minimum Speed	3 - 5 sec.	
Ramp Rate	1 Hz / sec.	

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VFD SETTINGS

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website www.aerzen.com/en-us

VFD SETTINGS

Date	Revision #
17-Mar-21	-

REFERENCE INFORMATION

Document No. BC-6-0239 rev "O"

Sales Order No.	SO-20-00311	Equip. No.	SBR.BLW-1 to 3	VFD Manufacturer	-
Wiring Diagram	-	Machine	GM25S	VFD Model No.	-

GENERAL DESIGN REQUIREMENTS

1. Parameter Settings and Nos. will be included only in the case of the VFD being provided by AERZEN USA, otherwise this area can be used by customer for reference information regarding settings & parameter nos.
2. The highest voltage increase rate is 1200 V / micro second.
3. Install filter, output reactor if e.g. the cabling exceeds i.e. >200', etc.
4. Minimum Frequency is set to protect the blower from insufficient gear lubrication. Additional safety features (i.e. motor over-temp. or high discharge temp.) may trigger a shutdown before minimum speed is reached.
5. When starting VFD, motor speed must reach Min. Frequency with in 3-5 seconds
6. Rate Ramp (Acceleration Time) between Min Frequency and Max. Frequency should be set to 1 Hz/s. Also, the Deceleration Time between Max. and Min. should be set to 1 Hz/s
7. When the a stop command is supplied, the Motor should be set to "Coast-to-Stop", and must not restart until the motor has come to a completed stop. A stop command could also be an emergency stop, fault, or power failure.
8. VFD should be set to a Constant Torque Mode (Note: All motors have a 1.0 service factor when used with a VFD)

PROJECT SPECIFIC PARAMETERS	SETTING	PARAMETER No.[1]
Horsepower (kilowatt)	40 HP (30 kW)	
Voltage	460	
Full Load Amps (Motor Over Current)	47.1	
Maximum Frequency	60	
Minimum Frequency	39	
Time to Minimum Speed	3 - 5 sec.	
Ramp Rate	1 Hz / sec.	

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VFD SETTINGS

	Date	Revision #
	17-Mar-21	-

SECTION 6

Component Breakdown

Component	Material	Protection Method (Standard)	Quality Document (Standard)	Protection Method (Upgrade)	Quality Document (Upgrade)
Base/Silencer*	Carbon Steel	Painted Externally (Solvent Based)	QH-00408	SikaCor Zinc R	QH-00510
Belt Guard	Galvanized Sheet Metal	N/A	N/A	N/A	N/A
Belt Guard Supports	Galvanized Carbon Steel	N/A	N/A	N/A	N/A
Blower Stage	Cast Carbon Steel	Painted Externally (Water Based)	QH-00408	SikaCor Zinc R	QH-00510
Connecting Housing (DN50)	Cast Aluminum	N/A	N/A	N/A	N/A
Connecting Housing (DN80 - DN250)	Cast Iron	Powder Coated	QH-00552	SikaCor Zinc R	QH-00510
Fasteners - Bolts, Studs, Nuts	Carbon Steel	Zinc Coated	N/A	N/A	N/A
Flex Connector	Silicone	N/A	N/A	N/A	N/A
Hose Clamps	Carbon Steel	Zinc Coated	N/A	N/A	N/A
Inlet Filter/ Silencer Housing	Carbon Steel	Powder Coated	QH-00552	SikaCor Zinc R	A-6-450
Inlet Hose	Reinforced Rubber	N/A	N/A	N/A	N/A
Inlet Silencer	Carbon Steel	Powder Coated	QH-00552	SikaCor Zinc R	A-6-450
Motor Mounting Hardware	Galvanized Carbon Steel	N/A	N/A	N/A	N/A
Piping (Galvanized)	Galvanized Carbon Steel	N/A	N/A	N/A	N/A
Piping (Painted)	Carbon Steel	Painted Externally	QH-00408	SikaCor Zinc R	A-6-450
Pressure Safety/Vacuum Breaker Valves	Carbon Steel (Flange)	Painted Flange	QH-00408	N/A	N/A
Sound Enclosure - Base	Carbon Steel	Powder Coated	QH-00552	SikaCor Zinc R	QH-00510
Sound Enclosure	Galvanized Sheet Metal	Powder Coated	QH-00419	SikaCor Zinc R	QH-00510
Vent Silencer	Carbon Steel	Powder Coated	QH-00552	SikaCor Zinc R	A-6-450

*If made in the USA, Protection Method goes from Painted Externally to Powder Coated (A-6-450)

General Painting Information

The machine castings are fettled, cleaned and primed; the primer used is specially developed for machinery parts and is particularly notable for its excellent bonding characteristic and elasticity. Its base is a quick drying synthetic resin binder possessing a high degree of water resistance. The proportion of pigment to binder is such to ensure the best protection for the machines.
Total dry Film Thickness: 70 µm (2.75 mil)

Surface Preparation	Sand blasting, mechanical cleaning to near white surfaces per SA 2,5 acc. to DIN ISO 8501 or SSPC10	
Primer	Alkyd Resin: RAL 6006	Manufacturer: Relius Coatings
Final Coat	Alkyd Resin: RAL 5001 (Blue)	Manufacturer: Relius Coatings (BASF) or Dr. Demuth GmbH

General Powder Coating Information

SP Polyester Powder Paint, RAL 5001, structure, glossy
Relius No.: I536-5401
Total dry film thickness: 80 - 110µm

General Upgraded Protection Information

Surface Preparation	Sa 2 ½
Priming Coat	SikaCorEG4 (80µm max)
Intermediate Coat	SikaCorEG1 (80µm max)
Finishing Coat	SikaCorEG5 (80µm max)

SECTION 7

Aerzen USA Corporation
108 Independence Way
Coatesville, PA 19320
Ph: (610) 380-0244, Fx: (610) 380-0278
www.aerzen.com/en-us

Pre-Commissioning Checklist

	Document #	A-7-0288 rev "4"

The purpose of this pre-commissioning checklist is to ensure readiness to successfully commission your Aerzen packages. We will need some information from you in order to better prepare for the commissioning. We ask that your on-site representative complete and return this checklist to Aerzen USA at your earliest convenience.

We will also need to know if you have a target date in mind for our service technician to be on-site, and if the plant maintenance personnel will be on-site at that time to receive maintenance training. This training is normally hands-on in nature and should not take more than 1-2 hours. In addition to the pre-commissioning checklist, we will need an on-site contact and phone number for our service technician.

We will make every effort to meet your target date for commissioning. Please keep in mind that our start-up/commissioning schedule can run three to five weeks out. The earlier we know your target date the better chance we have of reserving your request on our schedule.

Please be aware that should the commissioning prerequisites not be completed prior to our arrival, Aerzen USA reserves the right to charge any and all responsible parties for additional time and travel expenses required to complete the commissioning service.

Below is a checklist of items requiring attention prior to our arrival. Please verify your understanding and completion of the prerequisites by initialing the check the boxes corresponding to each requirement. Please send this checklist to the Aerzen Service Coordinator once all the prerequisites have been verified

1	The Aerzen package has not been damaged during shipping and/or while on-site	☐
2	The Aerzen package is installed in permanent position, is level, properly grounded and anchored.	☐
3	The process pipework for the Aerzen package inlet and discharge is connected in its final position and independently supported (temporary supports are not acceptable	☐
4	Electrical connections have been completed for the motor using flexible conduit to allow the motor to be raised into its operational position.	☐
4A	The package safety switches (if applicable) are wired to the PLC or MCC (as applicable).	☐
4B	The Aerzen control panel (if applicable) is wired to the PLC or MCC (as applicable).	☐
4C	The correct voltage is fed to the control panel. Refer to the project specific wiring diagram for the voltage required	☐
4D	If there is a VFD or Soft-Starter and supplied by others, it has been configured with the following motor settings:	☐
4D-1	Horsepower (kilowatt)	☐
4D-2	Voltage	☐
4D-3	Maximum Frequency	☐

4D Continued

	4D-4	Minimum Frequency - based on minimum speed of the blower or compressor in conjunction with the sheave combination	☐
	4D-5	Full Load Amps	☐
	4D-6	Time to Minimum Speed (3-5 seconds)	☐
	4D-7	Coast to Stop (do not brake)	☐
	4D-8	**CONSTANT TORQUE (VERY IMPORTANT!!!)**	☐
	4D-9	Restart - only when the machine has come to a complete stop.	☐
5		Belts or coupling bolts removed for rotation test	☐
6		Verification that machine is filled to proper oil level with correct oil (if delivered without oil)	☐
7		Required personnel scheduled to attend startup (electrician, operators, maintenance personnel, etc)	☐
8		Proper paperwork completed to allow Aerzen technician on site	☐
9		If required, on-site safety training requirements for Aerzen personnel must be scheduled in advance. Please advise type, length and place of training).	☐

Company

Project Name or Number

Number of Packages to be commissioned

Representative completing this check-list

Date Completed

Date reqested for start-up

Aerzen USA Corporation
108 Independence Way
Coatesville, PA 19320
Ph.: (610) 380-0244, Fax: (610) 380-0278
WWW.AERZEN.COM/EN-US

Start-Up Report

Document # BCH-7-0353_02 rev "B"

1.0 Machine data	
Date:	
Customer:	
Service Technician:	
Order # / SEO #:	
Serial #:	
Type:	
Package Serial #:	
Oil Type:	
Equipment ID:	
Operating hours total-Start:	
Operating hours total-End:	

2.0 Motor Data				
Model #:		Serial #:		Notes:
Motor Manufacturer		Motor Frame		
Motor HP Rating		Full Load Amps		
Motor Voltage Rating		Hertz		
Motor RPM		Service Factor		
Motor cooling		Motor Protection Type	Thermistor / Thermostat	
Motor Protection	NO / NC	Motor Protection Resistance		

3.0 Starter Data		
Manufacturer		Notes:
Starter type - Direct/Soft/VFD		
Actual voltage to motor		
Soft Start ramp up time		
VFD Max. Frequency		
VFD Min. Frequency		
VFD Ramp up Speed/Time		
VFD set to constant torque		
VFD Brake Mode = Coast		

4.0 Inspections					
	OK	Not OK		OK	Not OK
Sound Enclosure Aesthetics			Motor rotates in proper direction		
Package is level			Verify all oil lines are tight		
Oil drain hose, jack and funnel present			Oil filter		
Unit is properly anchored			Oil demister		
Expansion joints/flex connectors			Oil drain plugs tight		
Verify package is grounded			Cooling fan clearance in shroud		
Process piping is properly supported			Motor conduit conforms to IA-004545 rev "B"		
Anti-vibration feet			Sheaves are properly installed, set screws tightened		
Inlet air filter in place, clean & housing tightened			Enclosure inlet and outlet are free from obstructions		
Blower room ventilation adequate			All fasteners are secure		
Instrument connections tight			Check process piping path to the termination point		
Neutral chamber venting			Validate process piping will not dead head at startup		
Vent all pressure and vacuum gauges			Validate any customer added safety devices		
Motor and machine rotate freely by hand			Discuss application with end user		

4.1 Notes / Not OK, reason why. Correction needed/taken.

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Start-Up Report

Document # BCH-7-0353_02 rev "B"

5.0 Belt Drive Applications

	OK	Not OK	Notes / Not OK, reason why. Correction needed/taken.
Verify motor alignment			
V belt installed and tensioned?			
Verify V belt has the proper length			

6.0 Direct Drive Applications

	OK	Not OK	Notes / Not OK, reason why. Correction needed/taken.
Coupling bolt			
Compression sleeves			
Coupling halves (properly distanced)			
Coupling Alignment			

7.0 Safety Settings and Verification

7.1 Safety chain - Switch Based

Switch	Unit	Switch Point	Gauge Reading	Shutdown Initiated	Notes:

7.2 Safety chain - Controller Based

Controller:	Unit	Alarm	Fault	Functional	Notes:

8.0 Startup

	OK	Not OK	Notes:
Smooth Start Up			
Lubricate drive motor per O&M			

9.0 Functional Testing

	OK	Not OK	Notes:			
Aeromat			Closing time=			
Aeropress			Closing time=			
Aerovac			Closing time=			
Unload/load device are in synch			Closing time=			
Unload/Load Solenoid operational						
All gauges and switches operational						
S.E. fan has correct rotation						
PRV manual release functional			Set point =			
After fault does unit remain off						
Non-return flap (check valve)						
System is leak free-oil						
System is leak free-air						
Smooth running						
Motor cooling properly						

10.0 Post Run Checks

	OK	Not OK	Notes:
Smooth Coast Down			
Oil Level Correct			
Sheave Alignment			
Bolt Tightness			

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Start-Up Report

Document # BCH-7-0353_02 rev "B"

11.0 Technical data

11.1 Operational Readings

Elapsed Run Time	0:00	0:00	0:00	0:00	0:00		Notes:
Pressures							
Temperatures							
Miscellaneous							

11.2 Motor Operational Readings

Elapsed Run Time	0:00	0:00	0:00	0:00	0:00		Notes:

11.3 Vibration Readings

Elapsed Run Time	0:00	0:00	0:00	0:00	0:00		Notes:	Readings are in:	
Motor Non-Drive Horizontal									
Motor Non-Drive Vertical									
Motor Non-Drive Axial									
Motor Drive Horizontal									
Motor Drive Vertical									
Motor Drive Axial									

12.0 Notes/Summary

Aerzen USA Corporation
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Inspection Report

Document # BCH-7-0353_03 rev "C"

1.0 Machine data	
Date:	
Customer:	
Service Technician:	
Order # / SEO #:	
Serial #:	
Type:	
Package Serial #:	
Oil Type:	
Equipment ID:	
Operating hours total-Start:	
Operating hours total-End:	

2.0 Motor Data				
Model #:		Serial #:		Notes:
Motor Manufacturer		Motor Frame		
Motor HP Rating		Full Load Amps		
Motor Voltage Rating		Hertz		
Motor RPM		Service Factor		
Motor cooling		Motor Protection Type	Thermistor / Thermostat	
Motor Protection	NO / NC	Motor Protection Resistance		

3.0 Starter Data		
Manufacturer		Notes:
Starter type - Direct/Soft/VFD		
Actual voltage to motor		
Soft Start ramp up time		
VFD Max. Frequency		
VFD Min. Frequency		
VFD Ramp up Speed/Time		
VFD set to constant torque		
VFD Brake Mode = Coast		

4.0 Inspections					
	OK	Not OK		OK	Not OK
Sound Enclosure Aesthetics			Motor rotates in proper direction		
Package is level			Verify all oil lines are tight		
Oil drain hose, jack and funnel present			Oil filter		
Unit is properly anchored			Oil demister		
Expansion joints/flex connectors			Oil drain plugs tight		
Verify package is grounded			Cooling fan clearance in shroud		
Process piping is properly supported			Motor conduit conforms to IA-004545 rev "B"		
Anti-vibration feet			Sheaves are properly installed, set screws tightened		
Inlet air filter in place, clean & housing tightened			Enclosure inlet and outlet are free from obstructions		
Blower room ventilation adequate			All fasteners are secure		
Instrument connections tight			Check process piping path to the termination point		
Neutral chamber venting			Validate process piping will not dead head at startup		
Vent all pressure and vacuum gauges			Validate any customer added safety devices		
Motor and machine rotate freely by hand			Discuss application with end user		

4.1 Notes / Not OK, reason why. Correction needed/taken.

5.0 Maintenance				
Item Replaced	Yes	No	Part # and Qty.	Notes:
Oil				
Belts				
Oil Filter				
Air Filter				
Coupling Pins				
Coupling Bushing				
Oil Sample Taken			Tracking #:	

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Inspection Report

Document # BCH-7-0353_03 rev "C"

6.0 Belt Drive Applications			
	OK	Not OK	Notes / Not OK, reason why. Correction needed/taken.
Verify motor alignment			
V belt installed and tensioned?			
Verify V belt has the proper length			

7.0 Direct Drive Applications			
	OK	Not OK	Notes / Not OK, reason why. Correction needed/taken.
Coupling bolt			
Compression sleeves			
Coupling halves (properly distanced)			
Coupling Alignment			

8.0 Safety Settings and Verification

8.1 Safety chain - Switch Based

Switch	Unit	Switch Point	Gauge Reading	Shutdown Initiated	Notes:

8.2 Safety chain - Controller Based

Controller:	Unit	Alarm	Fault	Functional	Notes:

9.0 Startup			
	OK	Not OK	Notes:
Smooth Start Up			
Lubricate drive motor per O&M			

10.0 Functional Testing						
	OK	Not OK	Notes:			
Aeromat			Closing time=			
Aeropress			Closing time=			
Aerovac			Closing time=			
Unload/load device are in synch			Closing time=			
Unload/Load Solenoid operational						
All gauges and switches operational						
S.E. fan has correct rotation						
PRV manual release functional			Set point =			
After fault does unit remain off						
Non-return flap (check valve)						
System is leak free-oil						
System is leak free-air						
Smooth running						
Motor cooling properly						

11.0 Post Run Checks			
	OK	Not OK	Notes:
Smooth Coast Down			
Oil Level Correct			
Sheave Alignment			
Bolt Tightness			

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Inspection Report

Document # BCH-7-0353_03 rev "C"

12.0 Technical data

12.1 Operational Readings

Elapsed Run Time	0:00	0:00	0:00	0:00	0:00		Notes:
Pressures							
Temperatures							
Miscellaneous							

12.2 Motor Operational Readings

Elapsed Run Time	0:00	0:00	0:00	0:00	0:00		Notes:

12.3 Vibration Readings

Elapsed Run Time	0:00	0:00	0:00	0:00	0:00		Notes:	Readings are in:	
Motor Non-Drive Horizontal									
Motor Non-Drive Vertical									
Motor Non-Drive Axial									
Motor Drive Horizontal									
Motor Drive Vertical									
Motor Drive Axial									

13.0 Notes/Summary

Aerzen USA Corporation
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Training Sign In

Document # BCH-7-0353_06 rev "C"

1.0 Customer

Date:	
Customer:	
End User:	
Site Address:	
Service Technician:	
Equipment Type:	
Equipment Serial Number:	
Order # / SEO #:	

2.0 Trainee's Signatures

	Print	Signature	Title
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

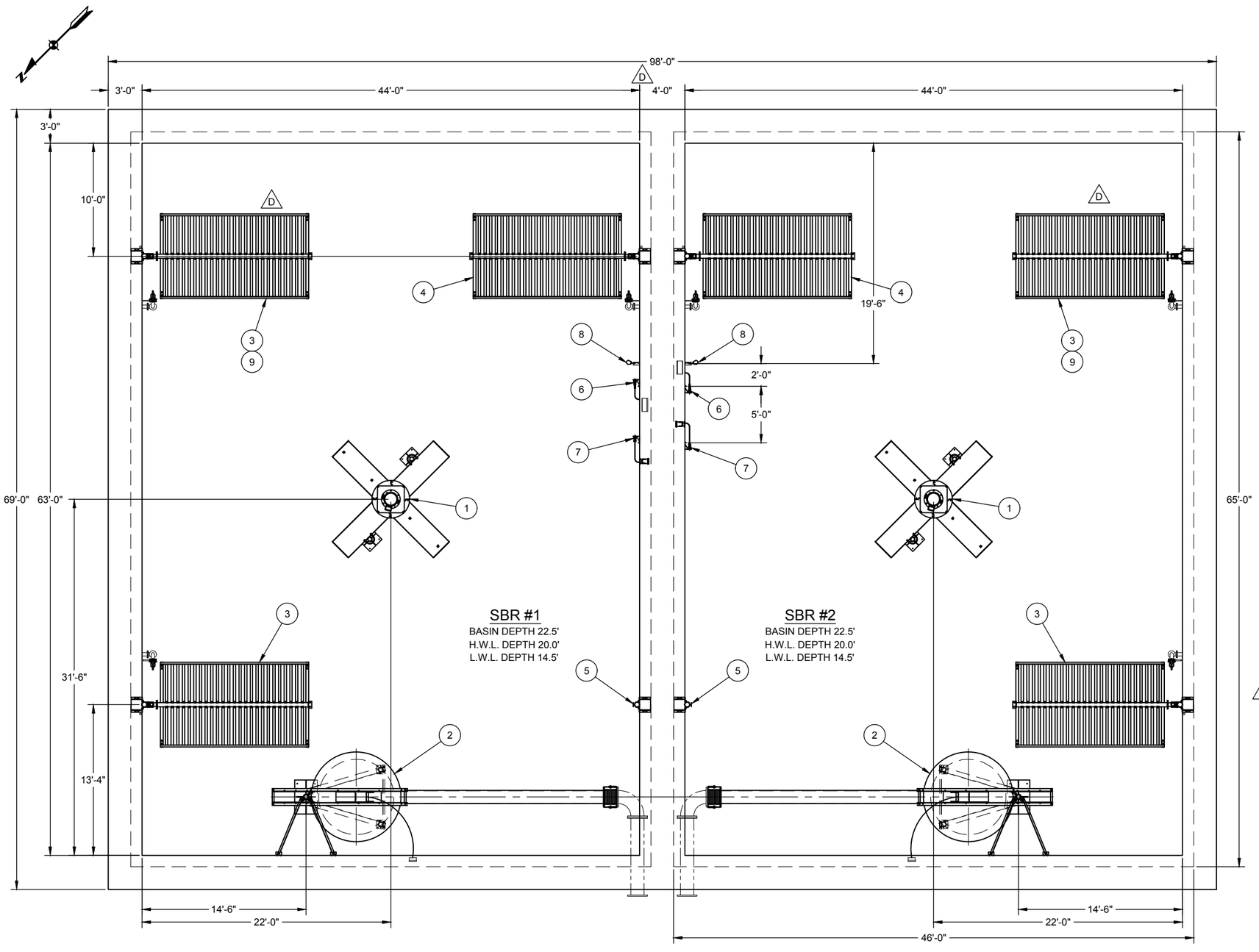
3.0 Training Topics

4.0 Signatures

Date	**Customer Name**	**Customer Signature**
Date	**FST Name**	**FST Signature**

SECTION 8

Placeholder for Seismic Calcs



GENERAL INSTALLATION NOTES:

1. PLEASE REVIEW ALL INDIVIDUAL INSTALLATION DRAWINGS FOR ACTUAL DETAILS. REFER TO ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. ALL THREADED FASTENERS MUST BE SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT (ITEM #10) IS REQUIRED ON ALL STAINLESS STEEL FASTENERS UNLESS OTHERWISE SPECIFIED.
4. ALL LOCAL ELECTRICAL DISCONNECTS / JUNCTION BOXES HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND LOCATED BY OTHERS.
5. ALL INFLUENT, EFFLUENT DECANT, AND SLUDGE WASTE PIPING HAS BEEN SHOWN FOR REFERENCE ONLY AND SHALL BE SUPPLIED AND INSTALLED BY OTHERS.
6. ALL WALKWAYS / PLATFORMS HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS.
7. ANY VALVE VAULTS, ELECTRICAL JUNCTION BOXES, OR PIPING ILLUSTRATED ON THESE DRAWINGS ARE SHOWN FOR REFERENCE ONLY. THESE ITEMS ARE NORMALLY SUPPLIED AND INSTALLED BY OTHERS, UNLESS SPECIFIED OTHERWISE.
8. VALVE AND LINE SIZES ARE TO BE VERIFIED BY THE ENGINEER BASED ON ACTUAL LINE LOSSES.
9. OVERFLOWS ARE RECOMMENDED WITHIN ALL BASINS.
10. IF FREEZING IS A CONCERN, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO HEAT TRACING AND INSULATION OF PUMPS, VALVES, AND PIPING AS WELL AS PROTECTION AGAINST INTERNAL TANK EQUIPMENT FREEZING SHALL BE SUPPLIED AND INSTALLED BY THE INSTALLING CONTRACTOR.
11. SBR CONTROL PANEL (ITEM #19) TO BE LOCATED AND INSTALLED BY OTHERS.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
19	1	9110167A30600	SBR CONTROL PANEL INSTALLATION NOTES	-	Y
18	1	9110167A30010	PURCHASED SPARE PARTS	-	-
17	1	9110167A30009	JOB SITE O&M MANUAL	-	-
16	2	2965501-1	NAMEPLATE INSTALLATION, AQUASBR	-	Y
15	1	2915768	PLIERS, SADDLE ASSEMBLY TOOL	STEEL	Y
14	1	2963762	WINCH ASSEMBLY, PORTABLE, ELEC w/8FT PWR CORD	-	Y
13	3	2614084	ADHESIVE MIXING NOZZLES (SIMPSON)	-	-
12	4	2619921	ADHESIVE CARTRIDGE, SIMPSON SET-3G	-	-
11	1	2614083	ADHESIVE DISPENSING GUN (SIMPSON)	-	-
10	1	2610904	LOK CEASE 20/20 ANTI-SEIZE LUBRICANT	-	-
9	2	9110167A30011	FINE BUBBLE DIFFUSER BLOW-OFF TUBE INSTL	-	Y
8	2	9110167A30008	HIGH LEVEL ALARM FLOAT SWITCH INSTALLATION	-	Y
7	2	9110167A30007	DO PROBE INSTALLATION, FIXED	304 SS	Y
6	2	9110167A30006	PRESSURE TRANSDUCER INSTALLATION, FIXED	304 SS	Y
5	2	9110167A30005	DIFFUSER INSTL, FB, RTRV, 316 SS, OH	316 SS	Y
4	2	9110167A30004	DIFFUSER INSTL, FB, RTRV, 316 SS, 25T, OH	316 SS	Y
3	4	9110167A30003	DIFFUSER INSTL, FB, RTRV, 316 SS, 25T, OH	316 SS	Y
2	2	9110167A30002	DECANTER INSTL, GALV, 8X7/14"	MILD STEEL	Y
1	2	9110167A30001	MIXER INSTL, 2-POST, GALV, 10 HP	MILD STEEL	Y

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL
JOB LOCATION: ORLEANS, MA

AQUA-AEROBIC SYSTEMS, INC.
A Matawater Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2020-11-30	SAH	SUBMITTAL
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION
C	C20751	2021-05-25	SAH	ITEM 19 WAS 9110167A30700
D	C20977	2021-10-05	SAH	WALKWAY WAS 3', MOVED DIFFUSERS

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SAH
DATE: 2020-11-30
WEIGHT:
SHEET: 1 OF 3

DRAWING NAME: GENERAL LIST & PLANT LAYOUT
DRAWING NUMBER: 9110167A30000
SCALE: 1/60
SIZE: D

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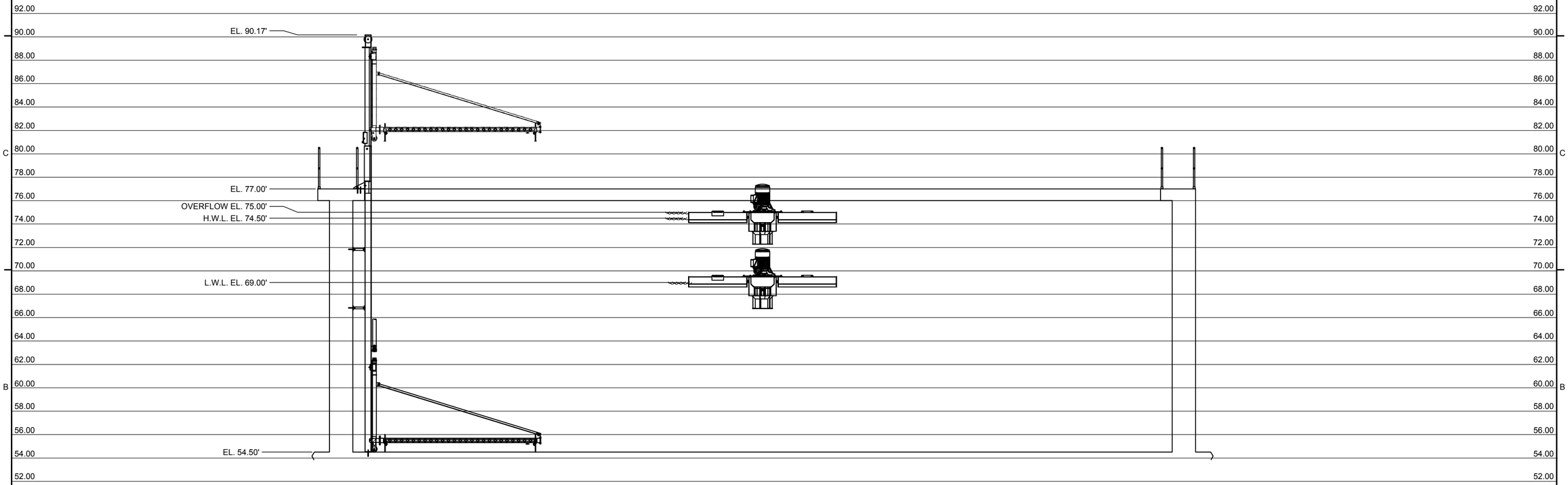

SBR BASINS

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL					AQUA-AEROBIC SYSTEMS, INC. A Matsusaki Company
JOB LOCATION: ORLEANS, MA					DO NOT SCALE DRAWING
					UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES. FRACTIONAL DIMENSIONS +/- 1/16; ALL TWO PLACE DECIMALS +/- 0.010; ALL THREE PLACE DECIMALS +/- 0.005; ALL ANGLES +/- 1/2". ANSI
A		2020-11-30	SAH	SUBMITTAL	MATERIAL:
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION	SIMILAR TO:
C	C20751	2021-05-25	SAH	ITEM 19 WAS 9110167A30700	TYPE:
D	C20977	2021-10-05	SAH	WALKWAY WAS 3', MOVED DIFFUSERS	DRAWN BY: SAH; DATE: 2020-11-30
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	WEIGHT: ; SHEET: 2 OF 3
DRAWING NAME: GENERAL LIST & PLANT LAYOUT					DRAWING NUMBER: 9110167A30000; SCALE: 1/48; SIZE: D

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GENERAL PROJECT NOTES

A. VERIFICATION OF ALL DIMENSIONS GIVEN AND WATER LEVELS DETAILED ON THESE DRAWINGS TO ENSURE ACCURATE FABRICATION OF EQUIPMENT IS BY OTHERS.

B. UNLESS IDENTIFIED ON A DRAWING BILL OF MATERIAL, ALL PIPING, SUPPORTS, GASKETS, HARDWARE, ELECTRICAL WIRING AND SUPPLY POWER BEYOND AQUA-AEROBIC SYSTEMS, INC. EQUIPMENT TERMINATIONS ILLUSTRATED ON THESE DRAWINGS IS SHOWN FOR REFERENCE ONLY. SIZING, LOCATION AND SUPPLY ARE TO BE DETERMINED BY OTHERS.

C. SOME GASKETS SUPPLIED WITH THIS EQUIPMENT MAY BE MADE OF STYRENE BUTADIENE / "RED RUBBER", URETHANE, OR EPDM. VERIFICATION THAT THESE MATERIALS ARE COMPATIBLE WITH THE CHEMICALS THAT WILL BE PRESENT IN THIS APPLICATION ARE BY OTHERS.

D. MOUNTING HARDWARE FOR THE CONTROL PANEL WILL BE PROVIDED BY OTHERS. FIELD INSTALLATION OF FLOOR AND/OR WALL MOUNTED CONTROL PANELS IS THE RESPONSIBILITY OF OTHERS.

E. DIMENSIONS ON THESE DRAWINGS ARE FINAL UNLESS CHANGED IN WRITING BY OTHERS. SPECIFIC NOTATION MUST BE SHOWN IN RED INK TO CHANGE ANY DIMENSIONS, COMPONENT PARTS, OR EQUIPMENT DETAILS. UNLESS CHANGES ARE SHOWN HEREON, AQUA-AEROBIC SYSTEMS, INC. SHALL NOT BE RESPONSIBLE FOR COSTS REQUIRED TO MODIFY OR CHANGE ITEMS AS A RESULT OF UNMARKED CHANGES OR CHANGES AFTER REVIEW. MANUFACTURED PRODUCTS WILL BE SHIPPED AS DIMENSIONED AND DESCRIBED WITHIN THIS MANUAL.

F. AQUA-AEROBIC SYSTEMS, INC. DOES NOT ASSUME THE RESPONSIBILITY OF COORDINATING THE CIVIL, MECHANICAL, OR DESIGN ENGINEERING THAT MAY BE REQUIRED.

G. IF FREEZING IS A CONCERN, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO HEAT TRACING AND INSULATION OF PUMPS, VALVES, AND PIPING AS WELL AS PROTECTION AGAINST INTERNAL TANK EQUIPMENT FREEZING SHALL BE SUPPLIED AND INSTALLED BY OTHERS.

H. REFER TO SECTION 1 OF THE OPERATION & MAINTENANCE MANUAL FOR A COMPLETE LIST OF RECOMMENDED SPARE PARTS OR THOSE PROVIDED FOR THIS PROJECT.

I. NO SPECIAL TOOLS ARE REQUIRED FOR NORMAL INSTALLATION OR ROUTINE MAINTENANCE OF EQUIPMENT TO BE FURNISHED.

J. COMPLETE FACTORY ASSEMBLY AND INSTALLATION DRAWINGS WITH PARTS LIST WILL BE PROVIDED WITHIN EACH OPERATION & MAINTENANCE MANUAL. OPERATION & MAINTENANCE MANUALS WILL BE MAILED PRIOR TO SHIPMENT OF EQUIPMENT. REVIEW ALL FACTORY ASSEMBLY AND INSTALLATION DRAWINGS PRIOR TO COMMENCING FINAL ASSEMBLY.

K. WHEN RECEIVING EQUIPMENT AND CRATES, THE SHIPMENT SHOULD BE COMPLETELY CHECKED TO VERIFY THAT NO TRANSIT DAMAGE HAS OCCURRED. ALL EQUIPMENT AND ACCESSORIES (IF ANY) MUST BE VERIFIED AGAINST THE PACKING LIST AND BILL OF LADING TO ASSURE PROPER CONTENTS.

L. UNLESS OTHERWISE SPECIFIED, ALL WALKWAYS, PLATFORMS, STAIRWAYS, HANDRAILING, ETC. HAVE BEEN SHOWN FOR REFERENCE ONLY AND ARE TO BE SUPPLIED AND INSTALLED BY OTHERS. AQUA-AEROBIC SYSTEMS, INC. IS NOT RESPONSIBLE FOR VERIFYING CLEARANCE WITH EQUIPMENT SUPPLIED BY OTHERS.

M. ADHESIVE ANCHORS ARE PROVIDED FOR ANCHORING EQUIPMENT TO THE BASIN FLOOR AND/OR WALLS. ANCHOR INSTALLATION AND FIELD ATTACHMENT OF EQUIPMENT TO THE BASIN IS THE RESPONSIBILITY OF OTHERS.

N. ANTI-SEIZE LUBRICANT IS REQUIRED ON ALL STAINLESS STEEL FASTENERS.

SBR PROJECT NOTES

A. AN OPENING IN THE HANDRAILING MUST BE PROVIDED FOR CLEARANCE OF THE DIFFUSER TRACK BEAM. ANY OBSTRUCTION SUCH AS LIGHT POLES, DISCONNECT BOXES, ETC. MUST BE OUTSIDE OF THE DIFFUSER RACK PIVOT RADIUS.

B. MOORING / SUPPORT POSTS PROVIDED BY AQUA-AEROBIC SYSTEMS, INC. MUST BE FILLED WITH CONCRETE BY OTHERS.

C. IF BASINS WITH SLOPED FLOORS ARE UTILIZED, SUPPLY OF MINIMUM 4000 PSI TYPE GROUT PADS BENEATH THE PROPOSED EQUIPMENT (SUCH AS BASE PLATES, BRACKETS, MOORING POSTS, DIFFUSER SUPPORTS / RACKS, ETC.) ARE REQUIRED TO PROVIDE FOR A LEVEL INSTALLATION ELEVATION FOR THE EQUIPMENT. GROUT PADS ARE TO BE PROVIDED BY OTHERS.

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL
JOB LOCATION: ORLEANS, MA

AQUA-AEROBIC SYSTEMS, INC.
A Matsusaka Company

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2020-11-30	SAH	SUBMITTAL
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION
C	C20751	2021-05-25	SAH	ITEM 19 WAS 9110167A30700
D	C20977	2021-10-05	SAH	WALKWAY WAS 3'; MOVED DIFFUSERS

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SAH
DATE: 2020-11-30
WEIGHT:
SHEET: 3 OF 3

DRAWING NAME: GENERAL LIST & PLANT LAYOUT
DRAWING NUMBER: 9110167A30000
SCALE: 1:1
SIZE: D

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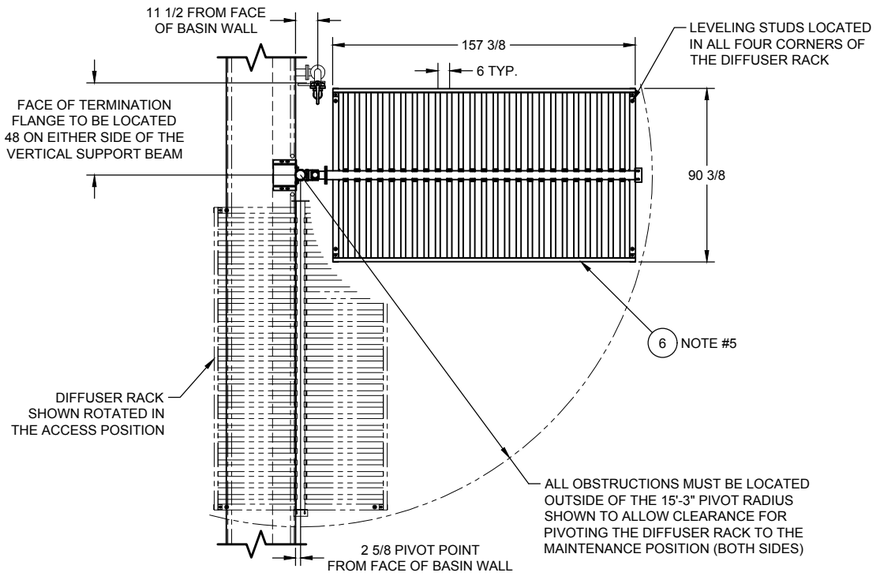


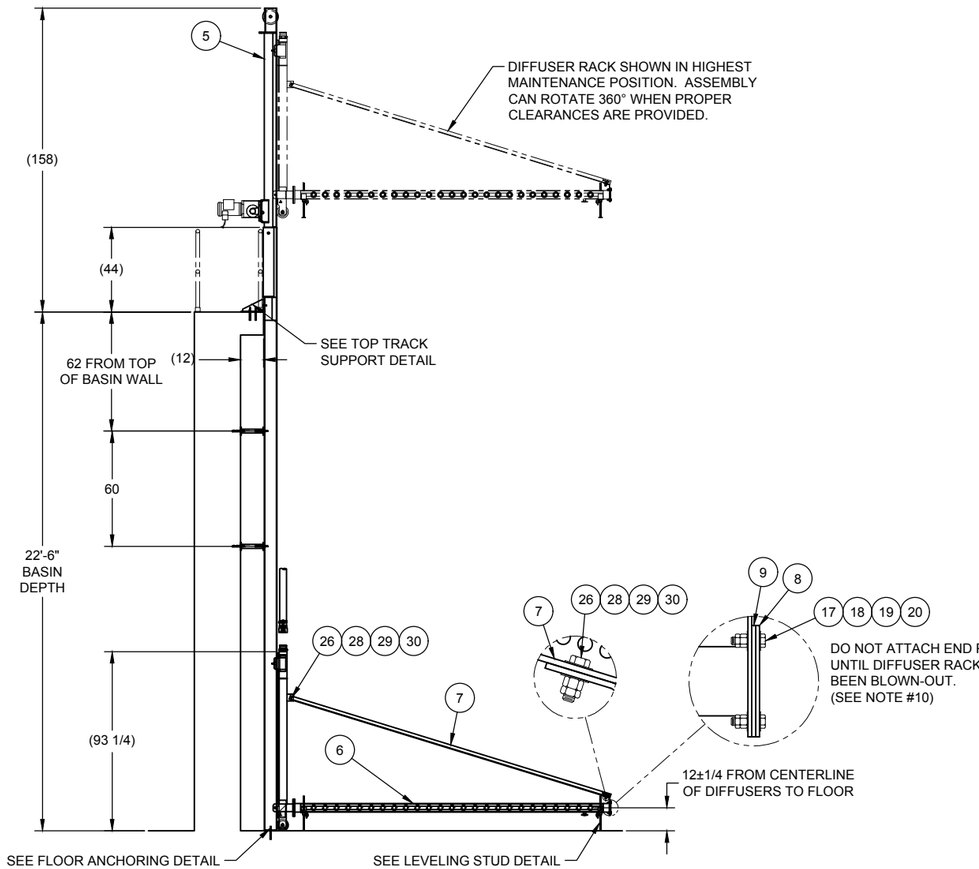
RETRIEVABLE DIFFUSER COMPONENTS

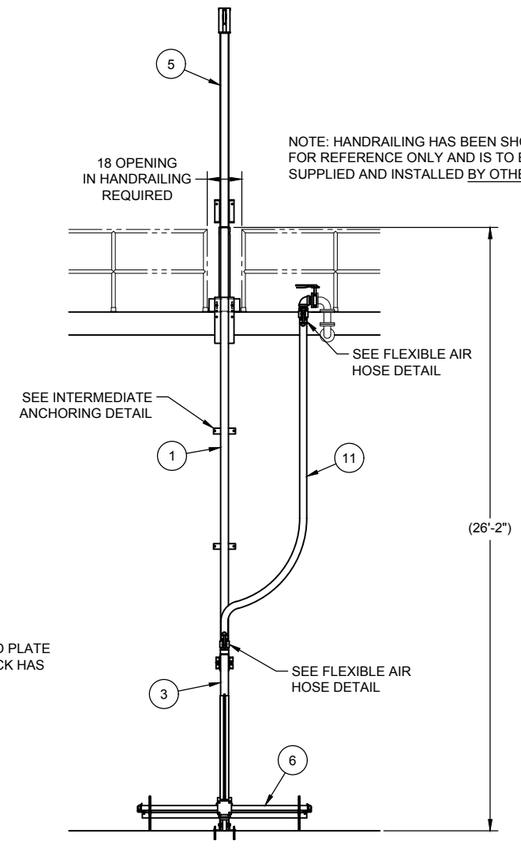
NOTE: THE RETRIEVABLE DIFFUSER INSTALLATION IS SUPPLIED AS FOUR (4) MAJOR COMPONENTS FOR FIELD ASSEMBLY/INSTALLATION BY OTHERS. SMALL COMPONENTS SUCH AS THE DIFFUSERS, LEVELING STUDS, BRACE ANGLES, AND MISCELLANEOUS HARDWARE ARE SHIPPED IN BOXES.

1. LIFTING MECHANISM ASSEMBLY 280 LBS.
2. VERTICAL AIR COLUMN ASSEMBLY 130 LBS.
3. VERTICAL SUPPORT BEAM WELDMENT 408 LBS.
4. DIFFUSER RACK ASSEMBLY 418 LBS.
5. MISCELLANEOUS ITEMS 140 LBS.
   (BRACE ANGLES AND MISCELLANEOUS HARDWARE)

RETRIEVABLE FINE BUBBLE DIFFUSER INSTALLATION NOTES:

1. PLEASE REVIEW ALL INSTALLATION AND ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS USED BE STAINLESS STEEL AND SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT IS RECOMMENDED ON ALL STAINLESS STEEL FASTENERS.
4. SET EACH VERTICAL SUPPORT BEAM INTO POSITION AND ATTACH TO BASIN WALL. THE VERTICAL SUPPORT BEAM MUST BE HELD VERTICAL AND PLUMB ± 1/4". ASSEMBLE THE LIFTING CABLE FROM THE VERTICAL AIR COLUMN OVER THE TOP SHEAVE OF THE LIFTING MECHANISM ASSEMBLY, THROUGH THE CABLE GUIDE, AND ATTACH TO DRUM OF WINCH. WITH A CRANE, LIFT AND SLIDE THE VERTICAL AIR COLUMN BEHIND THE FRONT FLANGE ON THE TRACK BEAM. CAUTION MUST BE OBSERVED TO PREVENT KINKING THE LIFTING CABLE. SLIDE THE VERTICAL AIR COLUMN DOWN THE TRACK BEAM UNTIL THE GUIDE WHEEL RESTS ON THE BASIN FLOOR. COIL THE REMAINING CABLE TOGETHER AND ATTACH TO THE WINCH BRACKET ON THE LIFTING MECHANISM ASSEMBLY.
5. ASSEMBLE THE DIFFUSER RACK ON THE BASIN FLOOR PER THE DIFFUSER RACK INSTALLATION DRAWING (ITEM #6) PROVIDED IN THE OPERATION AND MAINTENANCE MANUAL. ATTACH THE DIFFUSER RACK TO THE VERTICAL AIR COLUMN USING GASKETS, HARDWARE, AND BRACE ANGLES PROVIDED.
6. ALL DIFFUSER RACKS IN THE BASIN MUST BE HELD LEVEL TO EACH OTHER WITHIN ± 1/4" TO MAINTAIN UNIFORM AIR DISTRIBUTION.
7. ALL PIPING AND HARDWARE BEYOND THE ISOLATION VALVE (ITEM #10) IS SHOWN FOR REFERENCE ONLY AND IS TO SUPPLIED AND INSTALLED BY OTHERS.
8. REFER TO THE GENERAL LIST FOR DIFFUSER RACK LOCATIONS.
9. THE FINE BUBBLE DIFFUSER BLOW-OFF TUBE INSTALLATION IS LOCATED ON THE GENERAL LIST DRAWING. INSTALL IT AT THE LOCATION INDICATED ON THE GENERAL LIST, WHICH WILL BE ON THE RACK FARTHEST FROM THE DECANTER.
10. THE ENTIRE BASIN AIR MANIFOLD AND DIFFUSER RACK MUST HAVE ALL DEBRIS BLOWN OUT OF THE LINES PRIOR TO ATTACHING THE DIFFUSER HOSE ASSEMBLY. CAUTION MUST BE OBSERVED TO PREVENT DEBRIS FROM ENTERING INTO THE DIFFUSER RACK AND DIFFUSER TUBES. ONCE THE MANIFOLD PIPING HAS BEEN BLOWN OUT / CLEANED, ATTACH THE AIR HOSE TO THE VERTICAL AIR COLUMN AND REPEAT THIS OPERATION TO BLOW-OUT THE REMAINING DIFFUSER BANKS. ONCE COMPLETED THROUGHOUT THE ENTIRE BASIN, ATTACH THE END PLATE (ITEM #8) AND GASKET (ITEM #9) TO THE END OF THE DIFFUSER RACK. THIS OPERATION MUST BE DOCUMENTED AND / OR WITNESSED PRIOR TO START-UP OR LEAK TESTING OF THE DIFFUSER RACKS.





NOTE: ITEM #2 IS A SURPLUS SPARE, IF NEEDED, FOR CONSTRUCTION PURPOSES.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
33	2	2914940-13-6X0	INTERMEDIATE SUPPORT BRACKET WELDMENT, 12" LG	316 SS	Y
32	3	2606360	SAFETY WIRE, .050 DIA	316 SS	-
31	1	2912038	LOCKING PIN 316S B	316 SS	Y
30	18	2600426	WASHER, FLAT, 1/2" X 1 1/4"	316 SS	-
29	9	2600234	NUT, HEX, JAM, 1/2-13	316 SS	-
28	9	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
27	10	9110167A30102-2	KIT, ADHV ANCR, 1/2", SET-3G ADHESIVE	316 SS	Y
26	9	2600348	HHCS, 1/2-13 X 2"	316 SS	-
25	16	2602498	WASHER, FLAT, 5/8" X 1 1/4"	316 SS	-
24	8	2600302	NUT, HEX, JAM, 5/8-11	316 SS	-
23	8	2600301	NUT, HEX, FULL, 5/8-11	316 SS	-
22	8	2600344	HHCS, 5/8-11 X 2.75"	316 SS	-
21	1	2607946	GASKET, 4", EPDM W/HOLES	EPDM	-
20	8	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
19	4	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
18	4	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
17	4	2600421	HHCS, 3/8-16 X 1.5"	316 SS	-
16	4	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
15	1	2614247	ELBOW 90DEG 3"150# 316SS THD	316 SS	Y
14	1	2614246	NIPPLE 3" S40 X CLOSE, 316SS	316 SS	Y
13	1	2607619	FLANGE 3"150# 316S THD	316 SS	Y
12	1	2603742	CAM GROOVE, 3", MALE CAM X MALE NPT	NYLON	-
11	1	2606006-18	HOSE 3" X 17'0"LG	EPDM	Y
10	1	9110167A30302	VALVE, BFLY, 3", ABZ SERIES 709, LVR	-	-
9	1	2510003	GASKET, END PLATE	EPDM	Y
8	1	2510859	END PLATE(OTT DFSR) 316L 4# B	316L SS	Y
7	2	2513310	BRACE ANGLE 2'x2"x175" 316SS B	316 SS	Y
6	1	2966794-6X0	DIFFUSER RACK INSTL, 25-TUBE F/B, SSI	316 SS	Y
5	1	2964946	PUL ASY,UP VRT BM,316SS, 150" B	316 SS	Y
4	1	2915126-6X0	TOP TRACK SUPPORT WLDMT	316 SS	Y
3	1	2966800-50-6X0	VERTICAL AIR COLUMN ASSEMBLY, SSI	316 SS	Y
2	1	2966768	MEMBRANE REPLACEMENT KIT, SSI	-	-
1	1	2915019-17-6X0	VERT SUPT BEAM, OH, 316 SS, 26' 2" LG	316 SS	Y

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL
JOB LOCATION: ORLEANS, MA

AQUA-AEROBIC SYSTEMS, INC. A Matawater Company

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FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-DIFFUSER-92
TYPE:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2020-11-19	SAH	SUBMITTAL
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION

DRAWN BY: SAH DATE: 2020-11-19
WEIGHT: SHEET: 1 OF 2

DRAWING NAME: DIFFUSER INSTL, FB, RTRV, 316 SS, 25T, OH
DRAWING NUMBER: 9110167A30003
SCALE: 1/40 SIZE: D

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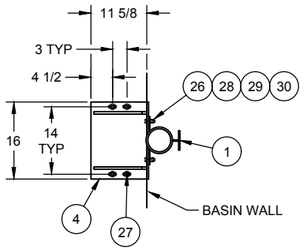
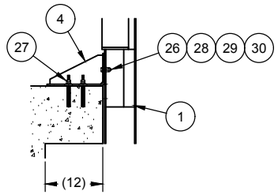
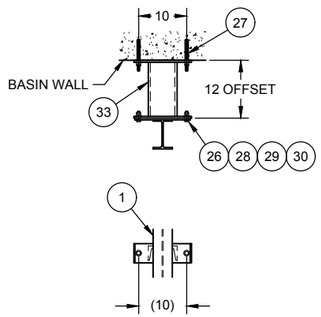
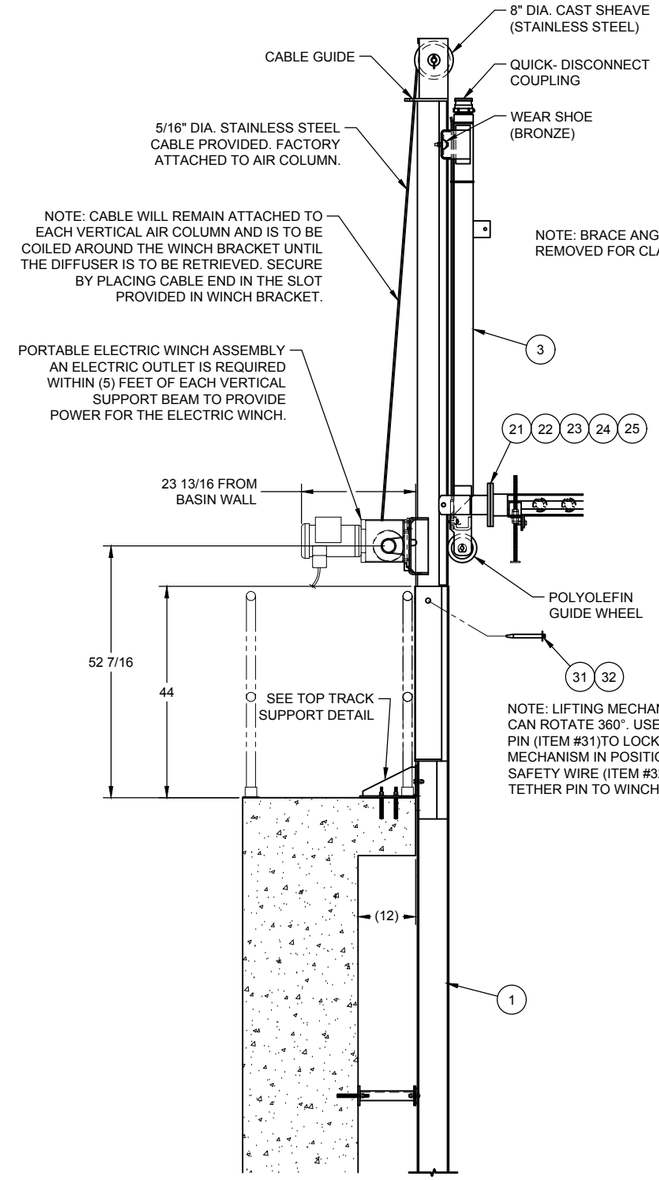




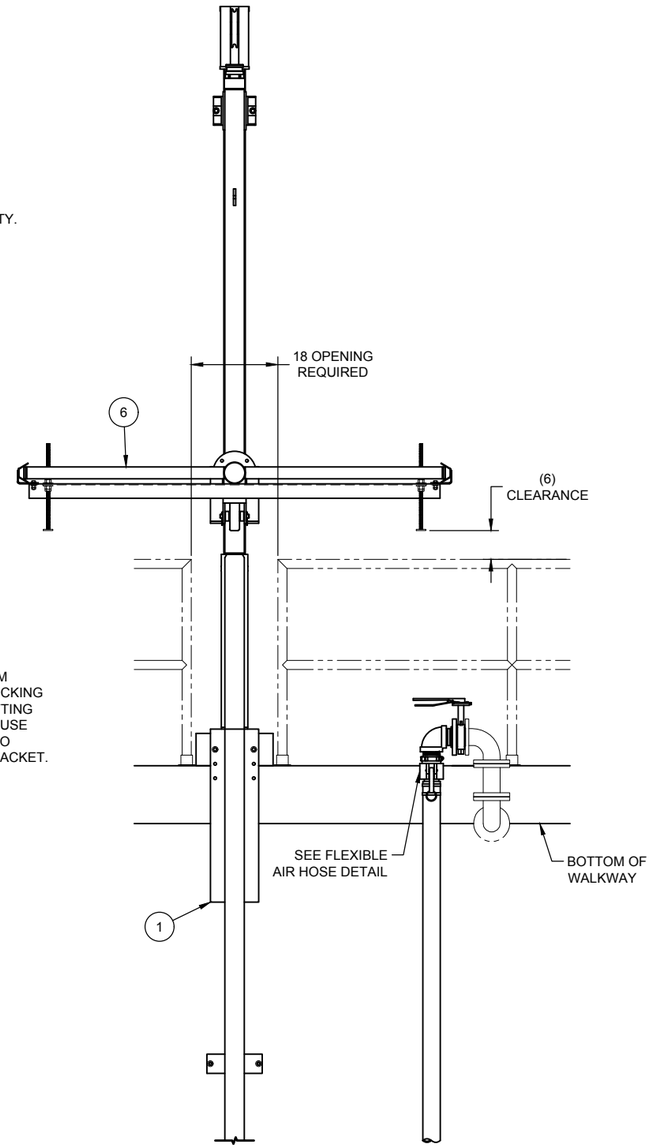
TOP TRACK SUPPORT DETAIL



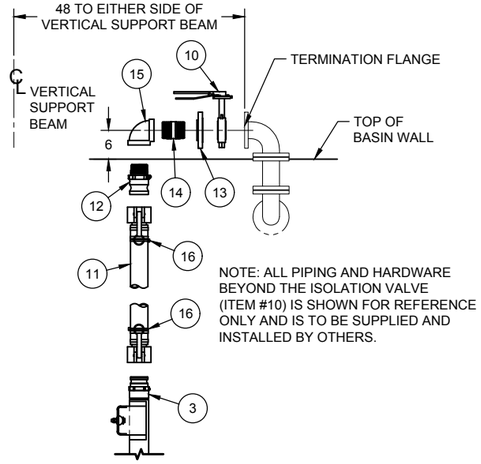
INTERMEDIATE SUPPORT BRACKET DETAIL



NOTE: LIFTING MECHANISM
CAN ROTATE 360°. USE LOCKING
PIN (ITEM #31)TO LOCK LIFTING
MECHANISM IN POSITION. USE
SAFETY WIRE (ITEM #32) TO
TETHER PIN TO WINCH BRACKET.



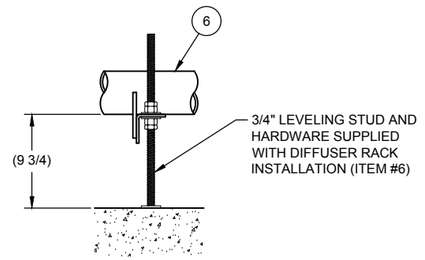
LIFTING MECHANISM DETAIL



NOTE: ALL PIPING AND HARDWARE BEYOND THE ISOLATION VALVE (ITEM #10) IS SHOWN FOR REFERENCE ONLY AND IS TO BE SUPPLIED AND INSTALLED BY OTHERS.

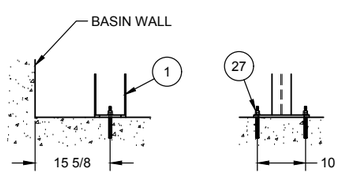
FLEXIBLE AIR HOSE DETAIL

NOTE: CLOSE CAM-LOCK LEVER ARMS, INSERT LOCKING PINS,AND TY-WRAP AROUND HOSE (BOTH ENDS). INSPECT THE GASKET INSIDE OF THE CAM-LOCK FITTING PRIOR TO ASSEMBLY. GASKET MAY FALL OUT DUE TO HANDLING. EACH FITTING MUST HAVE GASKET TO PREVENT LEAKS.



LEVELING STUD DETAIL

NOTE: REFER TO DIFFUSER RACK INSTALLATION DRAWING FOR COMPLETE ASSEMBLY INSTRUCTIONS AND DETAILS.



FLOOR ANCHORING DETAIL

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL					
JOB LOCATION: ORLEANS, MA					
A		2020-11-19	SAH	SUBMITTAL	
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION	
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

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ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-DIFFUSER-92
TYPE:
DRAWN BY: SAH DATE: 2020-11-19
WEIGHT: SHEET: 2 OF 2
DRAWING NAME: DIFFUSER INSTL, FB, RTRV, 316 SS, 25T, OH
DRAWING NUMBER: 9110167A30003
SCALE: 1:16 SIZE: D

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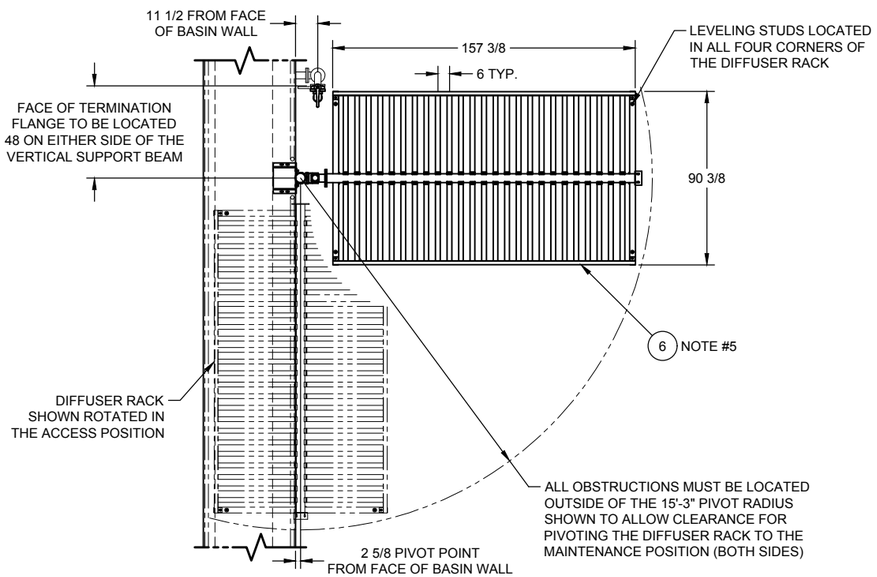

RETRIEVABLE DIFFUSER COMPONENTS

NOTE: THE RETRIEVABLE DIFFUSER INSTALLATION IS SUPPLIED AS FOUR (4) MAJOR COMPONENTS FOR FIELD ASSEMBLY/INSTALLATION BY OTHERS. SMALL COMPONENTS SUCH AS THE DIFFUSERS, LEVELING STUDS, BRACE ANGLES, AND MISCELLANEOUS HARDWARE ARE SHIPPED IN BOXES.

1. LIFTING MECHANISM ASSEMBLY 280 LBS.
2. VERTICAL AIR COLUMN ASSEMBLY 130 LBS.
3. VERTICAL SUPPORT BEAM WELDMENT 408 LBS.
4. DIFFUSER RACK ASSEMBLY 418 LBS.
5. MISCELLANEOUS ITEMS 140 LBS.
   (BRACE ANGLES AND MISCELLANEOUS HARDWARE)

RETRIEVABLE FINE BUBBLE DIFFUSER INSTALLATION NOTES:

1. PLEASE REVIEW ALL INSTALLATION AND ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS USED BE STAINLESS STEEL AND SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT IS RECOMMENDED ON ALL STAINLESS STEEL FASTENERS.
4. SET EACH VERTICAL SUPPORT BEAM INTO POSITION AND ATTACH TO BASIN WALL. THE VERTICAL SUPPORT BEAM MUST BE HELD VERTICAL AND PLUMB ± 1/4". ASSEMBLE THE LIFTING CABLE FROM THE VERTICAL AIR COLUMN OVER THE TOP SHEAVE OF THE LIFTING MECHANISM ASSEMBLY, THROUGH THE CABLE GUIDE, AND ATTACH TO DRUM OF WINCH. WITH A CRANE, LIFT AND SLIDE THE VERTICAL AIR COLUMN BEHIND THE FRONT FLANGE ON THE TRACK BEAM. CAUTION MUST BE OBSERVED TO PREVENT KINKING THE LIFTING CABLE. SLIDE THE VERTICAL AIR COLUMN DOWN THE TRACK BEAM UNTIL THE GUIDE WHEEL RESTS ON THE BASIN FLOOR. COIL THE REMAINING CABLE TOGETHER AND ATTACH TO THE WINCH BRACKET ON THE LIFTING MECHANISM ASSEMBLY.
5. ASSEMBLE THE DIFFUSER RACK ON THE BASIN FLOOR PER THE DIFFUSER RACK INSTALLATION DRAWING (ITEM #6) PROVIDED IN THE OPERATION AND MAINTENANCE MANUAL. ATTACH THE DIFFUSER RACK TO THE VERTICAL AIR COLUMN USING GASKETS, HARDWARE, AND BRACE ANGLES PROVIDED.
6. ALL DIFFUSER RACKS IN THE BASIN MUST BE HELD LEVEL TO EACH OTHER WITHIN ± 1/4" TO MAINTAIN UNIFORM AIR DISTRIBUTION.
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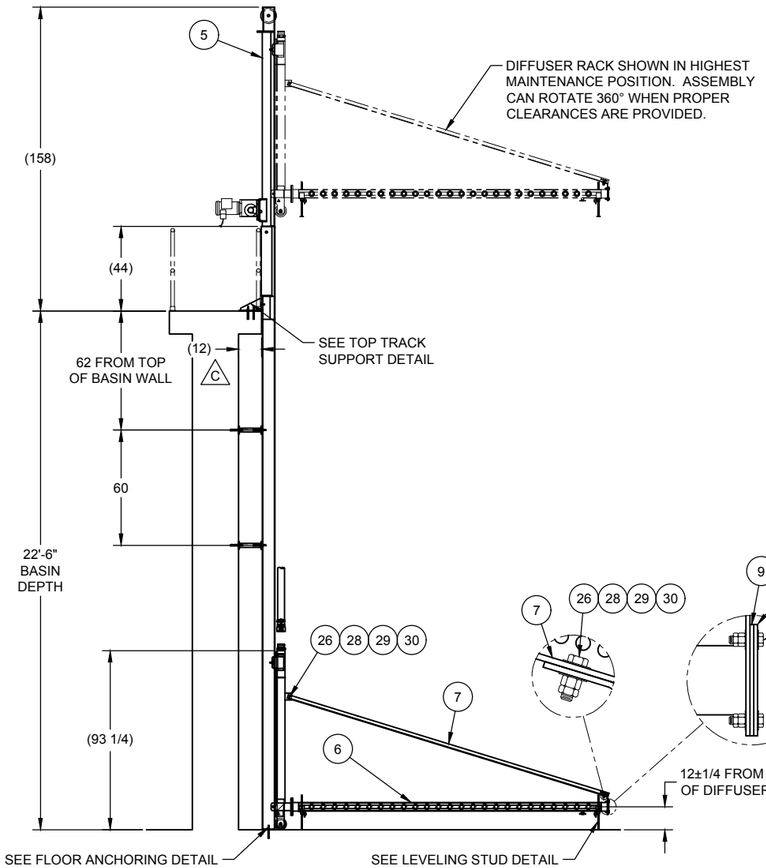
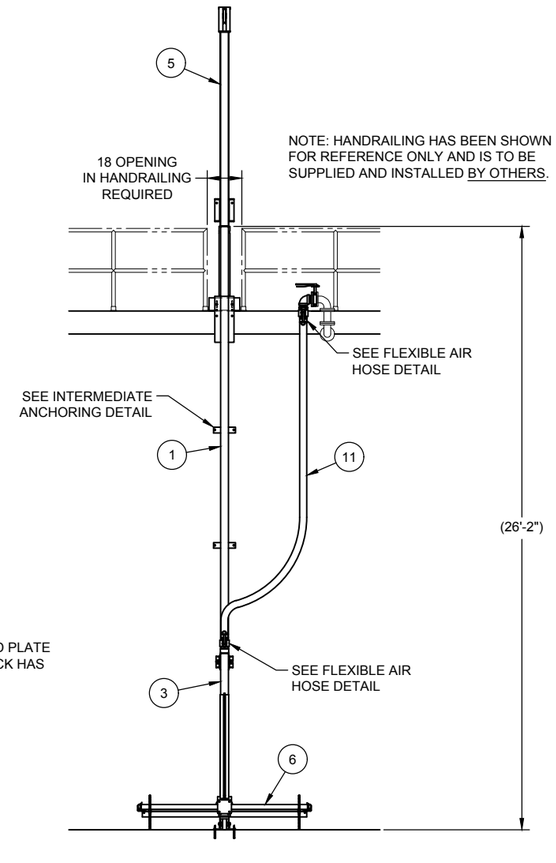
10. THE ENTIRE BASIN AIR MANIFOLD AND DIFFUSER RACK MUST HAVE ALL DEBRIS BLOWN OUT OF THE LINES PRIOR TO ATTACHING THE DIFFUSER HOSE ASSEMBLY. CAUTION MUST BE OBSERVED TO PREVENT DEBRIS FROM ENTERING INTO THE DIFFUSER RACK AND DIFFUSER TUBES. ONCE THE MANIFOLD PIPING HAS BEEN BLOWN OUT / CLEANED, ATTACH THE AIR HOSE TO THE VERTICAL AIR COLUMN AND REPEAT THIS OPERATION TO BLOW-OUT THE REMAINING DIFFUSER BANKS. ONCE COMPLETED THROUGHOUT THE ENTIRE BASIN, ATTACH THE END PLATE (ITEM #8) AND GASKET (ITEM #9) TO THE END OF THE DIFFUSER RACK. THIS OPERATION MUST BE DOCUMENTED AND / OR WITNESSED PRIOR TO START-UP OR LEAK TESTING OF THE DIFFUSER RACKS.





NOTE: ITEM #2 IS A SURPLUS SPARE, IF NEEDED, FOR CONSTRUCTION PURPOSES.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
33	2	2914940-13-6X0	INTERMEDIATE SUPPORT BRACKET WELDMENT, 12" LG	316 SS	Y
32	3	2606360	SAFETY WIRE, .050 DIA	316 SS	-
31	1	2912038	LOCKING PIN 316S B	316 SS	Y
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29	9	2600234	NUT, HEX, JAM, 1/2-13	316 SS	-
28	9	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
27	10	9110167A30102-2	KIT, ADHV ANCR, 1/2", SET-3G ADHESIVE	316 SS	Y
26	9	2600348	HHCS, 1/2-13 X 2"	316 SS	-
25	16	2602498	WASHER, FLAT, 5/8" X 1 1/4"	316 SS	-
24	8	2600302	NUT, HEX, JAM, 5/8-11	316 SS	-
23	8	2600301	NUT, HEX, FULL, 5/8-11	316 SS	-
22	8	2600344	HHCS, 5/8-11 X 2.75"	316 SS	-
21	1	2607946	GASKET, 4", EPDM W/HOLES	EPDM	-
20	8	2600381	WASHER, FLAT, 3/8" X 1" X .042"	316 SS	-
19	4	2600403	NUT, HEX, JAM, 3/8-16	316 SS	-
18	4	2600481	NUT, HEX, FULL, 3/8-16	316 SS	-
17	4	2600421	HHCS, 3/8-16 X 1.5"	316 SS	-
16	4	2600286	TY-WRAP/CABLE TIE 4" MAX DIA	NYLON	-
15	1	2614247	ELBOW 90DEG 3"150# 316SS THD	316 SS	Y
14	1	2614246	NIPPLE 3" S40 X CLOSE, 316SS	316 SS	Y
13	1	2607619	FLANGE 3"150# 316S THD	316 SS	Y
12	1	2603742	CAM GROOVE, 3", MALE CAM X MALE NPT	NYLON	-
11	1	2606006-18	HOSE 3" X 17'0"LG	EPDM	Y
10	1	9110167A30302	VALVE, BFLY, 3", ABZ SERIES 709, LVR	-	-
9	1	2510003	GASKET, END PLATE	EPDM	Y
8	1	2510859	END PLATE(OTT DFSR) 316L 4# B	316L SS	Y
7	2	2513310	BRACE ANGLE 2"x2"x175" 316SS B	316 SS	Y
6	1	2966794-6X0	DIFFUSER RACK INSTL, 25-TUBE F/B, SSI	316 SS	Y
5	1	2964946	PUL ASY,UP VRT BM,316SS, 150" B	316 SS	Y
4	1	2915126-6X0	TOP TRACK SUPPORT WLDMT	316 SS	Y
3	1	2966800-50-6X0	VERTICAL AIR COLUMN ASSEMBLY, SSI	316 SS	Y
2	1	2966768	MEMBRANE REPLACEMENT KIT, SSI	-	-
1	1	2915019-17-6X0	VERT SUPT BEAM, OH, 316 SS, 26' 2" LG	316 SS	Y

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL
JOB LOCATION: ORLEANS, MA

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DO NOT SCALE DRAWING

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FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-DIFFUSER-92
TYPE:
DRAWN BY: SAH DATE: 2020-11-19
WEIGHT: SHEET: 1 OF 2

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2020-11-19	SAH	SUBMITTAL
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION
C	C20977	2021-10-05	SAH	OVERHANG WAS 6"; ITEM 33 WAS 2614940-01

DRAWING NAME: DIFFUSER INSTL, FB, RTRV, 316 SS, 25T, OH
DRAWING NUMBER: 9110167A30004
SCALE: 1/40
SIZE: D

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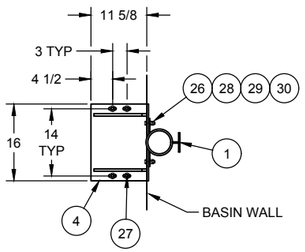
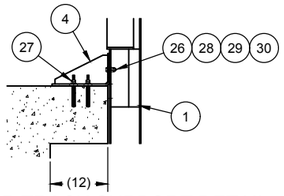
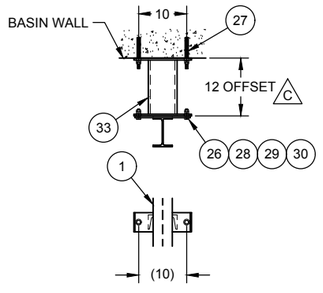
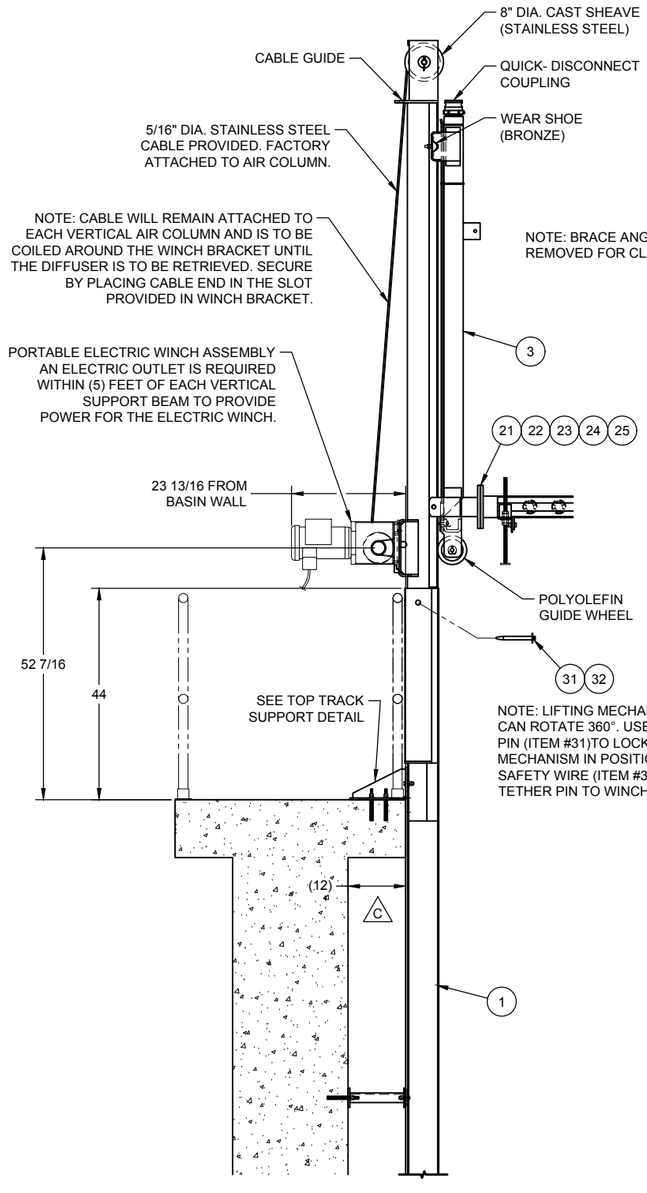


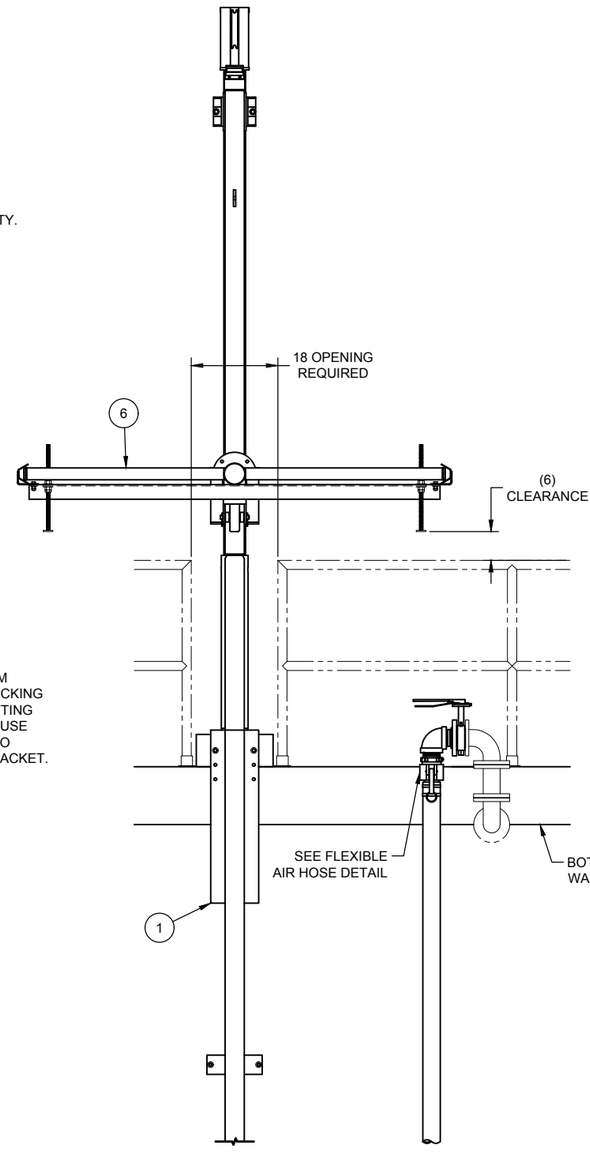


TOP TRACK SUPPORT DETAIL

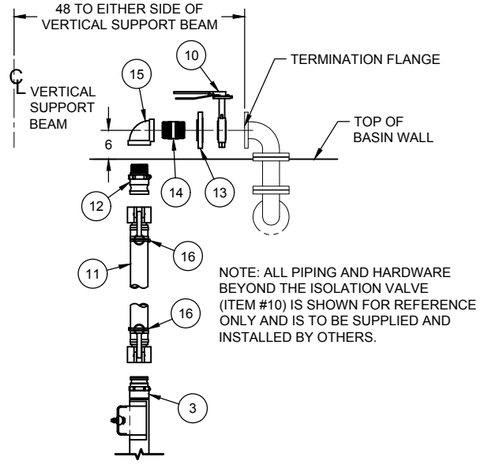


INTERMEDIATE SUPPORT BRACKET DETAIL





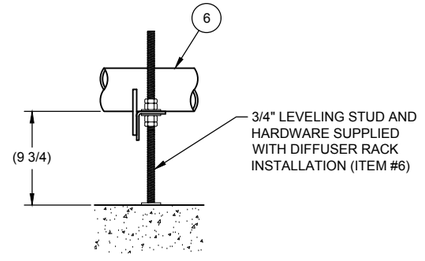
LIFTING MECHANISM DETAIL



NOTE: ALL PIPING AND HARDWARE BEYOND THE ISOLATION VALVE (ITEM #10) IS SHOWN FOR REFERENCE ONLY AND IS TO BE SUPPLIED AND INSTALLED BY OTHERS.

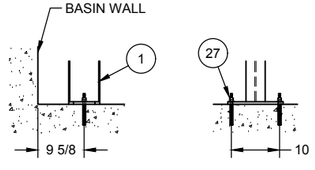
FLEXIBLE AIR HOSE DETAIL

NOTE: CLOSE CAM-LOCK LEVER ARMS, INSERT LOCKING PINS,AND TY-WRAP AROUND HOSE (BOTH ENDS). INSPECT THE GASKET INSIDE OF THE CAM-LOCK FITTING PRIOR TO ASSEMBLY. GASKET MAY FALL OUT DUE TO HANDLING. EACH FITTING MUST HAVE GASKET TO PREVENT LEAKS.



LEVELING STUD DETAIL

NOTE: REFER TO DIFFUSER RACK INSTALLATION DRAWING FOR COMPLETE ASSEMBLY INSTRUCTIONS AND DETAILS.



FLOOR ANCHORING DETAIL

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL					
JOB LOCATION: ORLEANS, MA					
A		2020-11-19	SAH	SUBMITTAL	
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION	
C	C20977	2021-10-05	SAH	OVERHANG WAS 6"; ITEM 33 WAS 2614940-01	
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	

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A Matasadar Company

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ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-DIFFUSER-92
TYPE:
DRAWN BY: SAH
DATE: 2020-11-19
WEIGHT:
SHEET: 2 OF 2

DRAWING NAME: DIFFUSER INSTL, FB, RTRV, 316 SS, 25T, OH
DRAWING NUMBER: 9110167A30004
SCALE: 1:16
SIZE: D

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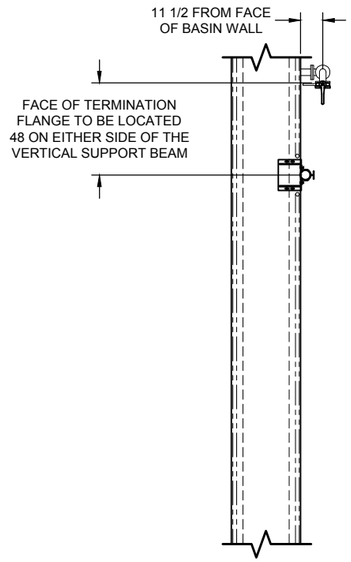


RETRIEVABLE DIFFUSER COMPONENTS

NOTE: THE RETRIEVABLE DIFFUSER INSTALLATION IS SUPPLIED AS FOUR (4) MAJOR COMPONENTS FOR FIELD ASSEMBLY/INSTALLATION BY OTHERS. SMALL COMPONENTS SUCH AS THE DIFFUSERS, LEVELING STUDS, BRACE ANGLES, AND MISCELLANEOUS HARDWARE ARE SHIPPED IN BOXES.

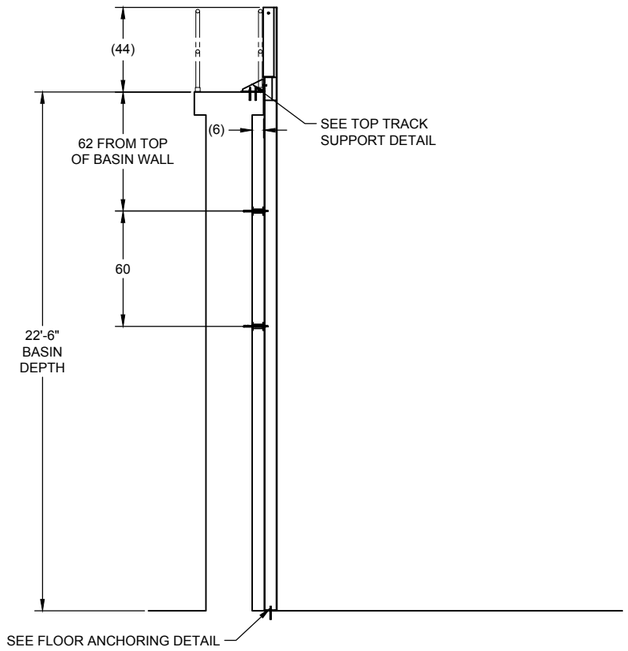
(ONLY VERTICAL SUPPORT BEAM SUPPLIED AT THIS TIME)

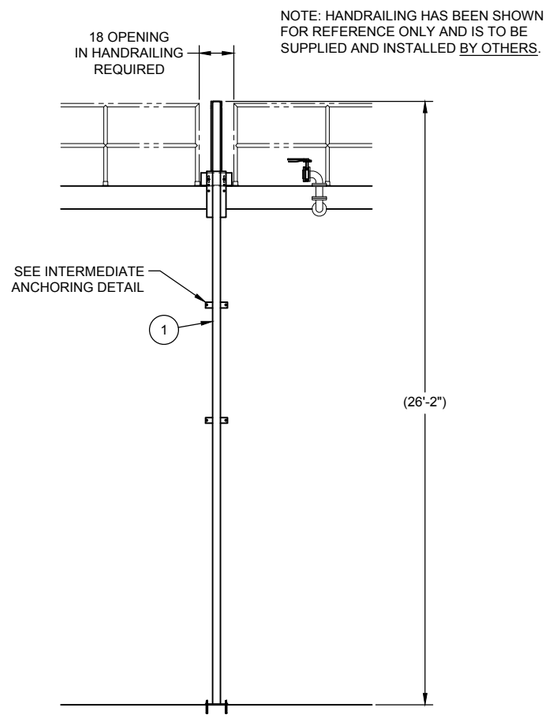
1. VERTICAL SUPPORT BEAM WELDMENT 408 LBS.

RETRIEVABLE FINE BUBBLE DIFFUSER INSTALLATION NOTES:

1. PLEASE REVIEW ALL INSTALLATION AND ASSEMBLY INSTRUCTIONS IN THE OPERATION AND MAINTENANCE MANUAL PRIOR TO INSTALLING THE EQUIPMENT.
2. IT IS RECOMMENDED THAT ALL THREADED FASTENERS USED BE STAINLESS STEEL AND SECURED WITH A FULL NUT AND A JAM NUT.
3. ANTI-SEIZE LUBRICANT IS RECOMMENDED ON ALL STAINLESS STEEL FASTENERS.
4. SET EACH VERTICAL SUPPORT BEAM INTO POSITION AND ATTACH TO BASIN WALL. THE VERTICAL SUPPORT BEAM MUST BE HELD VERTICAL AND PLUMB ± 1/4".
5. ALL PIPING AND HARDWARE BEYOND THE ISOLATION VALVE (ITEM #10) IS SHOWN FOR REFERENCE ONLY AND IS TO SUPPLIED AND INSTALLED BY OTHERS.
6. REFER TO THE GENERAL LIST FOR DIFFUSER RACK LOCATIONS.
7. THE FINE BUBBLE DIFFUSER BLOW-OFF TUBE INSTALLATION IS LOCATED ON THE GENERAL LIST DRAWING. INSTALL IT AT THE LOCATION INDICATED ON THE GENERAL LIST, WHICH WILL BE ON THE RACK FARTHEST FROM THE DECANTER.

NOTE: EMPTY SPACES IN THE BILL OF MATERIAL WILL BE FILLED WHEN THE DIFFUSER INSTALLATION IS COMPLETE.





ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
33	2	2914940-01-6X0	INTERMEDIATE SUPPORT BRACKET WELDMENT, 6" LG	316 SS	Y
32					
31					
30	18	2600426	WASHER, FLAT, 1/2" X 1 1/4"	316 SS	-
29	9	2600234	NUT, HEX, JAM, 1/2-13	316 SS	-
28	9	2600517	NUT, HEX, FULL, 1/2-13	316 SS	-
27	10	9110167A30102-2	KIT, ADHV ANCR, 1/2", SET-3G ADHESIVE	316 SS	Y
26	9	2600348	HHCS, 1/2-13 X 2"	316 SS	-
25					
24					
23					
22					
21					
20					
19					
18					
17					
16					
15					
14					
13					
12					
11					
10	1	9110167A30302	VALVE, BFLY, 3", ABZ SERIES 709, LVR	-	-
9					
8					
7					
6					
5					
4	1	2915126-6X0	TOP TRACK SUPPORT WLDMT	316 SS	Y
3					
2					
1	1	2915019-17-6X0	VERT SUPT BEAM, OH, 316 SS, 26' 2" LG	316 SS	Y

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL
JOB LOCATION: ORLEANS, MA

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A Metawater Company

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2020-11-19	SAH	SUBMITTAL
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION

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ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-DIFFUSER-92
TYPE:
DRAWN BY: SAH
DATE: 2020-11-19
WEIGHT:
SHEET: 1 OF 2

DRAWING NAME: DIFFUSER INSTL, FB, RTRV, 316 SS, OH
DRAWING NUMBER: 9110167A30005
SCALE: 1/40
SIZE: D

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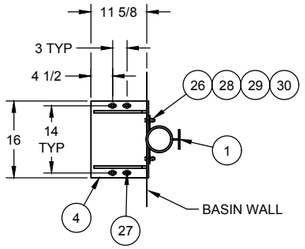
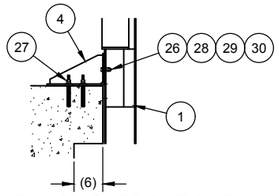
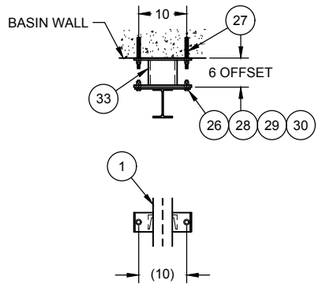
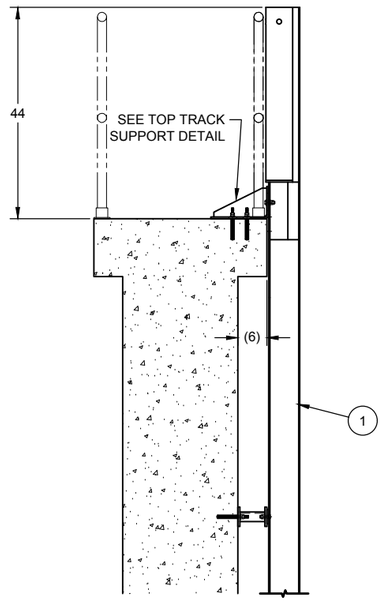


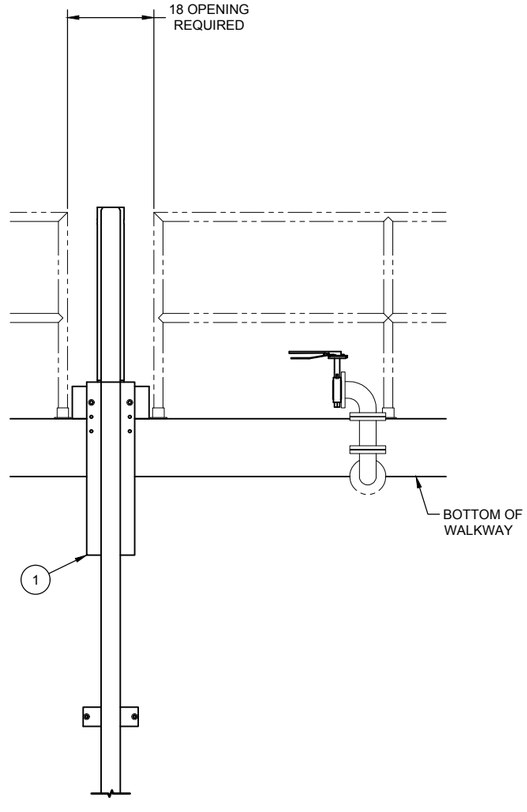


TOP TRACK SUPPORT DETAIL

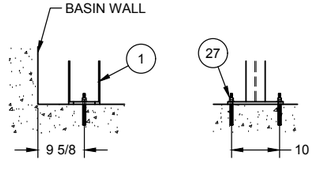


INTERMEDIATE SUPPORT BRACKET DETAIL

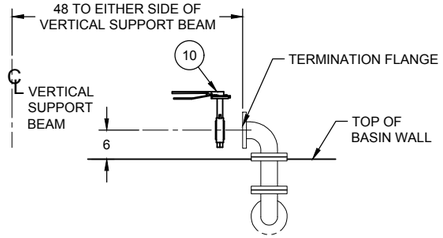




LIFTING MECHANISM DETAIL



FLOOR ANCHORING DETAIL



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FLEXIBLE AIR HOSE DETAIL

NOTE: CLOSE CAM-LOCK LEVER ARMS, INSERT LOCKING PINS,AND TY-WRAP AROUND HOSE (BOTH ENDS). INSPECT THE GASKET INSIDE OF THE CAM-LOCK FITTING PRIOR TO ASSEMBLY. GASKET MAY FALL OUT DUE TO HANDLING. EACH FITTING MUST HAVE GASKET TO PREVENT LEAKS.

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2020-11-19	SAH	SUBMITTAL
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JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL
JOB LOCATION: ORLEANS, MA

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ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: M-DIFFUSER-92
TYPE:
DRAWN BY: SAH
DATE: 2020-11-19
WEIGHT:
SHEET: 2 OF 2

DRAWING NAME: DIFFUSER INSTL, FB, RTRV, 316 SS, OH
DRAWING NUMBER: 9110167A30005
SCALE: 1/16
SIZE: D

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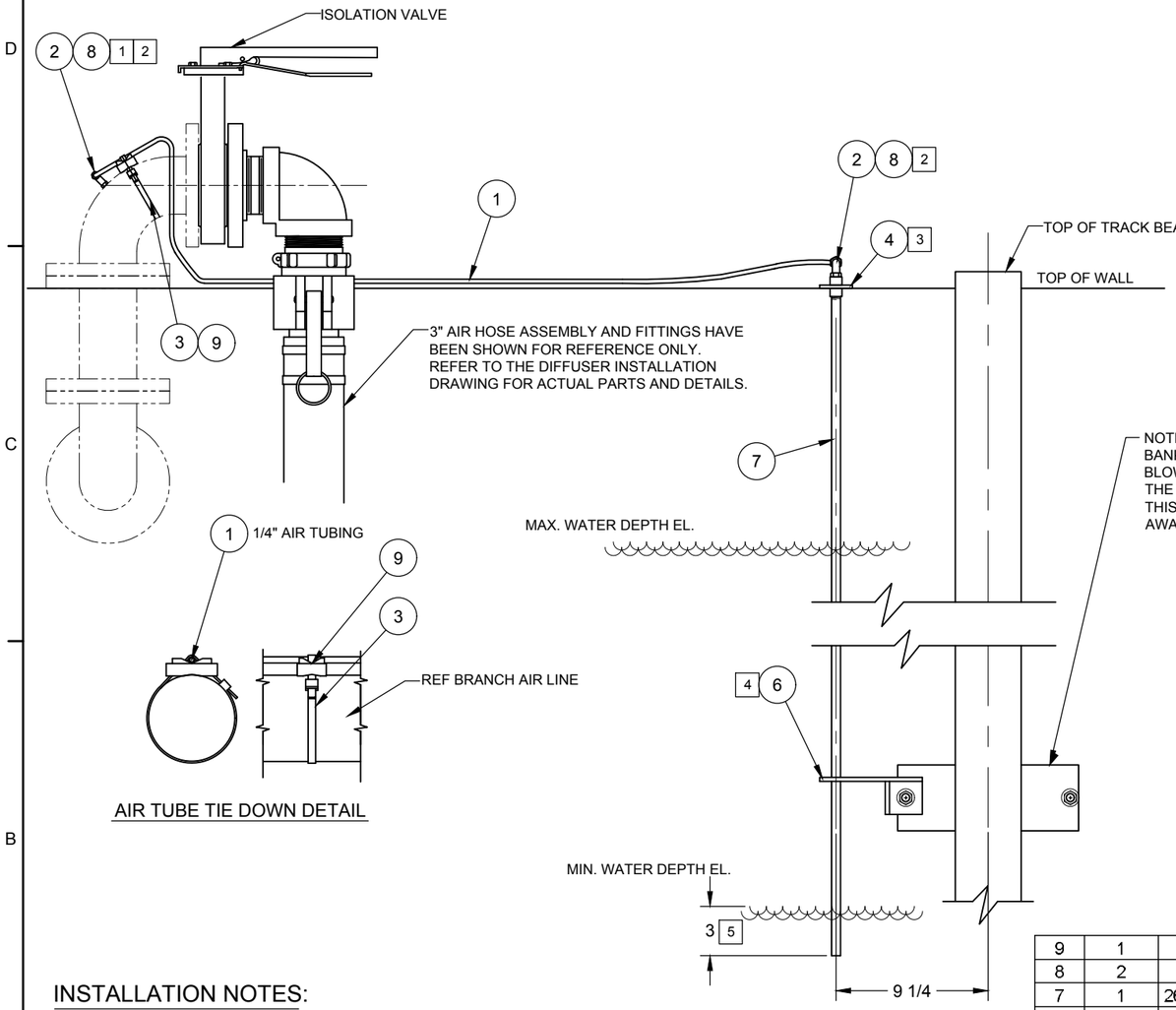
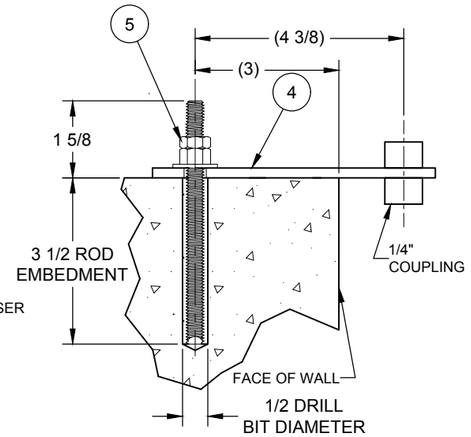


AIR TUBE TIE DOWN DETAIL



3/8" ADHESIVE ANCHOR DETAIL

REFER TO INSTALLATION INSTRUCTIONS DETAILED ON ADHESIVE ANCHOR KIT DRAWING

FIELD ASSEMBLE THE TOP SUPPORT BRACKET OVER THE ANCHOR ROD AND THEN INSTALL THE WASHER, FULL NUT AND JAM NUT AS SHOWN.
(TYPICAL INSTALLATION FOR ALL ADHESIVE TYPE ANCHORS)

INSTALLATION NOTES:

1. FIELD DRILL AND TAP A 1/4"-18 NPT PIPE THREAD, INTO THE TOP CENTERLINE OF 3" BRANCH AIR LINE. TAP MUST BE UPSTREAM OF ISOLATION VALVE AS DETAILED. REMOVE SHAVINGS.
2. SEAL THREADS OF MALE ELBOW AND THREAD INTO TAP, POSITIONING ELBOW FOR EASY INSTALLATION OF 1/4" AIR LINE. INSTALL AIR LINE ALONG TOP OF BASIN WALL AND OVER TO SIDE OF THE VERTICAL SUPPORT BEAM.
3. FIELD ANCHOR TOP SUPPORT BRACKET AS DETAILED. SEAL THREADS OF 90° MALE ELBOW AND INSTALL WITHIN COUPLING. CUT TUBING TO LENGTH REQUIRED AND SECURE TO MALE ELBOW.
4. FIELD ATTACH BOTTOM BRACKET ONTO THE 1/2" ANCHOR BOLT OF THE VERTICAL SUPPORT BEAM MOUNTING PLATE AS DETAILED. TIGHTEN AND SECURE BOTH 1/2" FULL NUT AND JAM NUT SO MOUNTING HOLE OF BOTTOM BRACKET IS LEVEL AND ALIGNED WITH COUPLING OF TOP SUPPORT. SLIP 1/4" BLOW-OFF PIPE THROUGH HOLE OF BOTTOM BRACKET AND THREAD INTO BOTTOM OF SUPPORT BRACKET COUPLING .
5. MARK A CUTTING LINE ON THE 1/4" PIPE AS DIMENSIONED (3" BELOW MIN. WATER DEPTH) THEN DIS-ASSEMBLE AND CUT OFF EXCESS PIPE AS MARKED. SLIP BLOW-OFF PIPE BACK THROUGH HOLE OF BOTTOM BRACKET AND RE-ASSEMBLE INTO TOP SUPPORT BRACKET .

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
9	1	2615721	SPACER, CABLE, STACKABLE	POLYPROPYLENE	-
8	2	2609599	HOSE CLAMP, .219" - .625"	STAINLESS STEEL	-
7	1	2617770-180-SX0	PIPE, 1/4", S40, 180" LG, TOE	304 SS	-
6	1	2913477	BLOW-OFF BOTTOM SUPPORT BRACKET WELDMENT	304 SS	Y
5	1	9110167A30102-1	KIT, ADHV ANCR, 3/8", SET-3G ADHESIVE	316 SS	Y
4	1	2912018	BLOW-OFF TOP SUPPORT BRACKET WELDMENT	304 SS	Y
3	1	2615722	CABLE TIE, 19" LG	POLYPROPYLENE	-
2	2	2611770	ELBOW, 90DEG, HOSE X MNPT, 0.17" X 1/4"	BRASS	-
1	15	2606539	TUBING, 1/4"OD X .170"ID, BLACK	POLYETHYLENE	-

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2020-12-07	SAH	SUBMITTAL
B	R19695	2021-05-14	SAH	RELEASE TO PRODUCTION

JOB NAME: DOWNTOWN AREA WWTF AND EFFLUENT DISPOSAL
JOB LOCATION: ORLEANS, MA

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ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 2963338
TYPE:
DRAWN BY: SAH
DATE: 2020-12-07
WEIGHT:
SHEET: 1 OF 1

DRAWING NAME: FINE BUBBLE DIFFUSER BLOW-OFF TUBE INSTL
DRAWING NUMBER: 9110167A30011
SCALE: 1/6
SIZE: C

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Electrical Department

PROJECT:	Orleans, MA Downtown Area WWTF and Effluent Disposal	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-01	DATE:	09/29/2021
SUBMITTAL NO:	304 (16260-001-4)	REVIEWER:	A. Abraham
SUBJECT:	Variable Frequency Drives	SPECIFICATION:	16260

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only (6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	MIX.BLW-4 Remote ESTOPs	1	~~Provide terminals within the VFD enclosure to land and extend the remote ESTOP auxiliary contact to the SBR-CP. Show ESTOP terminations on drawing R1USE01851-0001. (Typical for all VFDs with remote ESTOPs).~~ Response: Comply AECOM Response: No exceptions taken.
2.	MIX.BLW-4	1	~~It's noted the main circuit breaker on the VFD is rated 100A. The upstream circuit breaker feeding the VFD is rated 90A. Can the VFD main circuit breaker be reduced to 90A to better coordinate with the upstream breaker? Considering the drive input amps are 61.7A, it appears a 90A circuit breaker would be acceptable.~~ Response: Comply. Breaker changed to 90A. AECOM Response: No exceptions taken.
3.	MIX.BLW-1, -2	1	~~It's noted that the main circuit breaker on the VFD is rated 125A. The upstream circuit breaker feeding the VFD is rated 110A. Can the VFD main circuit breaker be reduced to 110A to better coordinate with the upstream breaker? Considering the drive input amps are 74.1A, it appears a 110A circuit breaker would be acceptable.~~ Response: Comply. Breaker changed to 110A. AECOM Response: No exceptions taken.
4.	Heavy Duty	1	~~It's noted the VFDs are indicated as "Heavy Duty". Confirm "Heavy Duty" is rated for constant torque applications.~~ Response: Confirmed. AECOM Response: No exceptions taken.
5.	Main Circuit Breakers	1	~~Provide TCC plots for each main circuit breaker.~~ Response: Trip curves provided for the new 90A and 110A breaker.

ITEM NUMBER	REFERENCE	CODE	COMMENT
			AECOM Response: No exceptions taken.
6.	Harmonic Analysis	2	(04/29/2021): ~~The harmonic analysis is based on a 1500kVA transformer with an unlimited utility fault. Obtain information on the actual transformer installed (size/impedance) along with the available short circuit fault current from the utility and revise the study.~~ ~~Response: VFD's will be coordinated when the study is complete.~~ ~~AECOM Response: Obtain available short circuit fault current from the utility. Revise study as indicated.~~ ~~Response: Coordination study submitted 7/13/21~~ ~~AECOM Response (07/29/2021): It is noted that this comment response incorrectly references the electrical system study submitted under Specification 16359, and not the Harmonic Analysis submitted under this submittal 16260. Unclear why the electrical system study is being referenced under this comment response.~~ ~~These are (2) different required documents with different specifications. It is noted that no changes have been made to the Harmonic Analysis included in this submittal. Provide Harmonic Analysis report as specified and as noted in comment dated April 2021.~~ Response: The harmonic analysis has been provided herein. AECOM Response: It is noted that the harmonic analysis has been submitted. Please see comment (9) included below regarding study.
7.	Harmonic Analysis	2	(04/29/2021): ~~Provide a harmonic analysis for the electrical system when powered from the standby generator as specified in section 16260-2.02-D.~~ ~~Response: VFD's will be coordinated when the study is complete.~~ ~~AECOM Response (06/14/2021): It is noted that only the utility power scenario has been provided in the harmonic analysis. Provide study that includes system powered from the standby generator as indicated.~~ ~~Response: Coordination study submitted 7/13/21~~ ~~AECOM Response (07/29/2021): It is noted that this comment response incorrectly references the electrical system study submitted under Specification 16359, and not the Harmonic Analysis submitted under this submittal 16260. Unclear why the electrical system study is being referenced under this comment response.~~

ITEM NUMBER	REFERENCE	CODE	COMMENT
			~~These are (2) different required documents with different specifications. It is noted that no changes have been made to the Harmonic Analysis included in this submittal. Provide Harmonic Analysis report as specified and as noted in comment dated April 2021.~~ Response: The harmonic analysis has been provided herein. AECOM Response: It is noted that the harmonic analysis has been submitted. Please see comment (9) included below regarding study.
8.	Harmonic Analysis	2	(04/29/2021): ~~Confirm the harmonic study is performed in accordance with 16260, Attachment A.~~ ~~Response: VFD's will be coordinated when the study is complete.~~ ~~AECOM Response (06/14/2021): Confirm the harmonic study is performed in accordance with 16260, Attachment A.~~ ~~Response: Coordination study submitted 7/13/21~~ ~~AECOM Response (07/29/2021): It is noted that this comment response incorrectly references the electrical system study submitted under Specification 16359, and not the Harmonic Analysis submitted under this submittal 16260. Unclear why the electrical system study is being referenced under this comment response.~~ Response: The harmonic analysis has been provided herein. AECOM Response: It is noted that the harmonic analysis has been submitted. Please see comment (9) included below regarding study.
9.		2	Submitted harmonic analysis includes HP's that are not consistent with the HP's indicated for VFD driven loads in the submittal. In example, submitted harmonic analysis single line includes a 30 HP motor for SBR.BLW-1,2,3 while the submittal bill of materials indicates qty.(3) 40 HP blower VFD's are being supplied. As a result, the SBR.BLW-1/2/3 are indicated in the study as having 18-pulse VFD's. However, these are 40 HP motors provided with 6-pulse VFD's per the submittal. Similarly, the MIX.BLW VFD types are not accurate. See attached redlines/comments to some of the submittal references that need to be updated. Please revise the harmonic analysis to reflect the HP/FLA for VFD's included in the submittal including type (18-pulse versus 6-pulse) as well as HP ratings for associated motors.
10.		3	Confirm that under Case 1 – Normal Utility power the total harmonic current distortion does not exceed the IEEE 519 limit of 8% when using correct VFD/motor HP's and VFD types (6-pulse versus 18-pulse) as noted. It is

ITEM NUMBER	REFERENCE	CODE	COMMENT
			noted that current HP's for all SBR and Mixing Blower VFD's are not accurate and the submitted total harmonic current distortion is 7.42%.
11.	10 E-005	3	Confirm the 100A harmonic filters per Contract single lines and submittal 16920-001-2 are reflected in the harmonic analysis. It is noted that there are references to 42 amps AHF included in the submittal.
REVIEWER SIGNATURE			
APPROVER SIGNATURE	Andrea Abraham		

Not consistent with VFD's included in this submittal - Revise

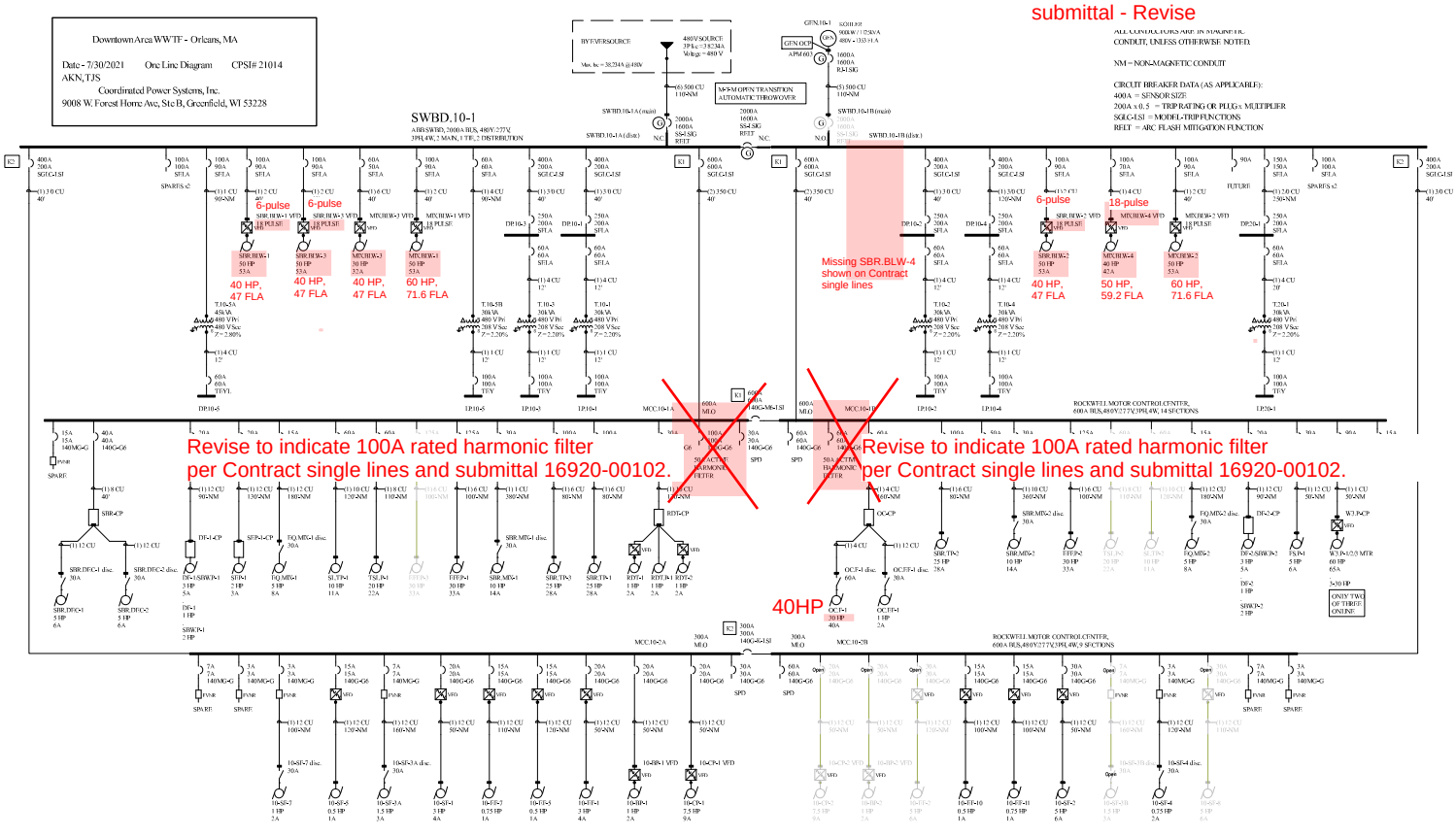
Downtown Area WWTF - Orleans, MA

Date - 7/30/2021 One Line Diagram CPSI# 21014

AKN, TJS

Coordinated Power Systems, Inc.

9008 W. Forest Home Ave, Ste B, Greenfield, WI 53228



LOADS AND MOTORS WITH HARMONIC SOURCE MODELS

Bus Name	Voltage	Component Name	LF Current	Harmonic Library
10-EF-1	480	10-EF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-EF-10	480	10-EF-10 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-11	480	10-EF-11 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-EF-5	480	10-EF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-7	480	10-EF-7 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-SF-1	480	10-SF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-SF-2	480	10-SF-2 mtr	6.0	Six Pulse, Z=8%, THDi=28%
10-SF-5	480	10-SF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
EFF.P-1	480	EFF.P-1 mtr	31.5	Six Pulse, Z=8%, THDi=28%
EFF.P-2	480	EFF.P-2 mtr	31.5	Six Pulse, Z=8%, THDi=28%
FS.P-1	480	FS.P-1 mtr	6.0	Six Pulse, Z=8%, THDi=28%
MIX.BLW-1 VFD ou	480	MIX.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-2 VFD ou	480	MIX.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-3 VFD ou	480	MIX.BLW-3	30.5	Six Pulse, Z=8%, THDi=28%
MIX.BLW-4 VFD ou	480	MIX.BLW-4	40.7	Six Pulse, Z=8%, THDi=28%
RDT-1 VFD output	480	RDT-1	1.6	Six Pulse, Z=8%, THDi=28%
RDT-2 VFD output	480	RDT-2	1.6	Six Pulse, Z=8%, THDi=28%
SBR.BLW-1 VFD ou	480	SBR.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-2 VFD ou	480	SBR.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-3 VFD ou	480	SBR.BLW-3	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.TP-1	480	SBR.TP-1 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SBR.TP-2	480	SBR.TP-2 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SBR.TP-3	480	SBR.TP-3 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SL.TP-1	480	SL.TP-1 mtr	11.0	Six Pulse, Z=8%, THDi=28%
TSL.P-1	480	TSL.P-1 mtr	21.3	Six Pulse, Z=8%, THDi=28%
VFD 10-BP-1 outp	480	10-BP-1	1.6	Six Pulse, Z=8%, THDi=28%
VFD 10-CP-1 outp	480	10-CP-1	8.6	Six Pulse, Z=8%, THDi=28%
VFD W3.P-CP OUTP	480	W3.P-1/2/3 MTR	62.6	Six Pulse, Z=8%, THDi=28%

MIX.BLW-1-VFD is 60 HP per this submittal and single lines (60 HP, 71.6 FLA)

MIX.BLW-2-VFD is18-pulse per this submittal and single lines. (60 HP, 71.6 FLA)

MIX.BLW-3-VFD is 40 HP per this submittal and single lines (40 HP, 47 FLA)

MIX.BLW-4-VFD is18-pulse per this submittal and single lines. (50 HP, 59.2 FLA)

SBR.BLW-1/2/3 are 6-pulse per this submittal and single lines - (40 HP, 47 FLA)

Town of Orleans, MA
Downtown Area WWTF and Effluent Disposal
Contract No. 2019-01 SRF No. 4486

Contractor Certification Stamp

Submittal No. 16260-001-4 Submittal Title: VFD Revised

Drawing No N/A Spec. Paragraph: _____

Deviations: N/A

Comment Responses:
Items 1-5 are acknowledged, no exceptions taken
comment 6-8: the harmonic analysis has been provided herein

Contractor – Daniel O'Connell's Sons
Subcontractor/Supplier – Annese Electrical
Date of Submission – 8/30/21

Daniel O'Connell's Sons

Representation is made to Owner and Engineer that Contractor has reviewed this submittal in accordance with Section 1300, Par. 3.01 and that the Contractor herby approves this submittal.

MAC — Initials

8/30/21 — Date

Engineer's Review:

- [ ] NO EXCEPTION TAKEN
- [ ] MAKE CORRECTIONS NOTED
- [ ] AMEND AND RESUBMIT
- [ ] REJECTED; SEE REMARKS
- [ ] FOR INFORMATION ONLY
- [ ] NOT REQUIRED FOR REVIEW

_____ Reviewed by

_____ Firm

_____ Date

Town of Orleans, MA
Wastewater Treatment Facility and Effluent Disposal
Contract No. 2019-01 / SRF No. 4486

Submittal for Approval

July 13, 2021

Specification Section / Equipment:
16260: Low Voltage Variable Frequency Drives

Consulting Engineer:
AECOM Technical Services, Inc.
9 Jonathan Bourne Drive
Pocasset, MA 02559

Manufacturer:
Rockwell Automation
100 Nickerson Road
Marlboro, MA 01752

Electrical Contractor:
Annese Electrical Services, Inc.
280 Libbey Industrial Parkway
Weymouth, MA 02189

Distributor:
Northeast Electrical Distributors
632 Cambridge St.
Worcester, MA 01610

Comments from review dated 6/11/21 are addressed in this Re-submittal:
Review Item 6 - Coordination study submitted 7/13/21
Review Item 7 - Coordination Study submitted 7/13/21
Review Item 8 - Coordination Study submitted 7/13/21

Town of Orleans, MA
Wastewater Treatment Facility and Effluent Disposal
Contract No. 2019-01 / SRF No. 4486

Supplier Local Contact Information

Manufacturers:

Allen Bradley/ Rockwell Automation
100 Nickerson Road
Marlboro, MA 01752

Landon Kendricks (978) 243-7425

Electrical Distributor:

Northeast Electrical Distributors
632 Cambridge Street
Worcester, MA 01610

Andy Powers (508) 277-6868
Kyle Kazarian (508) 713-4013
Keith Sullivan (401) 640-0968

ITEM	QTY	DESCRIPTION

30 **3** **PF753 40HP HD (6 Pulse) NEMA 12** **SBR.BLW-1,-2,-3 VFD**

One NEMA 12 Rittal Enclosure, approximately 87"H X 39"W X 24"D, with the following features:

- Qty. 1- PowerFlex 753 AC Drive, with Embedded I/O, Air Cooled, DC Input with Precharge, Open Type, 77 Amps, 50HP HD, 480 VAC, 3 PH, Frame 5, Filtered, CM Jumper Installed, DB Transistor
- Qty. 1- PF750-115V I/O Module-2AI,2AO,6DI,2RO
- Qty. 1- Door-Mounted Full Function HIM
- Qty. 1- Input Circuit Breaker Disconnect w/ Thru Door Operator, 65 KAIC (Input Thermal Magnetic breaker, 65KAIC, note does not necessarily reflect panel SCCR rating)
- * Qty. 1- Input Line Reactor, 5%
- Qty. 1- Control Power Transformer, Fused Primary/Secondary
- Qty. 1- Door-Mounted Hand/Off/Auto Selector Switch (800H Style)
- Qty. 1- In AUTO " contact on HOA
- Qty. 1- Elapsed Time Meter, 115V Control
- Qty. 1- Elapsed Time Meter, 115V Control
- Qty. 1- Run Relay
- Qty. 1- Fault Relay
- Qty. 1- Door-Mounted Run Pilot Light (Green 800H LED style)
- Qty. 1- Door-Mounted OFF Pilot Light (Red 800H LED style)
- Qty. 1- Door-Mounted Fault Pilot Light (Amber 800H LED style)
- Qty. 1- Motor overtemp pilot light , relay with contacts and reset •

Qty. 1- High pressure pilot light, relay with contact and reset

- Enclosure Fan & Filter Kit
- Qty. 1- Output dV/dt Filter

31 **2** **PF753 60HP HD (18 Pulse) NEMA 12** **MIX.BLW-1,-2 VFD**

One NEMA 12 Rittal Enclosure, approximately 87"H X 39"W X 24"D, with the following features:

- Qty. 1- PowerFlex 753 AC Drive, with Embedded I/O, Air Cooled, DC Input with Precharge, Open Type, 77 Amps, 50HP HD, 480 VAC, 3 PH, Frame 5, Filtered, CM Jumper Installed, DB Transistor
- Qty. 1- PF750-115V I/O Module-2AI,2AO,6DI,2RO
- Qty. 1- Door-Mounted Full Function HIM
- Qty. 1- Input Circuit Breaker Disconnect w/ Thru Door Operator, 65 KAIC (Input Thermal Magnetic breaker, 65KAIC, note does not necessarily reflect panel SCCR rating)
- Qty. 1- 18-Pulse Auto Transformer
- Qty. 1- 18-Pulse Bridge Assembly, Parallel Diode
- Qty. 1- Control Power Transformer, Fused Primary/Secondary
- Qty. 1- Door-Mounted Hand/Off/Auto Selector Switch (800H Style)
- Qty. 1- In AUTO " contact on HOA
- Qty. 1- Elapsed Time Meter, 115V Control
- Qty. 1- Run Relay
- Qty. 1- Fault Relay
- Qty. 1- Door-Mounted Run Pilot Light (Green 800H LED style)
- Qty. 1- Door-Mounted OFF Pilot Light (Red 800H LED style)
- Qty. 1- Door-Mounted Fault Pilot Light (Amber 800H LED style)
- Qty. 1- Motor overtemp pilot light , relay with contacts and reset
- Qty. 1- High pressure pilot light, relay with contact and reset
- Enclosure Fan & Filter Kit
- Qty. 1- Output dV/dt Filter

32 **1** **PF753 40HP HD (6 Pulse) NEMA 12** **MIX.BLW-3 VFD**

One NEMA 12 Enclosure, approximately 59"H x 37"W x 16"D, with the following features:

- Qty. 1- PowerFlex 753 Drive w/ Embedded I/O, 480 VAC, 3 Phase, 52 Amps, 30 HP Heavy Duty, 6 Pulse, w/DC Terminals, With Filtering/Jumper Installed, With Internal Transistor, w/o Internal Resistor
- Qty. 1- PF750-115V I/O Module-2AI,2AO,6DI,2RO
- Qty. 1- Door-Mounted Full Function HIM
- Qty. 1- Input Circuit Breaker Disconnect w/ Thru Door Operator, 65 KAIC (Input Thermal Magnetic breaker, 65KAIC, note does not necessarily reflect panel SCCR rating)
- Qty. 1- Input Line Reactor, 5%
- Qty. 1- Control Power Transformer, Fused Primary/Secondary
- Qty. 1- Door-Mounted Hand/Off/Auto Selector Switch (800H style)
- Qty. 1- In AUTO " contact on HOA
- Qty. 1- Elapsed Time Meter, 115V Control
- Qty. 1- Run Relay
- Qty. 1- Fault Relay
- Qty. 1- Door-Mounted Run Pilot Light (Green 800H LED style)
- Qty. 1- Door-Mounted OFF Pilot Light (Red 800H LED style)
- Qty. 1- Door-Mounted Fault Pilot Light (Amber 800H LED style)
- Qty. 1- Motor overtemp pilot light , relay with contacts and reset
- Qty. 1- High pressure pilot light, relay with contact and reset
- Enclosure Fan & Filter Kit
- Qty. 1- Output dV/dt Filter

33 **1** **PF753 50HP HD (18 Pulse) NEMA 12** **MIX.BLW-4 VFD**

One NEMA 12 Enclosure, approximately 59"H x 37"W x 16"D, with the following features:

- Qty. 1- PowerFlex 753 Drive w/ Embedded I/O, 480 VAC, 3 Phase, 65 Amps, 40 HP Heavy Duty, 6 Pulse, w/DC Terminals, With Filtering/Jumper Installed, With Internal Transistor, w/o Internal Resistor
- Qty. 1- PF750-115V I/O Module-2AI,2AO,6DI,2RO
- Qty. 1- Door-Mounted Full Function HIM
- Qty. 1- Input Circuit Breaker Disconnect w/ Thru Door Operator, 65 KAIC (Input Thermal Magnetic breaker, 65KAIC, note does not necessarily reflect panel SCCR rating)

* Qty. 1- 18-Pulse Auto Transformer
* Qty. 1- 18-Pulse Bridge Assembly, Parallel Diode

- Qty. 1- Control Power Transformer, Fused Primary/Secondary
- Qty. 1- Door-Mounted Hand/Off/Auto Selector Switch (800H style)
- Qty. 1- In AUTO " contact on HOA
- Qty. 1- Elapsed Time Meter, 115V Control
- Qty. 1- Run Relay
- Qty. 1- Fault Relay
- Qty. 1- Door-Mounted Run Pilot Light (Green 800H LED style)
- Qty. 1- Door-Mounted OFF Pilot Light (Red 800H LED style)
- Qty. 1- Door-Mounted Fault Pilot Light (Amber 800H LED style)
- Qty. 1- Motor overtemp pilot light , relay with contacts and reset •

Qty. 1- High pressure pilot light, relay with contact and reset

- Enclosure Fan & Filter Kit
- Qty. 1- Output dV/dt Filter

Rockwell Automation

NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF

POWERFLEX 50HP HD 18 PULSE, TYPE 12

RA PROJECT# R1USE01851-0001

UL 508A

MIX.BLW-4

APPROVAL DOCUMENTS - 04-14-21 REV 01

DATE	BY	APPROVAL
		DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

REV.	DATE	BY	ECN/CR. NO.

Rockwell Automation

TITLE SHEET FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP Date: 11/23/2020

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DRAWING INDEX FOR:
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
POWERFLEX 50HP HD 18 PULSE, TYPE 12
R1USE01851-0001

SH	SUBSEC	DRW_DESC1	DRW_DESC2	DRW_DESC3
N1	NOTES	TITLE SHEET FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N2	NOTES	INDEX SHEET FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N3	NOTES	GENERAL NOTES FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N4	NOTES	WIRE CLASSIFICATION FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N5	NOTES	TORQUE VALUES FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
1	0001	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	INCOMING POWER AND 18 PULSE FRONT END	PF753 50HP 18 PULSE VFD
5	0001	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	120VAC CONTROL POWER	PF753 50HP 18 PULSE VFD
11	0001	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	POWER AND MOTOR INTERFACE	PF753 50HP 18 PULSE VFD
14	0001	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	PORT 4 SLOT - 120VAC I/O MODULE	PF753 50HP 18 PULSE VFD
L0001	0001	DIMENSION DRAWING FOR	ITEM 0001	PF753 50HP 18 PULSE VFD
L0002	0001	LAYOUT DRAWING FOR DOOR	ITEM 0001	PF753 50HP 18 PULSE VFD
L0003	0001	LAYOUT DRAWING FOR PANEL	ITEM 0001	PF753 50HP 18 PULSE VFD

APPROVAL DOCUMENTS - 04-14-2021 REV 01

DATE	BY	APPROVAL
		DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

REV.	DATE	BY	ECN/CR. NO.

Rockwell Automation

INDEX SHEET FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP Date: 11/23/2020

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DRAWING STANDARDS:

SYMBOLS:

- ⌊ REFERS TO NOTE GIVEN BELOW
- ▲ LOW POWER CONTACT
- ARROW INDICATES FUNCTION INCREASE (ALWAYS CLOCKWISE)

4⌋ **DANGER** – THIS EQUIPMENT MAY BE AT LINE VOLTAGE EVEN WHEN NOT IN OPERATION. TO AVOID ELECTRIC SHOCK, DISCONNECT.

5⌋ **CAUTION** – NEVER REMOVE OR INSERT ANY MODULE OR CARD WHILE THE POWER IS ON.

9⌋ REMOVE JUMPER IF ADDITIONAL INTERLOCK IS ADDED.

13⌋ SEPARATELY MOUNTED, SUPPLIED BY OTHERS

14⌋ SEPARATELY MOUNTED, SUPPLIED BY ROCKWELL AUTOMATION

32⌋ MOTOR STABILIZING FIELD, S1 AND S2, IS NOT REQUIRED FOR NORMAL OPERATION. TAPE S1 AND S2 SEPARATELY AND DO NOT USE.

33⌋ DRIVE MOTOR CONNECTIONS AS SHOWN ARE FOR INDICATED ROTATION FACING COMMUTATOR END. FOR OPPOSITE ROTATION, INTERCHANGE A1 AND A2 CONNECTIONS IN MOTOR CONDUIT BOX.

34⌋ TACHOMETER LEADS MUST BE CONNECTED TO GIVE THE INDICATED POLARITY.

35⌋ IF OPPOSITE ROTATION IS DESIRED, CHANGE POLARITY OF THE COSINE SIGNAL BY INTERCHANGING THE COSINE INPUT LEADS.

36⌋ USE TWISTED TWO - CONDUCTOR CABLE. THIS CABLE MUST BE IN A SEPARATE SIGNAL CONDUIT. IT CANNOT BE RUN WITH OTHER CONDUCTORS OR CABLES. USE RELIANCE PART NUMBER 417900-76EAD OR EQUIVALENT. REFER TO FIELD INSTALLATION AND WIRING TABLE ON NEXT SHEET FOR WIRE SPECIFICATIONS.

38⌋ SIGNAL WIRE CABLES WITH THIS NOTE NUMBER CAN BE IN THE SAME SIGNAL CONDUIT. THEY CANNOT BE RUN WITH NON-SIGNAL WIRES. REFER TO FIELD INSTALLATION AND WIRING TABLE ON NEXT SHEET FOR WIRE SPECIFICATIONS.

38-1⌋ REFER TO NOTE 38. THE NUMBER FOLLOWING THE NOTE 38 IDENTIFIES THE CABLES THAT MAY BE GROUPED TOGETHER IN THE SAME SIGNAL CONDUIT. FOR EXAMPLE, CABLES REFERENCED WITH NOTE 38-1 CANNOT BE RUN IN THE SAME SIGNAL CONDUIT WITH NOTE 38-2 CABLES.

40⌋ COAXIAL CABLES WITH THIS NOTE CAN BE IN THE SAME SEPARATE SIGNAL CONDUIT. THEY CANNOT BE RUN WITH OTHER CONDUCTORS OR CABLES. FOR RECOMMENDED CABLE TYPE, REFER TO PRODUCT'S NETWORK MANUAL.

TYPE	CABLE P/N (BELDEN P/N)	CONNECTOR P/N (AMPHENOL P/N)
RG59	417900-148A (9259)	405504-74A (31-212-1005)
RG11	417900-149A (8238)	612293-B (6775)

TERMINATOR 75 OHM
RELIANCE P/N 707204-20A
AMPHENOL P/N 46650-75

41⌋ **DANGER** – DO NOT OPEN DISCONNECT SWITCH WHILE THE MOTOR IS ENERGIZED.

47⌋ RESOLVER WIRES: LOW LEVEL SIGNAL WIRING. MUST BE RUN IN SEPARATE SIGNAL CONDUIT OR TRAY.

BELDEN P/N	NO. OF TWISTED PAIRS		AWG #	RECOMMENDED MAXIMUM DIST. FOR EACH RESOLVER TYPE a> X1	a> X2	a> X5
9730	3		24	1000 FT.	1000 FT.	600 FT.

a> DISTANCES BEYOND THOSE RECOMMENDED MAY REQUIRE ADDITIONAL TUNING. USE RELIANCE CUSTOM PANEL 0-58801

b> MAY ONLY BE RUN IN CONDUIT, PER NEC

c> NOTE: CONNECT CABLE SHIELD TO GROUND AT CABINET ONLY

48⌋ FIBER-OPTIC CABLES WITH THIS NOTE MAY BE RUN WITH ANY LEVEL 1 SIGNAL WIRING. IF NECESSARY THESE CABLES MAY BE RUN WITH ANY LEVEL WIRING. SEE INSTALLATION MANUAL FOR RESTRICTIONS.

52⌋ REFER TO TRANSFORMER NAMEPLATE FOR CONNECTIONS OF PRIMARY LEADS.

53⌋ **DANGER** – TRANSFORMER IS CONNECTED TO LINE VOLTAGE EVEN WHEN THE A-C DISCONNECT IS OPEN.

DATE	BY	APPROVAL
		DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

99⌋ USER SUPPLIED PROTECTION MUST INCLUDE A DISCONNECTING DEVICE ON THE PRIMARY SIDE OF THE TRANSFORMER. PRIMARY AND SECONDARY WIRE PROTECTION FOR THE ISOLATION TRANSFORMER MUST BE PROVIDED PER NEC.

D⌋ MOUNTED ON DOOR.

H⌋ MOUNTED ON CABINET HOOD

R⌋ MOUNTED ON CONTROL HOUSE ROOF

T⌋ MOUNTED ON CABINET TRIM

E⌋ EXISTING EQUIPMENT

N⌋ NEW EQUIPMENT

USE EXAMP. LOCATION CODES	DESCRIPTION
REM_NS	REMOTE MOUNTED - NOT SUPPLIED BY ROCKWELL AUTOMATION.
REM_S	REMOTE MOUNTED - SUPPLIED BY ROCKWELL AUTOMATION.
REM	REMOTE MOUNTED.
OS_2	MTD. ON OPERATORS STATION No. 2
PB_3	MTD. ON PUSHBUTTON STATION No. 3

GENERAL NOTES:

1. FOR FURTHER DRIVE INFORMATION ON INSTRUCTION MANUALS, SEE RESPECTIVE SCHEMATIC SECTIONS.
2. ⏚ - BUILDING GROUND TO BE GROUNDED BY CUSTOMER.
   TE - SYSTEM ZERO POTENTIAL NODE
   PE - POWER EQUIPMENT GROUND
   ⏚ - PANEL (CHASSIS) GROUND
3. THE INTERNAL WIRING SELECTED MEETS OR EXCEEDS NEC, UL, AND CSA. INTERNAL POWER AND CONTROL WIRE HAS INSULATION RATED AT 105°C OR HIGHER.
4. * -INDICATES COMPONENTS SUPPLIED BY OTHERS.
5. (4) INDICATES FIELD INSTALLED WIRES AS WELL AS THE WIRING LEVEL.
   WHEN ACCOMPANIED WITH THE DESIGNATION (FWC) THE WIRES/CABLE ARE PRE-SUPPLIED AT THE SOURCE CONNECTION BY ROCKWELL FOR CUSTOMER INSTALLATION AT SITE. (FWC) INDICATES FURNISHED WITH CABINET.
6. —○— -INDICATES OUTGOING TERMINAL.
   —□— -INDICATES TERMINAL ON ELECTRONIC ASSEMBLY PRINTED CIRCUIT BOARD (1EA) ETC.
   CR —⊗— -INDICATES RELAY OR CONTACTOR WITH SUPPRESSOR.
7. COIL AND CONTACT CROSS REFERENCING - NUMBERS ADJACENT TO COIL AND UNDER CONTACT INDICATE SHEET AND LINE NUMBERS.
   101-03 NO 101-03 NC ← -INDICATES LINE NO. 03. ← -INDICATES SHEET NO. 101.
   NO - INDICATES NORMALLY OPEN CONTACTS
   NC - INDICATES NORMALLY CLOSED CONTACTS

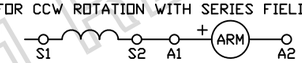
   OFF-PAGE CROSS REFERENCING - NUMBERS ADJACENT TO SOURCE AND DESTINATION SYMBOLS INDICATE SHEET AND LINE NUMBERS.
   FROM 1-24 ▼ TO 1-24 ▲ 1-24 ← -INDICATES LINE NO. 24. ← -INDICATES SHEET NO. 1.

REV DATE: 5-18-2017

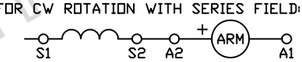
8. WIRE # GENERATION
   11242
   - 1 - INDICATES WIRE NUMBER.
   - 2 - INDICATES SEQUENCE (1,2,, 3 . . . etc.).
   - 4 - INDICATES LINE NUMBER 24.
   - 11 - INDICATES SHEET NUMBER 11.

   INTERNAL WIRE NUMBERS MAY BE 'FIXED' WITH A LINE AND SEQUENCE, BUT MAY SCHEMATICALLY SHOW A PREFIX.
9. TYPICAL DUAL VOLTAGE MOTOR FIELD CONNECTIONS ARE SHOWN BELOW. CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.

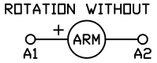
10. DC MOTOR ROTATION - CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.
    FOR CCW ROTATION FACING COMMUTATOR END:
    A1 IS POSITIVE
    F1 IS POSITIVE
    FOR CW ROTATION FACING COMMUTATOR END:
    A2 IS POSITIVE
    F1 IS POSITIVE
    FOR CCW ROTATION WITH SERIES FIELD:



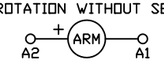
    FOR CW ROTATION WITH SERIES FIELD:



    FOR CCW ROTATION WITHOUT SERIES FIELD:



    FOR CW ROTATION WITHOUT SERIES FIELD:



11. AC MOTOR ROTATION - CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.
    FOR CW ROTATION VIEWED FROM MOTOR SHAFT:
    INVERTER OUTPUT U2 TO T1 (EUROPEAN MARKING U1)
    V2 TO T2 (EUROPEAN MARKING V1)
    W2 TO T3 (EUROPEAN MARKING W1)
    FOR CCW ROTATION VIEWED FROM MOTOR SHAFT:
    INVERTER OUTPUT U2 TO T1 (EUROPEAN MARKING U1)
    V2 TO T3 (EUROPEAN MARKING W1)
    W2 TO T2 (EUROPEAN MARKING V1)

    NOTE: NOT ALL AC MOTOR SUPPLIERS COMPLY WITH THE ABOVE CONVENTIONS.

COMBINATION MOTOR CONTROLLER WITH MOTOR CIRCUIT PROTECTOR

DANGER: To maintain overcurrent, short circuit and ground fault protection, the manufacturer's instructions for selecting current elements and setting the instantaneous-trip circuit breaker must be followed.

AVERTISSEMENTPour assurer une protection continue contre les surintensités, les court-circuits et une mise à la terre accidentelle, il est essentiel de choisir les ?el?ements thermiques et de régler le disjoncteur à déclenchement instantané selon la notice technique du fabricant.

Determine motor full load current and motor design type identifier from motor nameplate.

For Design B, C an D motors adjust motor circuit protector to operate at a current setting between ten (10) and thirteen (13) times the full load current. For Design E and N motors adjust motor circuit protector to operate at a current setting between thirteen (13) and seventeen (17) times the full load current.

NOTE: Motor circuit protector is set at minimum current setting when shipped from factory.

DANGER: Tripping of the instantaneous-trip circuit breaker is an indication that a fault current has been interrupted. Current carrying components of the magnetic motor controller should be examined and replaced if damaged, to provide continued protection against a risk of fire or electric shock. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced. (Refer to NEMA Standards Publication No. ICS 2.2 titled: 'Maintenance of Motor Controllers After a Fault Condition' Ñ also published as NEMA Standard Publication No. ICS 2, Part ICS 2-302.)

AVERTISSEMENTL'ouverture du disjoncteur à déclenchement instantané indique qu'un courant de défaut a été interrompu. Les composants conducteurs de la commande magnétique du moteur doivent être inspectés et remplacés s'ils ont subi des dommages, afin d'assurer une protection continue contre le risque d'incendie et de choc électrique. En cas de défaillance de l'élément thermique d'un relais de surcharge, celui-ci doit être remplacé dans sa totalité.

APPROVAL DOCUMENTS - 04-14-21 REV 01

REV.	DATE	BY	ECN/CR. NO.

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GENERAL NOTES FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP | Date: 11/23/2020

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FIELD INSTALLATION AND WIRING

CATEGORY	WIRING LEVEL	SUB-GROUP	SIGNAL DEFINITION	SIGNAL EXAMPLES	CABLE TYPE	MINIMUM SPACING IN INCHES BETWEEN LEVELS (STEEL CONDUIT/TRAY) 4S	4	3	3S	2	2S	1	SPACING NOTES
POWER (SEE NOTE 2-C FOR SPACING BELOW)	4	S	AC POWER (> 1000VAC)	2.3KV 3 PHASE AC LINES	PER NEC AND LOCAL CODES	SEE NOTE: 7	SEE NOTE: 7	SEE NOTE: 7		SEE NOTE: 7		SEE NOTE: 7	1 2 5
			AC POWER (TO 1000VAC)	480V 3 PHASE AC LINES	PER NEC AND LOCAL CODES								
			DC POWER	DC MOTOR ARMATURE	PER NEC AND LOCAL CODES		0	3/6		3/12		3/9	
			DC POWER	REGULATED DC MOTOR FIELD	PER NEC AND LOCAL CODES								
CONTROL (300V MAX OR 20 AMPS)	3		115VAC/VDC LOGIC	RELAY LOGIC, PLC I/O	PER NEC AND LOCAL CODES	SEE NOTE: 7	3/6	0		3/9		1/3	
			115VAC POWER	POWER SUPPLIES, INSTRUMENTS									
		S	24VAC/VDC LOGIC	PLC I/O	PER NEC AND LOCAL CODES								
MEDIUM LEVEL SIGNAL (PROCESS)	2		ANALOG SIGNALS DC SUPPLIES	REF/FEEDBACK SIGNAL, 5 TO 24VDC SUPPLIES	SHIELDED CABLE BELDEN 8770, 9418	SEE NOTE: 7	3/12	3/9		0		1/1	2 3 4 5 6
			DIGITAL (LOW SPEED)	TTL									
		S	DIGITAL (HIGH SPEED)	RESOLVER, ENCODER/COUNTER I/O, PULSE TACH FEEDBACK	SHIELDED CABLE BELDEN 9730, 9773, 9892 (SEE USER MANUAL)								
		SHLD	ANALOG SIGNALS	REF/FEEDBACK SIGNALS	SHIELDED CABLE, TWISTED CONDUCTORS BELDEN 8760, 9729								
LOW LEVEL SIGNAL (COMM.)	1		SERIAL COMMUNICATION	RS232, 422 TO TERMINALS, PRINTERS	SHIELDED CABLE RS232-BELDEN 8770,8760 RS422-BELDEN 9729,9730	SEE NOTE: 7	3/9	1/3		1/1		0	
		S	PLC SERIAL COMMUNICATION (> 20K BAUD)	PLC REMOTE I/O, PLC DATA HIGHWAY	TWINAXIAL CABLE BELDEN 9463 R-A 1770-CD								
		C	PLC SERIAL COMMUNICATION (> 5MB)	CONTROL NET	RG-6 QUAD SHIELD, COAX CABLE; A-B 1786-RG6 BELDEN 3092A								
		D	CAN COMMUNICATION	DEVICE - NET DRIVE - DRIVE	R-A 1485C-P1-C								
		E	ETHERNET	ETHERNET	R-A 1585								
		F	COMMUNICATION (> 5MB)	CONTROLNET ETHERNET	FIBER OPTIC		N/A	N/A		N/A		N/A	N/A

EXAMPLE: SPACING RELATIONSHIP BETWEEN 480VAC INCOMING LEADS
a. 480VAC LEADS ARE LEVEL 4.
b. 24VDC LEADS ARE LEVEL 3.
c. FOR SEPARATE STEEL CONDUITS, THE CONDUITS ARE TO BE 3 INCHES APART.
d. IN A CABLE TRAY THE TWO GROUPS OF LEADS ARE TO BE 6 INCHES APART.

SHIELDED CABLES RECOMMENDATIONS:

BELDEN	8770	18 AWG - 3 CONDUCTOR SHIELDED
BELDEN	8760	18 AWG - 2 CONDUCTOR SHIELDED
BELDEN	9418	18 AWG - 4 CONDUCTOR SHIELDED
BELDEN	9728	24 AWG - 4 SHIELDED PAIRS (8 COND.)
BELDEN	9729	24 AWG - 2 SHIELDED PAIRS (4 COND.)
BELDEN	9730	24 AWG - 3 SHIELDED PAIRS (6 COND.)
BELDEN	9892	20 AWG - 4 SHIELDED PAIRS (8 COND.)
BELDEN	9773	18 AWG - 3 SHIELDED PAIRS (6 COND.)
BELDEN	9463	75 OHM - TWINAXIAL (2 COND.)

REV DATE: 04-19-2019

FIELD WIRING INSIDE ROCKWELL ENCLOSURE:

1. CONNECTIONS WILL BE ONLY TO TERMINALS PROVIDED.
2. WIRE LENGTH FROM ENTRY POINT TO TERMINAL BOARD TO BE AS SHORT AS POSSIBLE.
3. SIGNAL WIRE MUST NOT BE LACED OR RUN WITH NON-SIGNAL WIRE AFTER ENTRY INTO THE ENCLOSURE.
4. INCOMING WIRE MUST NOT BE ROUTED IN WIRE CHANNELS OR THROUGH AREAS OF POWER AND CONTROL COMPONENTS AND WIRING.
5. USE LASHING BARS WHEN PROVIDED FOR CUSTOMER CONVENIENCE.

FIELD INSTALLATION GROUNDING GUIDELINES

1. FOR DRIVES INSTALLATION, REFER TO 'WIRING AND 'GROUNDING GUIDELINES', PUBLICATION DRIVES-IN001
2. FOR POWERFLEX SAR INSTALLATION, REFER TO 'POWERFLEX DC 'STANDALONE REGULATOR AND GATE AMPLIFIER USER MANUAL', PUBLICATION 23P-UM001_-EN-P
3. FOR PLC AND I/O INSTALLATION, REFER TO 'INDUSTRIAL AUTOMATION WIRING AND GROUNDING GUIDELINES', PUBLICATION 1770-4.1
4. NEC ARTICLE 250, GROUNDING AND BONDING
5. LOCAL CODE REQUIREMENTS

DATE	BY	APPROVAL
		DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

GENERAL NOTES:

1. STEEL CONDUIT IS RECOMMENDED FOR LEVELS 1 AND 2. FOR AC MOTOR CABLES, SEE NOTE 5.
   ALL CONDUITS CONNECTED TO THE CABINETS SHOULD BE PROPERLY SEALED TO MINIMIZE AIR OR WATER ENTRY INTO THE CABINETS. IF ALUMINUM CONDUIT IS USED.
   A. IT REQUIRES THE SAME MINIMUM SPACING IS USED AS THAT SHOWN FOR CABLE TRAYS.
   OR
   B. INDIVIDUAL STEEL JACKETED (STEEL MESH) CABLES ARE TO BE USED IF THE CONDUIT SPACINGS NEED BE THE SAME AS STEEL CONDUIT.
2. SPACING SHOWN BETWEEN LEVELS IS THE MINIMUM REQUIRED FOR PARALLEL RUNS ≤ 400 FEET. GREATER SPACINGS SHOULD BE USED WHERE POSSIBLE.
3. SHIELDS FOR SHIELDED CABLES MUST BE CONNECTED AT ONE END ONLY. THE OTHER END SHOULD BE CUT BACK AND INSULATED. SHIELDS FOR CABLES FROM A CABINET TO AN EXTERNAL DEVICE MUST BE CONNECTED AT CABINET END. SHIELDS FOR CABLES FROM ONE CABINET TO ANOTHER MUST BE CONNECTED AT THE SOURCE END CABINET. SPLICING OF SHIELDED CABLES, IF ABSOLUTELY NECESSARY, SHOULD BE DONE SUCH THAT SHIELD(S) REMAIN CONTINUOUS AND INSULATED FROM GROUND.
4. NO. 16 AWG WIRE IS THE MINIMUM RECOMMENDED SIZE FOR CONTROL (LEVEL 3). POWER WIRE IS SELECTED BY LOAD, USING 75 DEG C WIRE RATING (LEVELS 4 AND 4S).
5. ARMORED CABLE WITH A PVC OUTER JACKET IS REQUIRED TO PROVIDE THE NECESSARY ELECTRICAL SHIELDING FOR AC MOTOR CABLES CONNECTED TO A PWM INVERTER.
   RECOMMENDATIONS:
   METALLIC ARMOR:
   BEST PERFORMANCE: SHIELDED BELDEN CABLE PER TABLE BELOW, OR CONTINUOUS CORRUGATED ALUMINUM
   ACCEPTABLE PERFORMANCE: INTERLOCKED ALUMINUM, OR INTERLOCKED STEEL
   CONDUCTORS:
   BEST PERFORMANCE: PHASE CONDUCTORS - 3, GROUND CONDUCTORS - 3
   ACCEPTABLE PERFORMANCE: PHASE CONDUCTORS - 3, GROUND CONDUCTORS - 1
   THE CABLE CONNECTOR SELECTED MUST PROVIDE A GOOD ELECTRICAL CONNECTION BETWEEN THE ARMOR AND THE PE GROUND PLANE AT EACH END OF THE CABLE.
   SHIELDED CABLE RECOMMENDATIONS:

BELDEN	29500	#16 AWG
BELDEN	29501	#14 AWG
BELDEN	29502	#12 AWG
BELDEN	29503	#10 AWG
BELDEN	29504	#8 AWG
BELDEN	29505	#6 AWG
BELDEN	29506	#4 AWG
BELDEN	29507	#2 AWG

   DESCRIPTION - 4 CONDUCTOR TINNED COPPER, XLPE INSULATION, 600VRMS MAX, SPECIFICALLY DESIGNED FOR IGBT DRIVE APPLICATIONS. THE SHIELD SHOULD BE CONNECTED TO THE PE GROUND PLANE
6. SEE A-B PUBLICATION AG2.2 FOR ADDITIONAL CONTROLNET COAX CABLE RECOMMENDATIONS.

SPACING NOTES:

1. BOTH OUTGOING & RETURN CURRENT CARRYING CONDUCTORS ARE TO BE PULLED IN THE SAME CONDUIT OR LAYERED ADJACENT IN CABLE TRAY.
2. ROUTE CABLES OF THE FOLLOWING LEVELS AS INDICATED:
   A. LEVELS MUST BE RUN IN SEPARATE CONDUITS OR TRAYS.
   B. INTERMIXING OF LEVELS IS NOT ALLOWED.
   C. SPECIAL LEVELS 4S AND 3S MAY EXIST THAT REQUIRE SPECIFIC WIRES TO BE GROUPED FOR SPECIAL HANDLING.
   NOTE: FOR LEVELS 3 AND 4, THE AMPACITY RATINGS OF CONDUCTORS IN A BUNDLE MAY NOT EXCEED THE DERATING GUIDELINES OF NEC 310.15(2), AND TABLE 310.15(B)(2)a.
   D. LEVELS 1 AND 2 MAY HAVE THEIR RESPECTIVE CIRCUITS (WITHIN A GIVEN LEVEL) PULLED IN THE SAME CONDUIT OR LAYERED ADJACENT IN THE SAME CABLE TRAY.
   NOTE: THE RESPECTIVE CIRCUITS IN A GIVEN BUNDLE MAY EXPERIENCE SOME AMOUNT OF EMI COUPLING. SOME CIRCUIT APPLICATIONS MAY DICTATE SEPARATE SPACING.
3. CONDUCTORS OF LEVELS 1 AND 2 MUST BE SHIELDED WHERE INDICATED PER THE RECOMMENDATIONS OR EQUIVALENT.
4. IN CABLE TRAYS, STEEL SEPARATORS ARE ADVISABLE BETWEEN THE LEVELS.
5. IF CONDUIT IS USED IT IS REQUIRED THAT IT BE CONTINUOUS AND COMPOSED OF MAGNETIC STEEL. (SEE GENERAL NOTE 1 ABOVE)
6. FOR FURTHER INFORMATION ON SPACING OF PLC COMMUNICATION CABLES TO LEVEL 4, SEE R-A PLC INSTALLATION MANUAL.
7. PER NEC ARTICLE 300-3(C)(2) , CONDUCTORS OF CIRCUITS RATED OVER 1000V, NOMINAL, SHALL NOT OCCUPY THE SAME WIRING ENCLOSURE, CABLE, OR RACEWAY WITH CONDUCTORS 1000V NOMINAL OR LESS UNLESS PERMITTED BY NEC 300.3(C)(2)(a) THROUGH 300.3(C)(2)(D).

COIL AND SOLENOID SUPPRESSION:

BEFORE UTILIZING THE CONTROL CIRCUIT POWER AVAILABLE FOR OPERATION OF CUSTOMER SUPPLIED DEVICES, THE COILS OR SOLENOIDS OF SUCH DEVICES MUST BE SUPPRESSED. THE EXTERNAL CONTROL CIRCUIT WIRING MUST BE RUN IN A SEPARATE CONDUIT THAT DOES NOT HAVE VARIABLE SIGNAL VOLTAGES OR POWER CIRCUIT VOLTAGES PRESENT. ELECTRICAL TRANSIENTS MAY CAUSE OCCASIONAL DRIVE MALFUNCTIONING.

APPROVAL DOCUMENTS - CRM 4-21 REV 01

REV.	DATE	BY	ECN/CR. NO.

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WIRE CLASSIFICATION FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP Date: 11/23/2020

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WIRE TERMINATION TORQUE VALUES

BULLETIN 1492 TERMINAL BLOCKS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1492-H4	7.1	0.8	30-12 AWG
1492-H5	7.1	0.8	30-12 AWG
1492-H6	7.1	0.8	30-12 AWG
1492-H7	7.1	0.8	30-12 AWG
1492-J3	4.5-7.1	0.5-0.8	22-12 AWG
1492-JD3	4.5-7.1	0.5-0.8	22-12 AWG
1492-J4	9.0	1.0	22-10 AWG
1492-JD4	4.5	0.5	26-10 AWG
1492-J6	14.2	1.6	22-8 AWG
1492-J10	20.4	2.3	18-6 AWG
1492-J16	35.0	4.0	18-6 AWG
1492-J35	51.0	5.8	12-1/0 AWG
1492-J50	31.5	3.6	10-1/0 AWG
1492-J70	87.0	9.8	6-2/0 AWG
1492-J120	141.6	16.0	4-250MCM AWG
1492-JG3	7.1	0.8	22-12 AWG
1492-JG4	9.0	1.0	22-10 AWG
1492-JG6	14.2	1.6	22-8 AWG
1492-JG10	20.4	2.3	16-6 AWG
1492-JG16	35.0	4.0	24-4 AWG
1492-JG35	51.0	5.8	12-1 AWG
1492-JG50	31.5	3.6	10-1/0 AWG
1492-JG70	87.0	9.8	6-2/0 AWG
1492-JG120	88.5	10	4-3/0 AWG

BULLETIN 1492 FUSE BLOCKS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1492-FB1C30 (-L)	22	2.5	18-8 AWG
1492-FB1C30 (-L)	26	2.5	6-4 AWG
1492-FB2C30 (-L)	22	2.5	18-8 AWG
1492-FB2C30 (-L)	26	2.5	6-4 AWG
1492-FB3C30 (-L)	22	2.5	18-8 AWG
1492-FB3C30 (-L)	26	2.5	6-4 AWG
1492-FB1M30 (-L)	22	2.5	18-8 AWG
1492-FB1M30 (-L)	26	2.5	6-4 AWG
1492-FB2M30 (-L)	22	2.5	18-8 AWG
1492-FB2M30 (-L)	26	2.5	6-4 AWG
1492-FB3M30 (-L)	22	2.5	18-8 AWG
1492-FB3M30 (-L)	26	2.5	6-4 AWG
1492-FB1J30 (-L)	35	4	18-1 AWG
1492-FB2J30 (-L)	35	4	18-1 AWG
1492-FB3J30 (-L)	35	4	18-1 AWG
1492-FB1J60 (-L)	35	4	14-1 AWG
1492-FB2J60 (-L)	35	4	14-1 AWG
1492-FB3J60 (-L)	35	4	14-1 AWG

BULLETIN 100 CONTACTORS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
100-C09	13-22	1.5-2.5	(2) 16-10 AWG
100-C12	13-22	1.5-2.5	(2) 16-10 AWG
100-C16	13-22	1.5-2.5	(2) 16-10 AWG
100-C23	13-22	1.5-2.5	(2) 16-10 AWG
100-C30	22-31	2.5-3.5	14-6 AWG
100-C37	22-31	2.5-3.5	14-6 AWG
100-C43	22-31	2.5-3.5	14-6 AWG
100-C60	40-53	4.5-6.0	14-1 AWG
100-C72	40-53	4.5-6.0	14-1 AWG
100-C85	40-53	4.5-6.0	14-1 AWG
100-C97	40-53	4.5-6.0	14-1 AWG

BULLETIN 140G CIRCUIT BREAKERS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
140G-G-TLC1_	62	7.0	(1) 14-1/0 AWG
140G-G-MTL6_	62	7.0	(6) 14-2 AWG
140G-H-TLC1_	62	7.0	(1) 14-1/0 AWG
140G-H-MTL6_	62	7.0	(6) 14-2 AWG
140G-I-TLA1_	50	5.6	(1) 14-1/0 AWG
140G-I-TLA1A_	200	22.6	(1) 4-300 MCM AWG
140G-I-TLC1_	124	14.0	(1) 10-250 MCM AWG
140G-I-MTL6_	62	7.0	(6) 12-2 AWG
140G-J-TLA1_	50	5.6	(1) 14-1/0 AWG
140G-J-TLA1A_	200	22.6	(1) 4-300 MCM AWG
140G-J-TLC1_	124	14.0	(1) 10-250 MCM AWG
140G-J-MTL6_	62	7.0	(6) 12-2 AWG
140G-K-TLA1_	380	43	(1) 250-500 MCM AWG
140G-K-TLA2_	380	43	(2) 2/0-250 MCM AWG
140G-K-TLC1_	380	43	(1) 250-500 MCM AWG
140G-K-TLC2_	380	43	(2) 2/0-250 MCM AWG
140G-K-MTL6_	62	7	(6) 6-1/0 AWG
140G-M-TLA2_	274	31	(2) 250-500 MCM AWG
140G-M-TLA3_	380	43	(3) 2/0-400 MCM AWG
140G-M-TLC2_	274	31	(2) 3/0-350 MCM AWG
140G-M-TLC3_	380	43	(3) 2/0-350 MCM AWG
140G-N-TLA4_	380	43	(4) 4/0-500 MCM AWG
140G-N-TLC4_	380	43	(4) 4/0-500 MCM AWG

'_' IS EITHER 3 OR 4 DEPENDING ON HOW MANY POLES THE BREAKER HAS

BULLETIN 194R TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
194R-30-MTL3	14	1.6	14-8 AWG
194R-60-MTL3	24	2.8	14-4 AWG
194R-TL1	275	31	6-300 MCM AWG
194R-TL2	275	31	6-300 MCM AWG
194R-TL3	550	62	4-600 MCM AWG
194R-TL4	550	62	4-600 MCM AWG
194R-TL5	200	22.6	6-2 AWG
194R-TL6	375	42.4	1-350 MCM AWG
194R-TL7	375	42.4	2-600 MCM AWG
194R-TL8	375	42.4	2-600 MCM AWG
194R-TL9	375	42.4	2-600 MCM AWG
194R-TL10	375	42.4	2-600 MCM AWG

BULLETIN 1489-M CIRCUIT BREAKERS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1489-M_	13.3	1.5	18-16 AWG
1489-M_	17.7	2	14-10 AWG
1489-M_	39.8	4.5	8-4 AWG

BULLETIN 1321 OPEN REACTORS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1321-3R1-A	4.5	0.51	22-14 AWG
1321-3R1-B	4.5	0.51	22-14 AWG
1321-3R1-C	4.5	0.51	22-14 AWG
1321-3R2-A	4.5	0.51	22-14 AWG
1321-3R2-B	4.5	0.51	22-14 AWG
1321-3R2-C	4.5	0.51	22-14 AWG
1321-3R4-A	4.5	0.51	22-14 AWG
1321-3R4-B	4.5	0.51	22-14 AWG
1321-3R4-C	4.5	0.51	22-14 AWG
1321-3R8-A	4.5	0.51	22-14 AWG
1321-3R8-B	4.5	0.51	22-14 AWG
1321-3R8-C	4.5	0.51	22-14 AWG
1321-3R12-A	16	1.81	22-6 AWG
1321-3R12-B	16	1.81	22-6 AWG
1321-3R12-C	16	1.81	22-6 AWG
1321-3R18-A	16	1.81	22-6 AWG
1321-3R18-B	16	1.81	22-6 AWG
1321-3R18-C	16	1.81	22-6 AWG
1321-3R25-A	16	1.81	22-6 AWG
1321-3R25-B	16	1.81	22-6 AWG
1321-3R25-C	16	1.81	22-6 AWG
1321-3R35-A	16	1.81	22-6 AWG
1321-3R35-B	16	1.81	22-6 AWG
1321-3R35-C	20	2.26	18-4 AWG
1321-3R45-A	20	2.26	18-4 AWG
1321-3R45-B	20	2.26	18-4 AWG
1321-3R45-C	20	2.26	18-4 AWG
1321-3R55-A	45	5.09	6-1/0 AWG
1321-3R55-B	45	5.09	6-1/0 AWG
1321-3R55-C	45	5.09	6-1/0 AWG
1321-3R80-A	45	5.09	6-1/0 AWG
1321-3R80-B	45	5.09	6-1/0 AWG
1321-3R80-C	45	5.09	6-1/0 AWG
1321-3R100-A	150	16.95	2-4/0 AWG
1321-3R100-B	150	16.95	2-4/0 AWG
1321-3R100-C	150	16.95	2-4/0 AWG
1321-3R130-A	150	16.95	2-4/0 AWG
1321-3R130-B	150	16.95	2-4/0 AWG
1321-3R130-C	150	16.95	2-4/0 AWG
1321-3R160-A	150	16.95	2-4/0 AWG
1321-3R160-B	150	16.95	2-4/0 AWG
1321-3R160-C	150	16.95	2-4/0 AWG

POWERFLEX 750 SERIES AC DRIVES POWER TERMINAL BLOCKS

FRAME SIZE	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1,2	5	0.57	24-10 AWG
3	10.6	1.2	20-6 AWG
4	24	2.7	14-3 AWG
5	35	4.0	8-1 AWG
6	100	11.3	M8 x 1.25STUD
7	100	11.3	M8 x 1.25STUD

BULLETIN 1494R TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1494R-N1	45	5.09	14-4 AWG
1494R-N2	150	16.95	8-1/0 AWG
1494R-N3	275	31	6-4/0 AWG
1494R-N10	325	36.72	(2) 1/0-350 AWG
1494R-N11	325	36.72	(2) 1/0-350 AWG
1494R-N12	375	42.37	1/0-500 AWG
1494R-N14	303	34.23	(2) 1/0-250 AWG
1494R-N15	415	46.89	4-500 AWG

BULLETIN 199 TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
199-LE1	150	16.9	8-1/0 AWG
199-LF1	275	31	6-250MCM AWG
199-LG1	375	42	4-500MCM AWG
199-LH1	275	31	1/0-350MCM AWG
199-LJ1	275	31	1/0-500MCM AWG

BULLETIN 100 TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
100-DL110	70-90	8.0-10	14-2/0 AWG
100-DLE110	70-90	8.0-10	8-2/0 AWG
100-DL180	90-110	10-12	6-300MCM AWG
100-DL420	375	42	4-350MCM AWG
100-DL630	400	45	2/0-500MCM AWG
100-DL860	400	45	2/0-500MCM AWG

HOFFMAN GROUND BAR

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
P-GS2K	40	4.5	- AWG
P-GS4K	40	4.5	- AWG
P-GS6K	40	4.5	- AWG

BURNDY GROUND LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
KPA8CTP	12	1.36	14-6 AWG
KA26U	120	13.6	6-2/0 AWG
KA31U	375	42.4	6-350MCM AWG
KA34U	500	56.5	4-500MCM AWG

USE COPPER, 60°C WIRE IF RATED LESS THAN 100 AMPS
OR 75°C WIRE IF RATED 100 AMPS OR MORE

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		DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

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TORQUE VALUES FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP | Date: 11/23/2020

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480VAC, 3PH, 60Hz
FLA= 61.7
SCCR= 65KA

LINE TERMINATION
WIRE RANGE
(1)#10AWG-250MCM

ROTARY
OPERATOR

1BCP030
480VAC
USER
SUPPLIED
BRANCH
CIRCUIT
PROTECTION

L1 1CB030 1030
L2 1050
L3 1060
100A
REM
GND
GND
PE-BUS
TO 5-02
TO 5-02
2.1 FLA

LINE PE TERMINATION
WIRE RANGE
(2)#14AWG-00AWG

1030
1050
1060
PE-BUS
1MOV140

18P AUTO TRANS
AND 5% REACTOR
ARE ONE ASSEMBLY

1030 1050 1060
59.6 FLA
1REAC110
A1 B1 C1
A2 B2 C2
1111 1112 1113

1PT140
57.5KVA (FA)
18 PULSE
AUTOTRANSFORMER
0001
H1 H2 H3
GND
PE-BUS

FROM 14-08
5100
TO 14-08
1180
1131
X1 X2 X3 X4 X5 X6 X7 X8 X9

1151
1152
1153
1154
1155
1156
1157
1158
1159

1EA260
T1 T2 D1 D2 D3 D4 D5 D6 D7 D8 D9
BRIDGE THERMOSTATS
SNUBBER BOARD(S)
BRIDGE OUTPUT
CHASSIS GND
PE-BUS
69.7 FLA
1370 1371
TO 11-03 TO 11-06
650 VDC

APPROVAL DOCUMENTS - 04-14-21 REV 01

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		DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

UL 508A LABEL REQUIRED

REV.	DATE	BY	ECN/CR. NO.

Rockwell Automation

SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
INCOMING POWER AND 18 PULSE FRONT END
PF753 50HP 18 PULSE VFD
Drawn by: JSP Date: 11/23/2020

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480VAC

FROM 1-08 1030 — 5F060 5A 600V CLASS CC 5070

FROM 1-09 1060 — 5F061 5A 600V CLASS CC 5071

SEE N/P

5T080 H1 H3 H2 H4 — 480 VAC 1000 VA — 120VAC

TB1 X1 — 5100 — 5F100 10A 250V CLASS M — 5102 — X1 X2 — 5101 — TB1 N

PE-BUS

120VAC

5F170 2A 250V FNM — 5170 — 5THERM170 — 5171 — 5CR170 — FAN CONTROL NO 5-35 NC

FAN TRAY ASSEMBLY

5F210 6A 250V FNM — 5210 — TB-FAN 1 — TB-FAN1 1 — 5MTR210 115V 0.57A — 5101 — TB-FAN1 2 — TB-FAN 3 — TB1 N — 18P-XFMR COOLING FAN 1

5MTR230 115V 0.57A — 18P-XFMR COOLING FAN 2

PE — TB-FAN1 3 — TB-FAN 4

TB-FAN 2 — TB-FAN2 1 — 5MTR270 115V 0.57A — 5101 — TB-FAN2 2 — 18P-XFMR COOLING FAN 3

5MTR280 115V 0.57A — 18P-XFMR COOLING FAN 4

PE-BUS

PE — TB-FAN2 3

TB-FAN IS MOUNTED TO THE TOP SIDE OF THE FAN TRAY, WHILE THE (4) FANS, TB-FAN1 & 2 ARE MOUNTED TO THE BOTTOM SIDE OF THE FAN TRAY.

5F350 6A 250V FNM — 5350 — 5CR170 5-17 — 5351 — D 5MTR350 115V 1.5A — TRANSFORMER BAY EXHAUST COOLING FAN TB1 N

PE — D 5MTR370 115V 1.5A — TRANSFORMER BAY EXHAUST COOLING FAN

COOLING FANS ARE MOUNTED AT THE TOP OF THE DOOR.

PE-BUS

TO 5-45 — TO 5-45

DATE	BY	APPROVAL
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		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

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120VAC

FROM 5-38 5100 TB1 X1 — TB1 X1 — TB2 X1 — 13 ESTOP HS-1111 — TB2 1 — HIGH TEMPERATURE CR2 5470 21 22 5471 5-71 — HIGH PRESSURE CR3 5472 21 22 5-74 — D 5SS470 OFF RUN REMOTE X□□ — 5473 — TB2 3 — DRIVE FAULT 14CR140 11 12 5474 14-14 — 5CR470 — FROM 5-38 5101 TB1 N — VFD CONTROL RELAY NO 14-06 NC

ESTOP TO SBR-CP

5500 □□X — TB2 2 — 13 START

5530 — 5CR530 — DRIVE NOT IN REMOTE NO 14-10,14-71 NC

□X□

X□□

DRIVE RUNNING 14CR080 11 14 14-08 — TB1 X1 — 5560 — D RUN 5LT560 G — TB1 N

DRIVE RUNNING 14CR080 11 12 14-08 — 5590 — D □FF 5LT590 R

DRIVE FAULT 14CR140 11 14 14-14 — TB1 X1 — 5620 — D FAULT 5LT620 A

13 TSH-1111 — TB1 X1 — TB2 X1 — OPENS ON HIGH TEMP. — TB1 4 — 5650 — CR1 — TB1 N NO NC 5-68

CR1 11 12 5-65 — 5680 — D HIGH TEMP 5LT680 A

HIGH TEMPERATURE CR2 11 14 5-71 — 5710 — 5PB710 — D RESET — CR2 — HIGH TEMPERATURE NO 5-71,14-71 NC 5-47

HIGH PRESSURE CR3 11 14 5-74 — 5740 — 5741 — CR3 — HIGH PRESSURE NO 5-74,14-71 NC 5-47

13 PSH-1111 — TB1 X1 — TB2 X1 — CLOSES HIGH PRESSURE — TB1 5 — D HIGH PRESSURE 5LT770 A

TB1 X1 — TB2 X1 — 120 VAC TO BLOWER CONTROL PANEL — TB2 N — TB1 N

TO 11-32,14-17 — TO 11-29,14-18

REV.	DATE	BY	ECN/CR. NO.

Rockwell Automation

SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
120VAC CONTROL POWER
PF753 50HP 18 PULSE VFD

Drawn by: JSP — Date: 11/23/2020

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POWERFLEX 753
MODULE -20F14FD077JA0NNNNN
11EA030

HEAVY DUTY
CONT RGT: 65 AMP
FRAME SIZE 5

FROM 1-39 ◁ 1371 — DC(+)
650 VDC
69.7 FLA
FROM 1-39 ◁ 1370 — DC(-)

DC TO AC INVERTER

U/T1 — 11030 — (L1) A1 — BLK — QT1 — RL1 — QT4 — BLK/WHITE — A2 (T1) — 11031 — 11PDB030 (L1)
V/T2 — 11050 — (L2) B1 — RED — QT2 — RL2 — QT5 — RED/WHITE — B2 (T2) — 11051 — (L2)
W/T3 — 11060 — (L3) C1 — BLUE — QT3 — RL3 — QT6 — BLUE/WHITE — C2 (T3) — 11061 — (L3)

LINE — LOAD

TCI: V1K80A00
RC1 RC2 RC3
C1 C2 C3
GRD.
11LF030

PE — PE — PE — PE — MPE

CHASSIS
CM CAP
PE-B
SEE USER MANUAL

MPE
MPE
LOAD TERMINATION
WIRE RANGE
(1)#14-#2AWG

11MTR050
REM
T1 T2 T3
M
GND
50 HP
460 VAC
65 FULL LOAD AMPS
? RPM (BASE)
60 HZ. (BASE)

NOTE:
VERIFY MOTOR NAMEPLATE DATA
AT COMMISSIONING.

SHOP NOTE:
USE FERRULES ON 11LF030,
11PDB030 MOTOR TB AND MPE
CONNECTIONS

NOTE:
PE-B JUMPER SHOULD BE
DISCONNECTED FOR USE IN HIGH
RESISTANCE GROUND SYSTEMS

TB1
- AO0-
- AO0+
- 10VC
- +10V
- AI0-
- AI0+
- PTC-
- PTC+
- TO
- 24VC
- +24V
- DI C
- DI 1
- DI 2

PE-B CM CAP [X] IN OUT
SETTINGS AS SHIPPED

J1 ENABLE [X] IN OUT
J2 SAFETY [X] IN OUT

BR1
BR2

NOTE: DEFAULT JUMPER POSITIONS:
- J1 = IN
- J2 = IN
-IF DRIVE IS REPLACED
VERIFY JUMPER SETTINGS

TB3
- DI 0DC
- DI C
- DI 0AC

TB2
- R0NC
- R0C
- R0ND

STS

DPI PORT 1
DPI PORT 2

FROM 5-81 ◁ 5101 — DI C
11300 — DI 0AC

120VAC

FROM 5-81 ◁ 5100 — TB2 6 — 11JMP320 JUMPER — TB2 7

NOTE:
TO INSTALL E-STOP OR CUSTOMER
INTERLOCKS, REMOVE WIRE
JUMPER BETWEEN TB2 6 & 7

D
KIT #: 20-HIM-C6S 11HIM330
DOOR MOUNTED
HUMAN INTERFACE
MODULE

INSTALL CLOCK BATTERY, PN-71582, CR1220, PRIOR TO TESTING

APPROVAL DOCUMENTS - 04-14-21 REV 01

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		DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

UL 508A LABEL REQUIRED

REV.	DATE	BY	ECN/CR. NO.

Rockwell Automation

SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
POWER AND MOTOR INTERFACE
PF753 50HP 18 PULSE VFD
Drawn by: JSP Date: 11/23/2020

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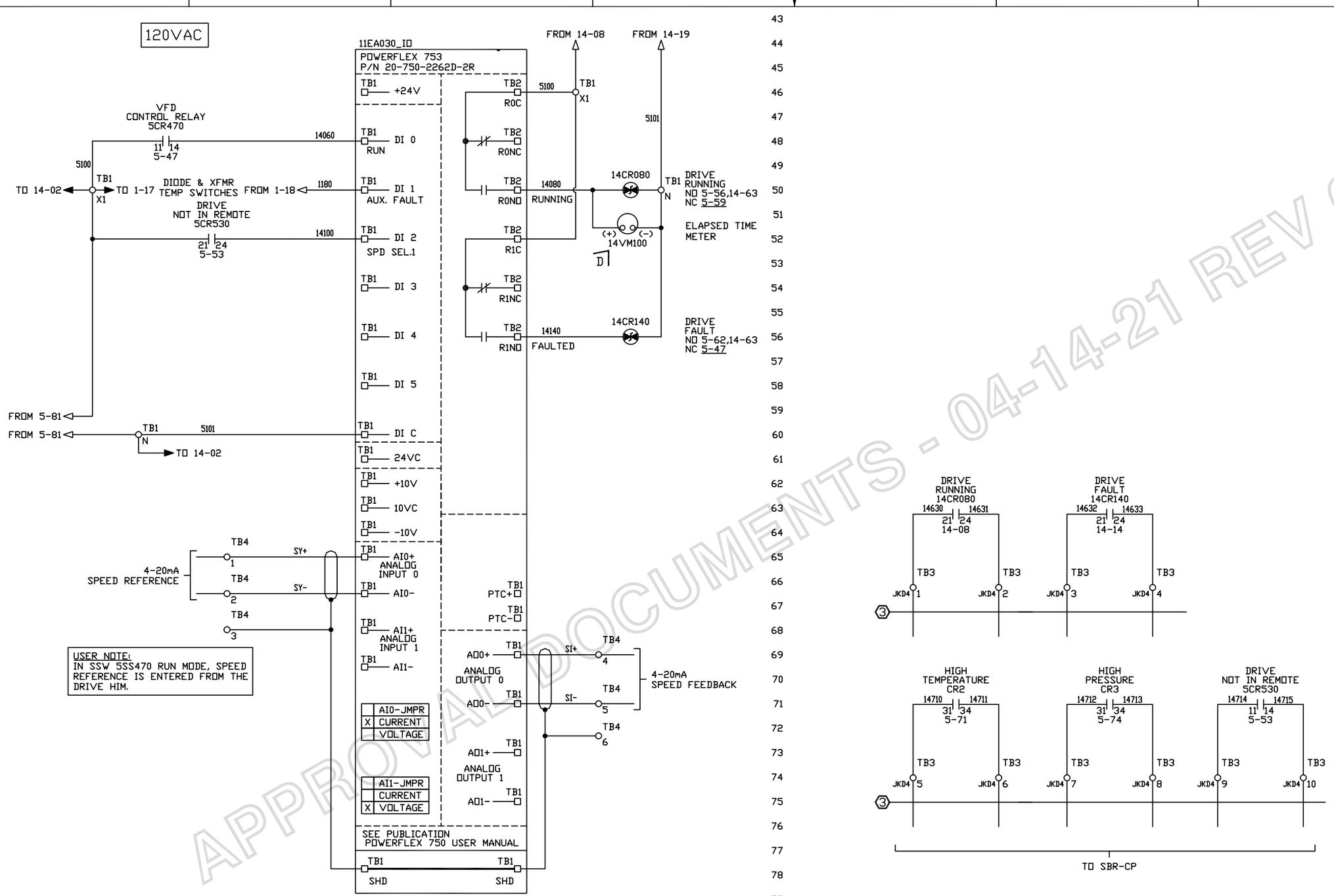

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SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
PORT 4 SLOT - 120VAC I/O MODULE
PF753 50HP 18 PULSE VFD

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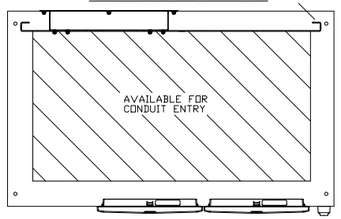
SHOP NOTE:

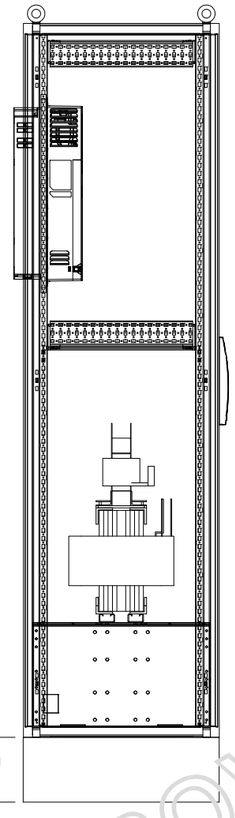
ROTATE THE FANS SO THAT THEY ARE NOT EXHAUSTING DOWN IN TO THE OPERATOR OCCUPIED AREA.

A) THE LEFT FAN NEEDS TO ROTATE 90° CLOCKWISE
B) THE RIGHT FAN NEEDS TO ROTATE 90° COUNTER CLOCKWISE.

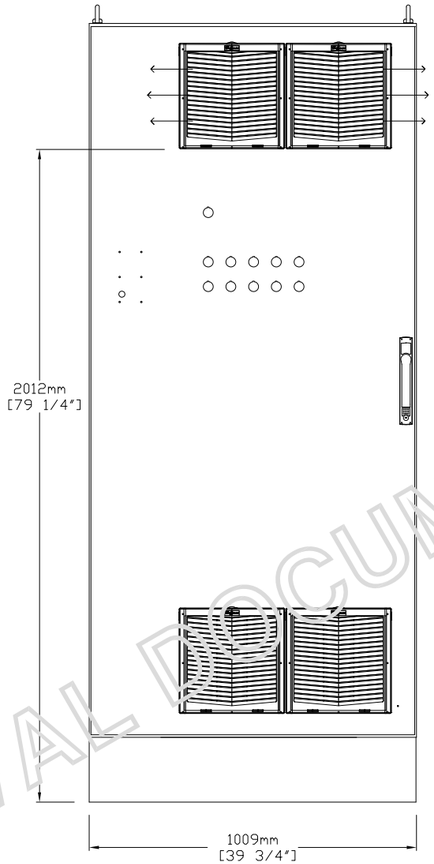
ENCLOSURE TOP VIEW



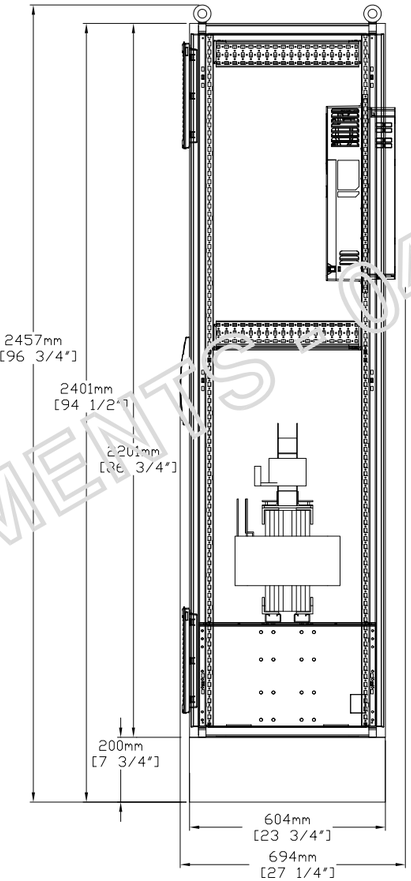
ENCLOSURE LEFT VIEW



ENCLOSURE FRONT VIEW

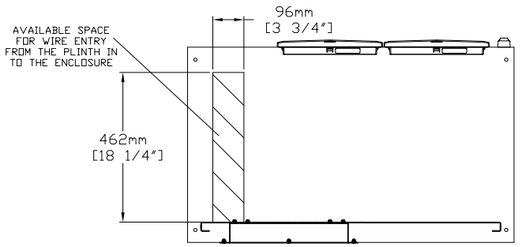


ENCLOSURE RIGHT VIEW



NOTE:
THE ENCLOSURE IS EQUIPPED WITH A 200MM SEALED PLINTH.

THE AVAILABLE SPACE FOR CONDUIT ENTRY IS 25.429 X 13.479 ON THE BASE AND TWO 13 X 2.75 SIDE WIREWAYS (LEFT/RIGHT).



TYPE 12 ENCLOSURE DESIGN
COLOR: RAL 7035 (GRAY)

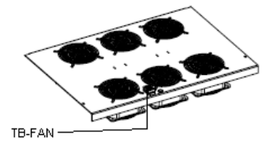
UL 508A LABEL REQUIRED

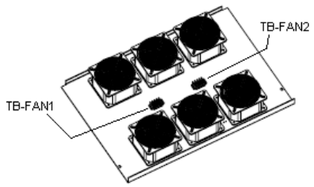
ENCLOSURE FANS

▲5MTR350
▲5MTR370

NOTE:
1. MOUNT TB-FAN ON THE TOP SIDE OF THE FAN TRAY ASSEMBLY.
2. MOUNT TB-FAN1 AND TB-FAN2 TO THE UNDERSIDE OF THE FAN TRAY ASSEMBLY. OTHERWISE IT DOESN'T PULL OUT PROPERLY.

TOP VIEW OF FAN TRAY ASSEM





BOTTOM VIEW OF FAN TRAY ASSEM

▲ENCL
▲UPPER_SUP
▲U_STRUT
▲UNISTRUT-NUT
▲XFMR_SUP-LH
▲XFMR_SUP-RH
▲XFMR_SUP-GUSSET
▲XFMR_BAFFLE_KIT
▲XFMR_SUP_BRK

4 FAN ASSEMBLY

▲FAN_TRAY_SUP
▲FAN_TRAY
▲5MTR210
▲5MTR230
▲5MTR270
▲5MTR280
▲5MTR_GUARD
▲TB-FAN
▲TB-FAN1
▲TB-FAN2
▲FAN-GROMMET

ENCLOSURE VENTS

▲BOT_INTAKE_VENTS

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DIMENSION DRAWING FOR
ITEM 0001
PF753 50HP 18 PULSE VFD

Drawn by: JSP | Date: 11/23/2020

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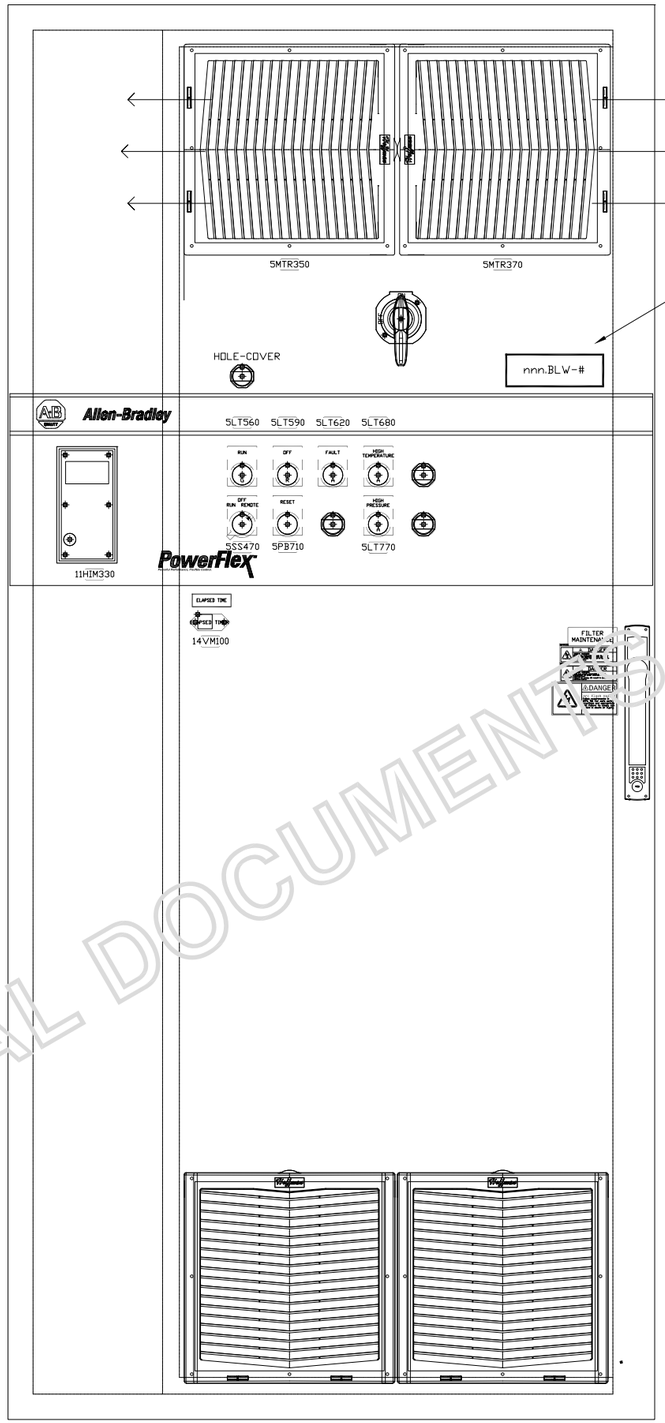

WHITE PHENOLIC
WITH BLACK
LETTERING

6"

MIX.BLW-4

2"

(MTD. ON BACK OF DOOR)

AFTER HOURS SUPPORT ON SITE FOR YOUR PARTS

(MTD. ON BACK OF DOOR)

Rockwell Automation

PROJECT#: R1USE01851

DIAGRAM: R1USE01851-0001
INPUT 480VAC 61.7 AMPS 3PH 60Hz
OUTPUT 480VAC 65 AMPS
LARGEST MOTOR: 50HP, 65AMPS
SHORT CIRCUIT CURRENT RATING:
65 KA RMS. SYMMETRICAL, 480VOLTS MAXIMUM
ENCLOSURE RATING: TYPE 12

Local Solution Center, Edison NJ 08837 USA

(MOUNT ON INSIDE & OUTSIDE OF DOOR)

UL LISTED
ENCLOSED INDUSTRIAL CONTROL PANEL
No: Xxxxxxx

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LAYOUT DRAWING FOR DOOR
ITEM 0001
PF753 50HP 18 PULSE VFD
Drawn by: JSP Date: 11/23/2020

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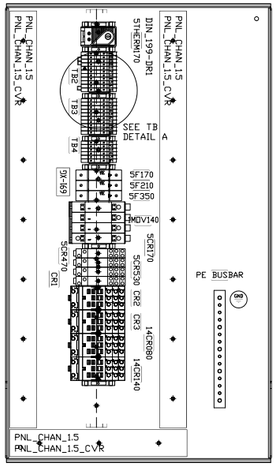
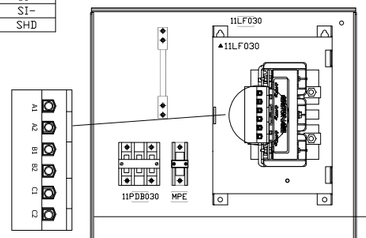
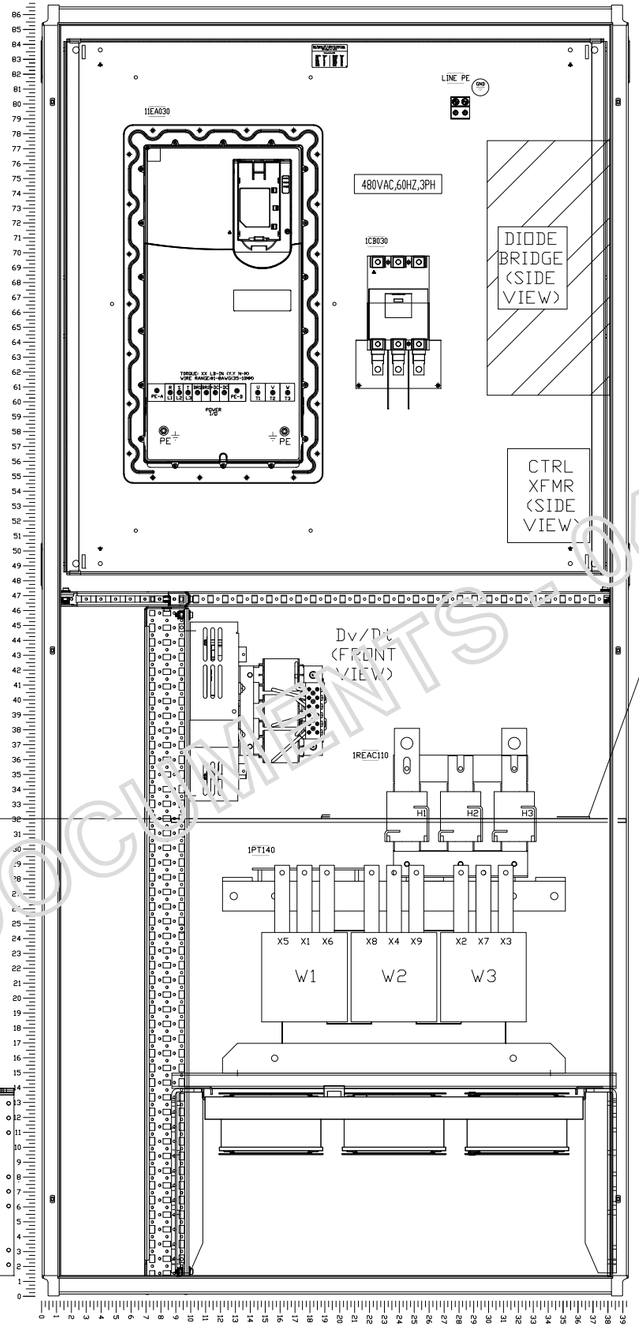
DETAIL A

STRIP-ID	TERM	WIREND
TB1	X1	5100
TB1	X1	5100
TB1	X1	5100
TB1	X1	5100
TB1	X1	5100
TB1	N	5101
TB1	N	5101
TB1	N	5101
TB1	N	5101
TB1	N	5101
TB2	N	5101
TB2	X1	5100
TB2	X1	5100
TB2	X1	5100
TB2	1	5470
TB2	2	5500
TB2	3	5473
TB2	4	5650
TB2	5	5741
TB2	6	5100
TB2	7	11300
TB3	1	14630
TB3	2	14631
TB3	3	14632
TB3	4	14633
TB3	5	14710
TB3	6	14711
TB3	7	14712
TB3	8	14713
TB3	9	14714
TB3	10	14715
TB4	1	SY+
TB4	2	SY-
TB4	3	SHD
TB4	4	SI+
TB4	5	SI-
TB4	6	SHD



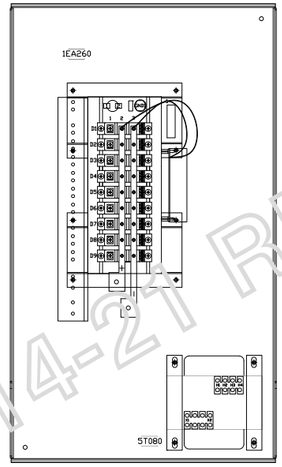


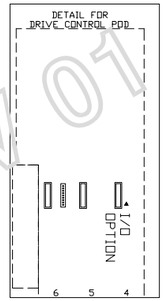


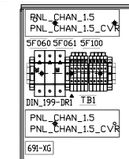
SHOP NOTE:
MOUNT INSIDE DOOR

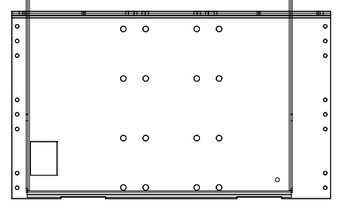
FUSE REPLACEMENT TABLE
REPLACE FUSES ONLY WITH EXACT TYPE, CLASS, AND RATING AS LISTED IN TABLE.

TAG	CLASS	TYPE	VOLTAGE	CURRENT
5F060	CC	TIME DELAY	600V	5A
5F061	CC	TIME DELAY	600V	5A
5F100	M	TIME DELAY	250V	10A
5F170	M	TIME DELAY	250V	2A
5F210	M	TIME DELAY	250V	6A
5F350	M	TIME DELAY	250V	6A









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Rockwell Automation

LAYOUT DRAWING FOR PANEL
ITEM 0001
PF753 50HP 18 PULSE VFD
Drawn by: JSP | Date: 11/23/2020

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D	R1USE01851 – 0001	01

Rockwell Automation

NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF

POWERFLEX 60HP HD 18 PULSE, TYPE 12

RA PROJECT# R1USE01851-0002

UL 508A

MIX.BLW-1, -2

APPROVAL DOCUMENTS - 04-14-21 REV 01

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TITLE SHEET FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP Date: 11/23/2020

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DRAWING INDEX FOR:
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
POWERFLEX 60HP HD 18 PULSE, TYPE 12
R1USE01851-0002

SH	SUBSEC	DRW_DESC1	DRW_DESC2	DRW_DESC3
N1	NOTES	TITLE SHEET FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N2	NOTES	INDEX SHEET FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N3	NOTES	GENERAL NOTES FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N4	NOTES	WIRE CLASSIFICATION FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N5	NOTES	TORQUE VALUES FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
1	0002	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	INCOMING POWER AND 18 PULSE FRONT END	PF753 60HP 18 PULSE VFD
5	0002	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	120VAC CONTROL POWER	PF753 60HP 18 PULSE VFD
11	0002	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	POWER AND MOTOR INTERFACE	PF753 60HP 18 PULSE VFD
14	0002	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	PORT 4 SLOT - 120VAC I/O MODULE	PF753 60HP 18 PULSE VFD
L0001	0002	DIMENSION DRAWING FOR	ITEM 0002	PF753 60HP 18 PULSE VFD
L0002	0002	LAYOUT DRAWING FOR DOOR	ITEM 0002	PF753 60HP 18 PULSE VFD
L0003	0002	LAYOUT DRAWING FOR PANEL	ITEM 0002	PF753 60HP 18 PULSE VFD

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INDEX SHEET FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

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DRAWING STANDARDS:

SYMBOLS:

- ⌊ REFERS TO NOTE GIVEN BELOW
- ▲ LOW POWER CONTACT
- ARROW INDICATES FUNCTION INCREASE (ALWAYS CLOCKWISE)

4⌋ **DANGER** – THIS EQUIPMENT MAY BE AT LINE VOLTAGE EVEN WHEN NOT IN OPERATION. TO AVOID ELECTRIC SHOCK, DISCONNECT.

5⌋ **CAUTION** – NEVER REMOVE OR INSERT ANY MODULE OR CARD WHILE THE POWER IS ON.

9⌋ REMOVE JUMPER IF ADDITIONAL INTERLOCK IS ADDED.

13⌋ SEPARATELY MOUNTED, SUPPLIED BY OTHERS

14⌋ SEPARATELY MOUNTED, SUPPLIED BY ROCKWELL AUTOMATION

32⌋ MOTOR STABILIZING FIELD, S1 AND S2, IS NOT REQUIRED FOR NORMAL OPERATION. TAPE S1 AND S2 SEPARATELY AND DO NOT USE.

33⌋ DRIVE MOTOR CONNECTIONS AS SHOWN ARE FOR INDICATED ROTATION FACING COMMUTATOR END. FOR OPPOSITE ROTATION, INTERCHANGE A1 AND A2 CONNECTIONS IN MOTOR CONDUIT BOX.

34⌋ TACHOMETER LEADS MUST BE CONNECTED TO GIVE THE INDICATED POLARITY.

35⌋ IF OPPOSITE ROTATION IS DESIRED, CHANGE POLARITY OF THE COSINE SIGNAL BY INTERCHANGING THE COSINE INPUT LEADS.

36⌋ USE TWISTED TWO - CONDUCTOR CABLE. THIS CABLE MUST BE IN A SEPARATE SIGNAL CONDUIT. IT CANNOT BE RUN WITH OTHER CONDUCTORS OR CABLES. USE RELIANCE PART NUMBER 417900-76EAD OR EQUIVALENT. REFER TO FIELD INSTALLATION AND WIRING TABLE ON NEXT SHEET FOR WIRE SPECIFICATIONS.

38⌋ SIGNAL WIRE CABLES WITH THIS NOTE NUMBER CAN BE IN THE SAME SIGNAL CONDUIT. THEY CANNOT BE RUN WITH NON-SIGNAL WIRES. REFER TO FIELD INSTALLATION AND WIRING TABLE ON NEXT SHEET FOR WIRE SPECIFICATIONS.

38-1⌋ REFER TO NOTE 38. THE NUMBER FOLLOWING THE NOTE 38 IDENTIFIES THE CABLES THAT MAY BE GROUPED TOGETHER IN THE SAME SIGNAL CONDUIT. FOR EXAMPLE, CABLES REFERENCED WITH NOTE 38-1 CANNOT BE RUN IN THE SAME SIGNAL CONDUIT WITH NOTE 38-2 CABLES.

40⌋ COAXIAL CABLES WITH THIS NOTE CAN BE IN THE SAME SEPARATE SIGNAL CONDUIT. THEY CANNOT BE RUN WITH OTHER CONDUCTORS OR CABLES. FOR RECOMMENDED CABLE TYPE, REFER TO PRODUCT'S NETWORK MANUAL.

TYPE	CABLE P/N (BELDEN P/N)	CONNECTOR P/N (AMPHENOL P/N)
RG59	417900-148A (9259)	405504-74A (31-212-1005)
RG11	417900-149A (8238)	612293-B (6775)

TERMINATOR 75 OHM
RELIANCE P/N 707204-20A
AMPHENOL P/N 46650-75

41⌋ **DANGER** – DO NOT OPEN DISCONNECT SWITCH WHILE THE MOTOR IS ENERGIZED.

47⌋ RESOLVER WIRES: LOW LEVEL SIGNAL WIRING. MUST BE RUN IN SEPARATE SIGNAL CONDUIT OR TRAY.

BELDEN P/N	NO. OF TWISTED PAIRS		AWG #	RECOMMENDED MAXIMUM DIST. FOR EACH RESOLVER TYPE a> X1	a> X2	a> X5
9730	3		24	1000 FT.	1000 FT.	600 FT.

a> DISTANCES BEYOND THOSE RECOMMENDED MAY REQUIRE ADDITIONAL TUNING. USE RELIANCE CUSTOM PANEL 0-58801

b> MAY ONLY BE RUN IN CONDUIT, PER NEC

c> NOTE: CONNECT CABLE SHIELD TO GROUND AT CABINET ONLY

48⌋ FIBER-OPTIC CABLES WITH THIS NOTE MAY BE RUN WITH ANY LEVEL 1 SIGNAL WIRING. IF NECESSARY THESE CABLES MAY BE RUN WITH ANY LEVEL WIRING. SEE INSTALLATION MANUAL FOR RESTRICTIONS.

52⌋ REFER TO TRANSFORMER NAMEPLATE FOR CONNECTIONS OF PRIMARY LEADS.

53⌋ **DANGER** – TRANSFORMER IS CONNECTED TO LINE VOLTAGE EVEN WHEN THE A-C DISCONNECT IS OPEN.

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99⌋ USER SUPPLIED PROTECTION MUST INCLUDE A DISCONNECTING DEVICE ON THE PRIMARY SIDE OF THE TRANSFORMER. PRIMARY AND SECONDARY WIRE PROTECTION FOR THE ISOLATION TRANSFORMER MUST BE PROVIDED PER NEC.

D⌋ MOUNTED ON DOOR.

H⌋ MOUNTED ON CABINET HOOD

R⌋ MOUNTED ON CONTROL HOUSE ROOF

T⌋ MOUNTED ON CABINET TRIM

E⌋ EXISTING EQUIPMENT

N⌋ NEW EQUIPMENT

USE EXAMP. LOCATION CODES	DESCRIPTION
REM_NS	REMOTE MOUNTED - NOT SUPPLIED BY ROCKWELL AUTOMATION.
REM_S	REMOTE MOUNTED - SUPPLIED BY ROCKWELL AUTOMATION.
REM	REMOTE MOUNTED.
OS_2	MTD. ON OPERATORS STATION No. 2
PB_3	MTD. ON PUSHBUTTON STATION No. 3

GENERAL NOTES:

1. FOR FURTHER DRIVE INFORMATION ON INSTRUCTION MANUALS, SEE RESPECTIVE SCHEMATIC SECTIONS.
2. ⏚ - BUILDING GROUND TO BE GROUNDED BY CUSTOMER.
   TE - SYSTEM ZERO POTENTIAL NODE
   PE - POWER EQUIPMENT GROUND
   ⏚ - PANEL (CHASSIS) GROUND
3. THE INTERNAL WIRING SELECTED MEETS OR EXCEEDS NEC, UL, AND CSA. INTERNAL POWER AND CONTROL WIRE HAS INSULATION RATED AT 105°C OR HIGHER.
4. * -INDICATES COMPONENTS SUPPLIED BY OTHERS.
5. (4) INDICATES FIELD INSTALLED WIRES AS WELL AS THE WIRING LEVEL.
   WHEN ACCOMPANIED WITH THE DESIGNATION (FWC) THE WIRES/CABLE ARE PRE-SUPPLIED AT THE SOURCE CONNECTION BY ROCKWELL FOR CUSTOMER INSTALLATION AT SITE. (FWC) INDICATES FURNISHED WITH CABINET.
6. —○— -INDICATES OUTGOING TERMINAL.
   —□— -INDICATES TERMINAL ON ELECTRONIC ASSEMBLY PRINTED CIRCUIT BOARD (1EA) ETC.
   CR —⊗— -INDICATES RELAY OR CONTACTOR WITH SUPPRESSOR.
7. COIL AND CONTACT CROSS REFERENCING - NUMBERS ADJACENT TO COIL AND UNDER CONTACT INDICATE SHEET AND LINE NUMBERS.
   101-03 —| |— —◯— NO 101-03 ← -INDICATES LINE NO. 03.
   NC ← -INDICATES SHEET NO. 101.
   NO - INDICATES NORMALLY OPEN CONTACTS
   NC - INDICATES NORMALLY CLOSED CONTACTS

   OFF-PAGE CROSS REFERENCING - NUMBERS ADJACENT TO SOURCE AND DESTINATION SYMBOLS INDICATE SHEET AND LINE NUMBERS.
   FROM 1-24 ← 1-24 ← -INDICATES LINE NO. 24.
   TO 1-24 ← -INDICATES SHEET NO. 1.

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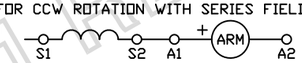
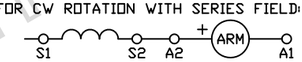
8. WIRE # GENERATION
   11242
   - 1 - INDICATES WIRE NUMBER.
   - 2 - INDICATES SEQUENCE (1,2,, 3 . . . etc.).
   - 4 - INDICATES LINE NUMBER 24.
   - 11 - INDICATES SHEET NUMBER 11.

   INTERNAL WIRE NUMBERS MAY BE 'FIXED' WITH A LINE AND SEQUENCE, BUT MAY SCHEMATICALLY SHOW A PREFIX.
9. TYPICAL DUAL VOLTAGE MOTOR FIELD CONNECTIONS ARE SHOWN BELOW. CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.

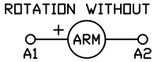
10. DC MOTOR ROTATION - CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.
    FOR CCW ROTATION FACING COMMUTATOR END:
    A1 IS POSITIVE
    F1 IS POSITIVE
    FOR CW ROTATION FACING COMMUTATOR END:
    A2 IS POSITIVE
    F1 IS POSITIVE
    FOR CCW ROTATION WITH SERIES FIELD:



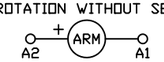
    FOR CW ROTATION WITH SERIES FIELD:



    FOR CCW ROTATION WITHOUT SERIES FIELD:



    FOR CW ROTATION WITHOUT SERIES FIELD:



11. AC MOTOR ROTATION - CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.
    FOR CW ROTATION VIEWED FROM MOTOR SHAFT:
    INVERTER OUTPUT U2 TO T1 (EUROPEAN MARKING U1)
    V2 TO T2 (EUROPEAN MARKING V1)
    W2 TO T3 (EUROPEAN MARKING W1)
    FOR CCW ROTATION VIEWED FROM MOTOR SHAFT:
    INVERTER OUTPUT U2 TO T1 (EUROPEAN MARKING U1)
    V2 TO T3 (EUROPEAN MARKING W1)
    W2 TO T2 (EUROPEAN MARKING V1)

    NOTE: NOT ALL AC MOTOR SUPPLIERS COMPLY WITH THE ABOVE CONVENTIONS.

COMBINATION MOTOR CONTROLLER WITH MOTOR CIRCUIT PROTECTOR

DANGER: To maintain overcurrent, short circuit and ground fault protection, the manufacturer's instructions for selecting current elements and setting the instantaneous-trip circuit breaker must be followed.

AVERTISSEMENTPour assurer une protection continue contre les surintensités, les court-circuits et une mise à la terre accidentelle, il est essentiel de choisir les ?el?ements thermiques et de régler le disjoncteur à déclenchement instantané selon la notice technique du fabricant.

Determine motor full load current and motor design type identifier from motor nameplate.

For Design B, C an D motors adjust motor circuit protector to operate at a current setting between ten (10) and thirteen (13) times the full load current. For Design E and N motors adjust motor circuit protector to operate at a current setting between thirteen (13) and seventeen (17) times the full load current.

NOTE: Motor circuit protector is set at minimum current setting when shipped from factory.

DANGER: Tripping of the instantaneous-trip circuit breaker is an indication that a fault current has been interrupted. Current carrying components of the magnetic motor controller should be examined and replaced if damaged, to provide continued protection against a risk of fire or electric shock. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced. (Refer to NEMA Standards Publication No. ICS 2.2 titled: 'Maintenance of Motor Controllers After a Fault Condition' Ñ also published as NEMA Standard Publication No. ICS 2, Part ICS 2-302.)

AVERTISSEMENTL'ouverture du disjoncteur à déclenchement instantané indique qu'un courant de défaut a été interrompu. Les composants conducteurs de la commande magnétique du moteur doivent être inspectés et remplacés s'ils ont subi des dommages, afin d'assurer une protection continue contre le risque d'incendie et de choc électrique. En cas de défaillance de l'élément thermique d'un relais de surcharge, celui-ci doit être remplacé dans sa totalité.

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GENERAL NOTES FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP Date: 11/23/2020

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FIELD INSTALLATION AND WIRING

CATEGORY	WIRING LEVEL	SUB-GROUP	SIGNAL DEFINITION	SIGNAL EXAMPLES	CABLE TYPE	MINIMUM SPACING IN INCHES BETWEEN LEVELS (STEEL CONDUIT/TRAY) 4S	4	3	3S	2	2S	1	SPACING NOTES
POWER (SEE NOTE 2-C FOR SPACING BELOW)	4	S	AC POWER (> 1000VAC)	2.3KV 3 PHASE AC LINES	PER NEC AND LOCAL CODES	SEE NOTE: 7	SEE NOTE: 7	SEE NOTE: 7		SEE NOTE: 7		SEE NOTE: 7	1 2 5
			AC POWER (TO 1000VAC)	480V 3 PHASE AC LINES	PER NEC AND LOCAL CODES								
			DC POWER	DC MOTOR ARMATURE	PER NEC AND LOCAL CODES		0	3/6		3/12		3/9	
			DC POWER	REGULATED DC MOTOR FIELD	PER NEC AND LOCAL CODES								
CONTROL (300V MAX OR 20 AMPS)	3		115VAC/VDC LOGIC	RELAY LOGIC, PLC I/O	PER NEC AND LOCAL CODES	SEE NOTE: 7	3/6	0		3/9		1/3	
			115VAC POWER	POWER SUPPLIES, INSTRUMENTS									
		S	24VAC/VDC LOGIC	PLC I/O	PER NEC AND LOCAL CODES								
MEDIUM LEVEL SIGNAL (PROCESS)	2		ANALOG SIGNALS DC SUPPLIES	REF/FEEDBACK SIGNAL, 5 TO 24VDC SUPPLIES	SHIELDED CABLE BELDEN 8770, 9418	SEE NOTE: 7	3/12	3/9		0		1/1	2 3 4 5 6
			DIGITAL (LOW SPEED)	TTL									
		S	DIGITAL (HIGH SPEED)	RESOLVER, ENCODER/COUNTER I/O, PULSE TACH FEEDBACK	SHIELDED CABLE BELDEN 9730, 9773, 9892 (SEE USER MANUAL)								
		SHLD	ANALOG SIGNALS	REF/FEEDBACK SIGNALS	SHIELDED CABLE, TWISTED CONDUCTORS BELDEN 8760, 9729								
LOW LEVEL SIGNAL (COMM.)	1		SERIAL COMMUNICATION	RS232, 422 TO TERMINALS, PRINTERS	SHIELDED CABLE RS232-BELDEN 8770,8760 RS422-BELDEN 9729,9730	SEE NOTE: 7	3/9	1/3		1/1		0	
		S	PLC SERIAL COMMUNICATION (> 20K BAUD)	PLC REMOTE I/O, PLC DATA HIGHWAY	TWINAXIAL CABLE BELDEN 9463 R-A 1770-CD								
		C	PLC SERIAL COMMUNICATION (> 5MB)	CONTROL NET	RG-6 QUAD SHIELD, COAX CABLE; A-B 1786-RG6 BELDEN 3092A								
		D	CAN COMMUNICATION	DEVICE - NET DRIVE - DRIVE	R-A 1485C-P1-C								
		E	ETHERNET	ETHERNET	R-A 1585								
		F	COMMUNICATION (> 5MB)	CONTROLNET ETHERNET	FIBER OPTIC		N/A	N/A		N/A		N/A	N/A

EXAMPLE: SPACING RELATIONSHIP BETWEEN 480VAC INCOMING LEADS
a. 480VAC LEADS ARE LEVEL 4.
b. 24VDC LEADS ARE LEVEL 3.
c. FOR SEPARATE STEEL CONDUITS, THE CONDUITS ARE TO BE 3 INCHES APART.
d. IN A CABLE TRAY THE TWO GROUPS OF LEADS ARE TO BE 6 INCHES APART.

SHIELDED CABLES RECOMMENDATIONS:

BELDEN	8770	18 AWG - 3 CONDUCTOR SHIELDED
BELDEN	8760	18 AWG - 2 CONDUCTOR SHIELDED
BELDEN	9418	18 AWG - 4 CONDUCTOR SHIELDED
BELDEN	9728	24 AWG - 4 SHIELDED PAIRS (8 COND.)
BELDEN	9729	24 AWG - 2 SHIELDED PAIRS (4 COND.)
BELDEN	9730	24 AWG - 3 SHIELDED PAIRS (6 COND.)
BELDEN	9892	20 AWG - 4 SHIELDED PAIRS (8 COND.)
BELDEN	9773	18 AWG - 3 SHIELDED PAIRS (6 COND.)
BELDEN	9463	75 OHM - TWINAXIAL (2 COND.)

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FIELD WIRING INSIDE ROCKWELL ENCLOSURE:

1. CONNECTIONS WILL BE ONLY TO TERMINALS PROVIDED.
2. WIRE LENGTH FROM ENTRY POINT TO TERMINAL BOARD TO BE AS SHORT AS POSSIBLE.
3. SIGNAL WIRE MUST NOT BE LACED OR RUN WITH NON-SIGNAL WIRE AFTER ENTRY INTO THE ENCLOSURE.
4. INCOMING WIRE MUST NOT BE ROUTED IN WIRE CHANNELS OR THROUGH AREAS OF POWER AND CONTROL COMPONENTS AND WIRING.
5. USE LASHING BARS WHEN PROVIDED FOR CUSTOMER CONVENIENCE.

FIELD INSTALLATION GROUNDING GUIDELINES

1. FOR DRIVES INSTALLATION, REFER TO 'WIRING AND 'GROUNDING GUIDELINES', PUBLICATION DRIVES-IN001
2. FOR POWERFLEX SAR INSTALLATION, REFER TO 'POWERFLEX DC 'STANDALONE REGULATOR AND GATE AMPLIFIER USER MANUAL', PUBLICATION 23P-UM001_-EN-P
3. FOR PLC AND I/O INSTALLATION, REFER TO 'INDUSTRIAL AUTOMATION WIRING AND GROUNDING GUIDELINES', PUBLICATION 1770-4.1
4. NEC ARTICLE 250, GROUNDING AND BONDING
5. LOCAL CODE REQUIREMENTS

GENERAL NOTES:

1. STEEL CONDUIT IS RECOMMENDED FOR LEVELS 1 AND 2. FOR AC MOTOR CABLES, SEE NOTE 5.
   ALL CONDUITS CONNECTED TO THE CABINETS SHOULD BE PROPERLY SEALED TO MINIMIZE AIR OR WATER ENTRY INTO THE CABINETS. IF ALUMINUM CONDUIT IS USED.
   A. IT REQUIRES THE SAME MINIMUM SPACING IS USED AS THAT SHOWN FOR CABLE TRAYS.
   OR
   B. INDIVIDUAL STEEL JACKETED (STEEL MESH) CABLES ARE TO BE USED IF THE CONDUIT SPACINGS NEED BE THE SAME AS STEEL CONDUIT.
2. SPACING SHOWN BETWEEN LEVELS IS THE MINIMUM REQUIRED FOR PARALLEL RUNS ≤ 400 FEET. GREATER SPACINGS SHOULD BE USED WHERE POSSIBLE.
3. SHIELDS FOR SHIELDED CABLES MUST BE CONNECTED AT ONE END ONLY. THE OTHER END SHOULD BE CUT BACK AND INSULATED. SHIELDS FOR CABLES FROM A CABINET TO AN EXTERNAL DEVICE MUST BE CONNECTED AT CABINET END. SHIELDS FOR CABLES FROM ONE CABINET TO ANOTHER MUST BE CONNECTED AT THE SOURCE END CABINET. SPLICING OF SHIELDED CABLES, IF ABSOLUTELY NECESSARY, SHOULD BE DONE SUCH THAT SHIELD(S) REMAIN CONTINUOUS AND INSULATED FROM GROUND.
4. NO. 16 AWG WIRE IS THE MINIMUM RECOMMENDED SIZE FOR CONTROL (LEVEL 3). POWER WIRE IS SELECTED BY LOAD, USING 75 DEG C WIRE RATING (LEVELS 4 AND 4S).
5. ARMORED CABLE WITH A PVC OUTER JACKET IS REQUIRED TO PROVIDE THE NECESSARY ELECTRICAL SHIELDING FOR AC MOTOR CABLES CONNECTED TO A PWM INVERTER.
   RECOMMENDATIONS:
   METALLIC ARMOR:
   BEST PERFORMANCE: SHIELDED BELDEN CABLE PER TABLE BELOW, OR CONTINUOUS CORRUGATED ALUMINUM
   ACCEPTABLE PERFORMANCE: INTERLOCKED ALUMINUM, OR INTERLOCKED STEEL
   CONDUCTORS:
   BEST PERFORMANCE: PHASE CONDUCTORS - 3, GROUND CONDUCTORS - 3
   ACCEPTABLE PERFORMANCE: PHASE CONDUCTORS - 3, GROUND CONDUCTORS - 1
   THE CABLE CONNECTOR SELECTED MUST PROVIDE A GOOD ELECTRICAL CONNECTION BETWEEN THE ARMOR AND THE PE GROUND PLANE AT EACH END OF THE CABLE.
   SHIELDED CABLE RECOMMENDATIONS:

BELDEN	29500	#16 AWG
BELDEN	29501	#14 AWG
BELDEN	29502	#12 AWG
BELDEN	29503	#10 AWG
BELDEN	29504	#8 AWG
BELDEN	29505	#6 AWG
BELDEN	29506	#4 AWG
BELDEN	29507	#2 AWG

   DESCRIPTION - 4 CONDUCTOR TINNED COPPER, XLPE INSULATION, 600VRMS MAX, SPECIFICALLY DESIGNED FOR IGBT DRIVE APPLICATIONS. THE SHIELD SHOULD BE CONNECTED TO THE PE GROUND PLANE
6. SEE A-B PUBLICATION AG2.2 FOR ADDITIONAL CONTROLNET COAX CABLE RECOMMENDATIONS.

SPACING NOTES:

1. BOTH OUTGOING & RETURN CURRENT CARRYING CONDUCTORS ARE TO BE PULLED IN THE SAME CONDUIT OR LAYERED ADJACENT IN CABLE TRAY.
2. ROUTE CABLES OF THE FOLLOWING LEVELS AS INDICATED:
   A. LEVELS MUST BE RUN IN SEPARATE CONDUITS OR TRAYS.
   B. INTERMIXING OF LEVELS IS NOT ALLOWED.
   C. SPECIAL LEVELS 4S AND 3S MAY EXIST THAT REQUIRE SPECIFIC WIRES TO BE GROUPED FOR SPECIAL HANDLING.
   NOTE: FOR LEVELS 3 AND 4, THE AMPACITY RATINGS OF CONDUCTORS IN A BUNDLE MAY NOT EXCEED THE DERATING GUIDELINES OF NEC 310.15(2), AND TABLE 310.15(B)(2)a.
   D. LEVELS 1 AND 2 MAY HAVE THEIR RESPECTIVE CIRCUITS (WITHIN A GIVEN LEVEL) PULLED IN THE SAME CONDUIT OR LAYERED ADJACENT IN THE SAME CABLE TRAY.
   NOTE: THE RESPECTIVE CIRCUITS IN A GIVEN BUNDLE MAY EXPERIENCE SOME AMOUNT OF EMI COUPLING. SOME CIRCUIT APPLICATIONS MAY DICTATE SEPARATE SPACING.
3. CONDUCTORS OF LEVELS 1 AND 2 MUST BE SHIELDED WHERE INDICATED PER THE RECOMMENDATIONS OR EQUIVALENT.
4. IN CABLE TRAYS, STEEL SEPARATORS ARE ADVISABLE BETWEEN THE LEVELS.
5. IF CONDUIT IS USED IT IS REQUIRED THAT IT BE CONTINUOUS AND COMPOSED OF MAGNETIC STEEL. (SEE GENERAL NOTE 1 ABOVE)
6. FOR FURTHER INFORMATION ON SPACING OF PLC COMMUNICATION CABLES TO LEVEL 4, SEE R-A PLC INSTALLATION MANUAL.
7. PER NEC ARTICLE 300-3(C)(2) , CONDUCTORS OF CIRCUITS RATED OVER 1000V, NOMINAL, SHALL NOT OCCUPY THE SAME WIRING ENCLOSURE, CABLE, OR RACEWAY WITH CONDUCTORS 1000V NOMINAL OR LESS UNLESS PERMITTED BY NEC 300.3(C)(2)(a) THROUGH 300.3(C)(2)(D).

COIL AND SOLENOID SUPPRESSION:

BEFORE UTILIZING THE CONTROL CIRCUIT POWER AVAILABLE FOR OPERATION OF CUSTOMER SUPPLIED DEVICES, THE COILS OR SOLENOIDS OF SUCH DEVICES MUST BE SUPPRESSED. THE EXTERNAL CONTROL CIRCUIT WIRING MUST BE RUN IN A SEPARATE CONDUIT THAT DOES NOT HAVE VARIABLE SIGNAL VOLTAGES OR POWER CIRCUIT VOLTAGES PRESENT. ELECTRICAL TRANSIENTS MAY CAUSE OCCASIONAL DRIVE MALFUNCTIONING.

APPROVAL DOCUMENTS - CRM 4-21 REV 01

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WIRE CLASSIFICATION FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP Date: 11/23/2020

Sheet N4 Of Next Sh N5

Size D | R1USE01851-0002 | Ver 01

WIRE TERMINATION TORQUE VALUES

BULLETIN 1492 TERMINAL BLOCKS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1492-H4	7.1	0.8	30-12 AWG
1492-H5	7.1	0.8	30-12 AWG
1492-H6	7.1	0.8	30-12 AWG
1492-H7	7.1	0.8	30-12 AWG
1492-J3	4.5-7.1	0.5-0.8	22-12 AWG
1492-JD3	4.5-7.1	0.5-0.8	22-12 AWG
1492-J4	9.0	1.0	22-10 AWG
1492-JD4	4.5	0.5	26-10 AWG
1492-J6	14.2	1.6	22-8 AWG
1492-J10	20.4	2.3	18-6 AWG
1492-J16	35.0	4.0	18-6 AWG
1492-J35	51.0	5.8	12-1/0 AWG
1492-J50	31.5	3.6	10-1/0 AWG
1492-J70	87.0	9.8	6-2/0 AWG
1492-J120	141.6	16.0	4-250MCM AWG
1492-JG3	7.1	0.8	22-12 AWG
1492-JG4	9.0	1.0	22-10 AWG
1492-JG6	14.2	1.6	22-8 AWG
1492-JG10	20.4	2.3	16-6 AWG
1492-JG16	35.0	4.0	24-4 AWG
1492-JG35	51.0	5.8	12-1 AWG
1492-JG50	31.5	3.6	10-1/0 AWG
1492-JG70	87.0	9.8	6-2/0 AWG
1492-JG120	88.5	10	4-3/0 AWG

BULLETIN 1492 FUSE BLOCKS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1492-FB1C30 (-L)	22	2.5	18-8 AWG
1492-FB1C30 (-L)	26	2.5	6-4 AWG
1492-FB2C30 (-L)	22	2.5	18-8 AWG
1492-FB2C30 (-L)	26	2.5	6-4 AWG
1492-FB3C30 (-L)	22	2.5	18-8 AWG
1492-FB3C30 (-L)	26	2.5	6-4 AWG
1492-FB1M30 (-L)	22	2.5	18-8 AWG
1492-FB1M30 (-L)	26	2.5	6-4 AWG
1492-FB2M30 (-L)	22	2.5	18-8 AWG
1492-FB2M30 (-L)	26	2.5	6-4 AWG
1492-FB3M30 (-L)	22	2.5	18-8 AWG
1492-FB3M30 (-L)	26	2.5	6-4 AWG
1492-FB1J30 (-L)	35	4	18-1 AWG
1492-FB2J30 (-L)	35	4	18-1 AWG
1492-FB3J30 (-L)	35	4	18-1 AWG
1492-FB1J60 (-L)	35	4	14-1 AWG
1492-FB2J60 (-L)	35	4	14-1 AWG
1492-FB3J60 (-L)	35	4	14-1 AWG

BULLETIN 100 CONTACTORS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
100-C09	13-22	1.5-2.5	(2) 16-10 AWG
100-C12	13-22	1.5-2.5	(2) 16-10 AWG
100-C16	13-22	1.5-2.5	(2) 16-10 AWG
100-C23	13-22	1.5-2.5	(2) 16-10 AWG
100-C30	22-31	2.5-3.5	14-6 AWG
100-C37	22-31	2.5-3.5	14-6 AWG
100-C43	22-31	2.5-3.5	14-6 AWG
100-C60	40-53	4.5-6.0	14-1 AWG
100-C72	40-53	4.5-6.0	14-1 AWG
100-C85	40-53	4.5-6.0	14-1 AWG
100-C97	40-53	4.5-6.0	14-1 AWG

BULLETIN 140G CIRCUIT BREAKERS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
140G-G-TLC1_	62	7.0	(1) 14-1/0 AWG
140G-G-MTL6_	62	7.0	(6) 14-2 AWG
140G-H-TLC1_	62	7.0	(1) 14-1/0 AWG
140G-H-MTL6_	62	7.0	(6) 14-2 AWG
140G-I-TLA1_	50	5.6	(1) 14-1/0 AWG
140G-I-TLA1A_	200	22.6	(1) 4-300 MCM AWG
140G-I-TLC1_	124	14.0	(1) 10-250 MCM AWG
140G-I-MTL6_	62	7.0	(6) 12-2 AWG
140G-J-TLA1_	50	5.6	(1) 14-1/0 AWG
140G-J-TLA1A_	200	22.6	(1) 4-300 MCM AWG
140G-J-TLC1_	124	14.0	(1) 10-250 MCM AWG
140G-J-MTL6_	62	7.0	(6) 12-2 AWG
140G-K-TLA1_	380	43	(1) 250-500 MCM AWG
140G-K-TLA2_	380	43	(2) 2/0-250 MCM AWG
140G-K-TLC1_	380	43	(1) 250-500 MCM AWG
140G-K-TLC2_	380	43	(2) 2/0-250 MCM AWG
140G-K-MTL6_	62	7	(6) 6-1/0 AWG
140G-M-TLA2_	274	31	(2) 250-500 MCM AWG
140G-M-TLA3_	380	43	(3) 2/0-400 MCM AWG
140G-M-TLC2_	274	31	(2) 3/0-350 MCM AWG
140G-M-TLC3_	380	43	(3) 2/0-350 MCM AWG
140G-N-TLA4_	380	43	(4) 4/0-500 MCM AWG
140G-N-TLC4_	380	43	(4) 4/0-500 MCM AWG

'_' IS EITHER 3 OR 4 DEPENDING ON HOW MANY POLES THE BREAKER HAS

BULLETIN 194R TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
194R-30-MTL3	14	1.6	14-8 AWG
194R-60-MTL3	24	2.8	14-4 AWG
194R-TL1	275	31	6-300 MCM AWG
194R-TL2	275	31	6-300 MCM AWG
194R-TL3	550	62	4-600 MCM AWG
194R-TL4	550	62	4-600 MCM AWG
194R-TL5	200	22.6	6-2 AWG
194R-TL6	375	42.4	1-350 MCM AWG
194R-TL7	375	42.4	2-600 MCM AWG
194R-TL8	375	42.4	2-600 MCM AWG
194R-TL9	375	42.4	2-600 MCM AWG
194R-TL10	375	42.4	2-600 MCM AWG

BULLETIN 1489-M CIRCUIT BREAKERS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1489-M_	13.3	1.5	18-16 AWG
1489-M_	17.7	2	14-10 AWG
1489-M_	39.8	4.5	8-4 AWG

BULLETIN 1321 OPEN REACTORS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1321-3R1-A	4.5	0.51	22-14 AWG
1321-3R1-B	4.5	0.51	22-14 AWG
1321-3R1-C	4.5	0.51	22-14 AWG
1321-3R2-A	4.5	0.51	22-14 AWG
1321-3R2-B	4.5	0.51	22-14 AWG
1321-3R2-C	4.5	0.51	22-14 AWG
1321-3R4-A	4.5	0.51	22-14 AWG
1321-3R4-B	4.5	0.51	22-14 AWG
1321-3R4-C	4.5	0.51	22-14 AWG
1321-3R8-A	4.5	0.51	22-14 AWG
1321-3R8-B	4.5	0.51	22-14 AWG
1321-3R8-C	4.5	0.51	22-14 AWG
1321-3R12-A	16	1.81	22-6 AWG
1321-3R12-B	16	1.81	22-6 AWG
1321-3R12-C	16	1.81	22-6 AWG
1321-3R18-A	16	1.81	22-6 AWG
1321-3R18-B	16	1.81	22-6 AWG
1321-3R18-C	16	1.81	22-6 AWG
1321-3R25-A	16	1.81	22-6 AWG
1321-3R25-B	16	1.81	22-6 AWG
1321-3R25-C	16	1.81	22-6 AWG
1321-3R35-A	16	1.81	22-6 AWG
1321-3R35-B	16	1.81	22-6 AWG
1321-3R35-C	20	2.26	18-4 AWG
1321-3R45-A	20	2.26	18-4 AWG
1321-3R45-B	20	2.26	18-4 AWG
1321-3R45-C	20	2.26	18-4 AWG
1321-3R55-A	45	5.09	6-1/0 AWG
1321-3R55-B	45	5.09	6-1/0 AWG
1321-3R55-C	45	5.09	6-1/0 AWG
1321-3R80-A	45	5.09	6-1/0 AWG
1321-3R80-B	45	5.09	6-1/0 AWG
1321-3R80-C	45	5.09	6-1/0 AWG
1321-3R100-A	150	16.95	2-4/0 AWG
1321-3R100-B	150	16.95	2-4/0 AWG
1321-3R100-C	150	16.95	2-4/0 AWG
1321-3R130-A	150	16.95	2-4/0 AWG
1321-3R130-B	150	16.95	2-4/0 AWG
1321-3R130-C	150	16.95	2-4/0 AWG
1321-3R160-A	150	16.95	2-4/0 AWG
1321-3R160-B	150	16.95	2-4/0 AWG
1321-3R160-C	150	16.95	2-4/0 AWG

POWERFLEX 750 SERIES AC DRIVES POWER TERMINAL BLOCKS

FRAME SIZE	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1,2	5	0.57	24-10 AWG
3	10.6	1.2	20-6 AWG
4	24	2.7	14-3 AWG
5	35	4.0	8-1 AWG
6	100	11.3	M8 x 1.25STUD
7	100	11.3	M8 x 1.25STUD

BULLETIN 1494R TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1494R-N1	45	5.09	14-4 AWG
1494R-N2	150	16.95	8-1/0 AWG
1494R-N3	275	31	6-4/0 AWG
1494R-N10	325	36.72	(2) 1/0-350 AWG
1494R-N11	325	36.72	(2) 1/0-350 AWG
1494R-N12	375	42.37	1/0-500 AWG
1494R-N14	303	34.23	(2) 1/0-250 AWG
1494R-N15	415	46.89	4-500 AWG

BULLETIN 199 TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
199-LE1	150	16.9	8-1/0 AWG
199-LF1	275	31	6-250MCM AWG
199-LG1	375	42	4-500MCM AWG
199-LH1	275	31	1/0-350MCM AWG
199-LJ1	275	31	1/0-500MCM AWG

BULLETIN 100 TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
100-DL110	70-90	8.0-10	14-2/0 AWG
100-DLE110	70-90	8.0-10	8-2/0 AWG
100-DL180	90-110	10-12	6-300MCM AWG
100-DL420	375	42	4-350MCM AWG
100-DL630	400	45	2/0-500MCM AWG
100-DL860	400	45	2/0-500MCM AWG

HOFFMAN GROUND BAR

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
P-GS2K	40	4.5	- AWG
P-GS4K	40	4.5	- AWG
P-GS6K	40	4.5	- AWG

BURNDY GROUND LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
KPA8CTP	12	1.36	14-6 AWG
KA26U	120	13.6	6-2/0 AWG
KA31U	375	42.4	6-350MCM AWG
KA34U	500	56.5	4-500MCM AWG

USE COPPER, 60°C WIRE IF RATED LESS THAN 100 AMPS
OR 75°C WIRE IF RATED 100 AMPS OR MORE

DATE	BY	APPROVAL
04/14/21	BDC	DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

REV.	DATE	BY	ECN/CR. NO.

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TORQUE VALUES FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP | Date: 11/23/2020

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Size D | R1USE01851-0002 | Ver 01

APPROVAL DOCUMENT - 04-14-21 REV 01

480VAC, 3PH, 60Hz
FLA= 74.1
SCCR= 65KA

LINE TERMINATION
WIRE RANGE
(1)#10AWG-250MCM

ROTARY
OPERATOR

1BCP030

480VAC
USER
SUPPLIED
BRANCH
CIRCUIT
PROTECTION

L1 1CB030 1030
L2 1050
L3 1060

REM

125A

GND
GND
PE-BUS

TO 5-02
TO 5-02

2.1 FLA

LINE PE TERMINATION
WIRE RANGE
(2)#14AWG-00AWG

1030
1050
1060

PE-BUS

1MOV140

FROM 14-08 5100

TO 14-08 1180

1131

18P AUTO TRANS
AND 5% REACTOR
ARE ONE ASSEMBLY

1030 1050 1060

72.3 FLA

1REAC110
A1 B1 C1
A2 B2 C2

1111 1112 1113

1PT140

72KVA (FA)
18 PULSE
AUTOTRANSFORMER

H1 H2 H3

0002

GND
PE-BUS

X1 X2 X3 X4 X5 X6 X7 X8 X9

1151
1152
1153
1154
1155
1156
1157
1158
1159

1EA260

T1 T2 D1 D2 D3 D4 D5 D6 D7 D8 D9

BRIDGE
THERMOSTATS

D1 D2 D3 D4 D5 D6 D7 D8 D9

K AK A

SNUBBER
BOARD(S)

BRIDGE
OUTPUT

CHASSIS GND
PE-BUS

79.9 FLA

1370 1371

TO 11-03 TO 11-06
650 VDC

APPROVED DOCUMENTS - 04-14-21 REV 01

DATE	BY	APPROVAL
04/14/21	BDC	DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

UL 508A LABEL REQUIRED

REV.	DATE	BY	ECN/CR. NO.

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SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
INCOMING POWER AND 18 PULSE FRONT END
PF753 60HP 18 PULSE VFD

Drawn by: JSP Date: 04/13/2021

Sheet 1 Of Next Sh 5

Size D

R1USE01851-0002

Ver 01

480VAC

FROM 1-08 1030 — 5F060 5A 600V CLASS CC 5070

FROM 1-09 1060 — 5F061 5A 600V CLASS CC 5071

SEE N/P

5T080 H1 H3 H2 H4 — 480 VAC 1000 VA — 120VAC

TB1 X1 — 5100 — 5F100 10A 250V CLASS M — 5102 — X1 X2 — 5101 — TB1 N

PE-BUS

120VAC

5F170 2A 250V FNM — 5170 — 5THERM170 — 5171 — 5CR170 — FAN CONTROL NO 5-35 NC

FAN TRAY ASSEMBLY

5F210 6A 250V FNM — 5210 — TB-FAN 1 — TB-FAN1 1 — 5MTR210 115V 0.57A — 5101 — TB-FAN1 2 — TB-FAN 3 — TB1 N — 18P-XFMR COOLING FAN 1

5MTR230 115V 0.57A — 18P-XFMR COOLING FAN 2

PE — TB-FAN1 3 — TB-FAN 4

TB-FAN 2 — TB-FAN2 1 — 5MTR270 115V 0.57A — 5101 — TB-FAN2 2 — 18P-XFMR COOLING FAN 3

5MTR280 115V 0.57A — 18P-XFMR COOLING FAN 4

PE-BUS

PE — TB-FAN2 3

TB-FAN IS MOUNTED TO THE TOP SIDE OF THE FAN TRAY, WHILE THE (4) FANS, TB-FAN1 & 2 ARE MOUNTED TO THE BOTTOM SIDE OF THE FAN TRAY.

5F350 6A 250V FNM — 5350 — 5CR170 5-17 — 5351 — D 5MTR350 115V 1.5A — TRANSFORMER BAY EXHAUST COOLING FAN TB1 N

PE — D 5MTR370 115V 1.5A — TRANSFORMER BAY EXHAUST COOLING FAN

COOLING FANS ARE MOUNTED AT THE TOP OF THE DOOR.

PE-BUS

TO 5-45 — TO 5-45

DATE	BY	APPROVAL
04/14/21	BDC	DESIGN REVIEW
		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

UL 508A LABEL REQUIRED

120VAC

FROM 5-38 5100 TB1 X1 — TB1 X1 — TB2 X1 — 13 ESTOP HS-1111 — TB2 1 — HIGH TEMPERATURE CR2 5470 21 22 5471 5-71 — HIGH PRESSURE CR3 5472 21 22 5-74 — D 5SS470 OFF RUN REMOTE X□□ — 5473 — TB2 3 — DRIVE FAULT 14CR140 11 12 5474 14-14 — 5CR470 — FROM 5-38 5101 TB1 N — VFD CONTROL RELAY NO 14-06 NC

ESTOP TO SBR-CP

5500 □□X — TB2 2 — 13 START

5530 — 5CR530 — DRIVE NOT IN REMOTE NO 14-10,14-71 NC

□X□

X□□

DRIVE RUNNING 14CR080 11 14 14-08 — TB1 X1 — 5560 — D RUN 5LT560 G — TB1 N

DRIVE RUNNING 14CR080 11 12 14-08 — 5590 — D □FF 5LT590 R

DRIVE FAULT 14CR140 11 14 14-14 — TB1 X1 — 5620 — D FAULT 5LT620 A

13 TSH-1111 OPENS ON HIGH TEMP. — TB1 X1 — TB2 X1 — TB1 4 — 5650 — CR1 — TB1 N NO NC 5-68

CR1 11 12 5-65 — 5680 — D HIGH TEMP 5LT680 A

HIGH TEMPERATURE CR2 11 14 5-71 — 5710 — D RESET 5PB710 — CR2 — HIGH TEMPERATURE NO 5-71,14-71 NC 5-47

HIGH PRESSURE CR3 11 14 5-74 — 5740 — 5741 — CR3 — HIGH PRESSURE NO 5-74,14-71 NC 5-47

13 PSH-1111 CLOSES HIGH PRESSURE — TB1 X1 — TB2 X1 — TB1 5 — D HIGH PRESSURE 5LT770 A

120 VAC TO BLOWER CONTROL PANEL — TB1 X1 — TB1 N

TO 11-32,14-17 — TO 11-29,14-18

REV.	DATE	BY	ECN/CR. NO.

Rockwell Automation

SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
120VAC CONTROL POWER
PF753 60HP 18 PULSE VFD

Drawn by: JSP — Date: 04/13/2021

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APPROVAL DOCUMENTS 04-14-21 REV 01

POWERFLEX 753
MODULE -20F14FD096JA0NNNNN
11EA030

HEAVY DUTY
CONT RGT: 77 AMP
FRAME SIZE 5

FROM 1-39 ◁ 1371 — DC(+)
650 VDC
79.9 FLA
FROM 1-39 ◁ 1370 — DC(-)

DC TO AC INVERTER

U/T1 — 11030 — (L1) A1 — BLK — QT1 — RL1 — QT4 — BLK/WHITE — A2 (T1) — 11031 — 11PDB030 (L1)
V/T2 — 11050 — (L2) B1 — RED — QT2 — RL2 — QT5 — RED/WHITE — B2 (T2) — 11051 — (L2)
W/T3 — 11060 — (L3) C1 — BLUE — QT3 — RL3 — QT6 — BLUE/WHITE — C2 (T3) — 11061 — (L3)

TCI: V1K80A00
LINE
LOAD
RC1 RC2 RC3
C1 C2 C3
GRD.
11LF030

PE — PE — PE — MPE
PE
CHASSIS
CM CAP
PE-B
SEE USER MANUAL

MPE
MPE
LOAD TERMINATION
WIRE RANGE
(1)#14-#2AWG

11MTR050
REM
T1 T2 T3
M
GND
60 HP
460 VAC
77 FULL LOAD AMPS
? RPM (BASE)
60 HZ. (BASE)

NOTE:
VERIFY MOTOR NAMEPLATE DATA
AT COMMISSIONING.

SHOP NOTE:
USE FERRULES ON 11LF030,
11PDB030 MOTOR TB AND MPE
CONNECTIONS

NOTE:
PE-B JUMPER SHOULD BE
DISCONNECTED FOR USE IN HIGH
RESISTANCE GROUND SYSTEMS

TB1
- AO0-
- AO0+
- 10VC
- +10V
- AI0-
- AI0+
- PTC-
- PTC+
- TO
- 24VC
- +24V
- DI C
- DI 1
- DI 2

PE-B CM CAP [X] IN / OUT
SETTINGS AS SHIPPED

J1 ENABLE [X] IN / OUT
J2 SAFETY [X] IN / OUT

BR1
BR2

NOTE: DEFAULT JUMPER POSITIONS:
- J1 = IN
- J2 = IN
-IF DRIVE IS REPLACED
VERIFY JUMPER SETTINGS

TB3
- DI 0DC
- DI C
- DI 0AC

TB2
- R0NC
- R0C
- R0ND

STS

FROM 5-81 ◁ 5101 — DI C
11300 — DI 0AC
120VAC
FROM 5-81 ◁ 5100 — TB2 6 — 11JMP320 JUMPER — TB2 7

NOTE:
TO INSTALL E-STOP OR CUSTOMER
INTERLOCKS, REMOVE WIRE
JUMPER BETWEEN TB2 6 & 7

DPI PORT 1
DPI PORT 2

D
KIT #: 20-HIM-C6S 11HIM330
DOOR MOUNTED
HUMAN INTERFACE
MODULE

INSTALL CLOCK BATTERY, PN-71582, CR1220, PRIOR TO TESTING

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		FOR MANUFACTURING
		AS SHIPPED
		AS COMMISSIONED

UL 508A LABEL REQUIRED

REV.	DATE	BY	ECN/CR. NO.

Rockwell Automation

SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
POWER AND MOTOR INTERFACE
PF753 60HP 18 PULSE VFD
Drawn by: JSP Date: 04/13/2021

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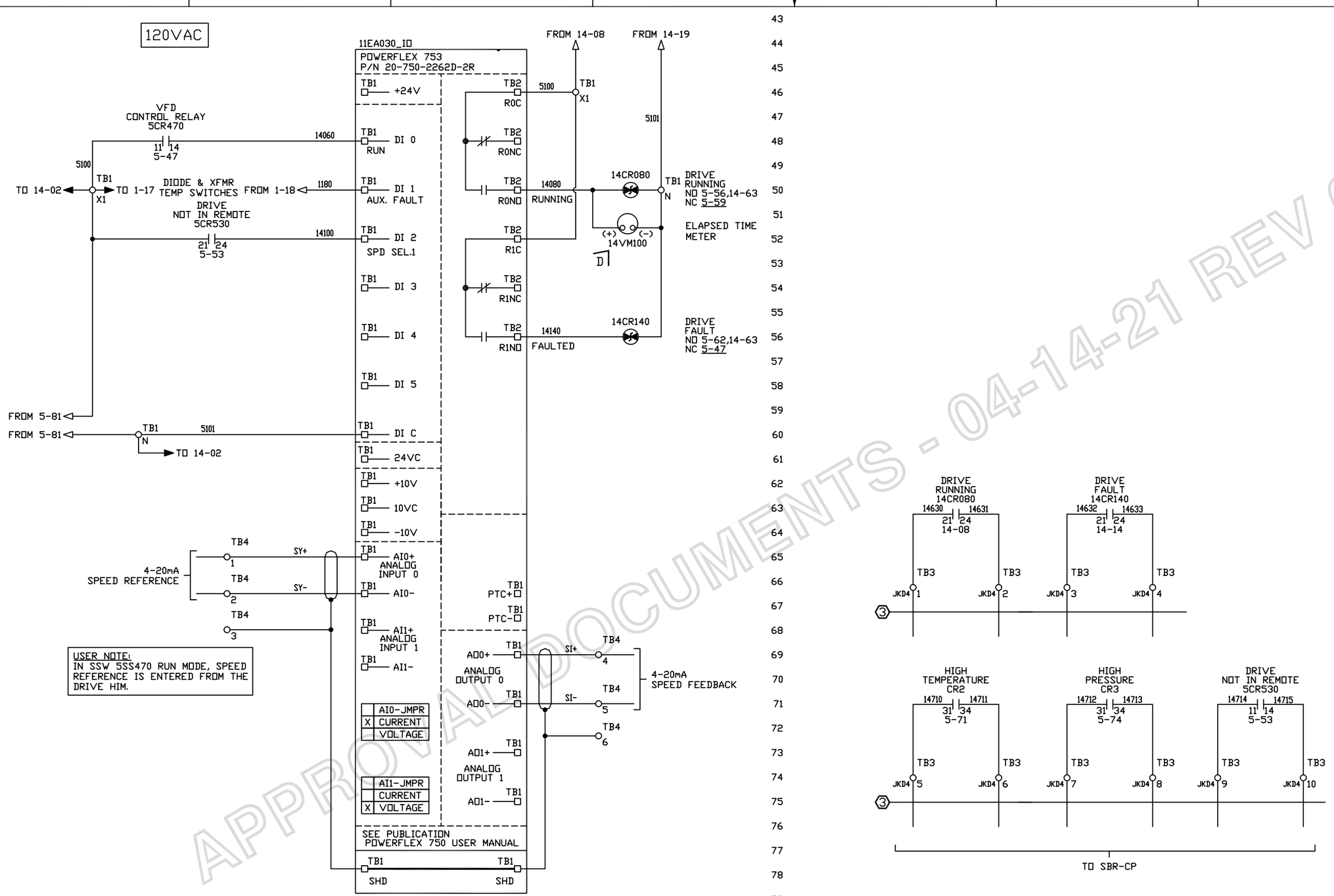

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UL 508A LABEL REQUIRED

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SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
PORT 4 SLOT - 120VAC I/O MODULE
PF753 60HP 18 PULSE VFD

Drawn by: JSP Date: 04/13/2021

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TYPE 12 ENCLOSURE DESIGN
COLOR: RAL 7035 (GRAY)

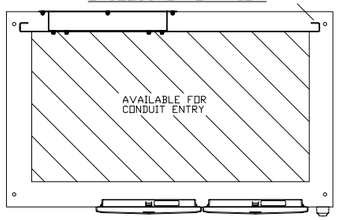
UL 508A LABEL REQUIRED

SHOP NOTE:

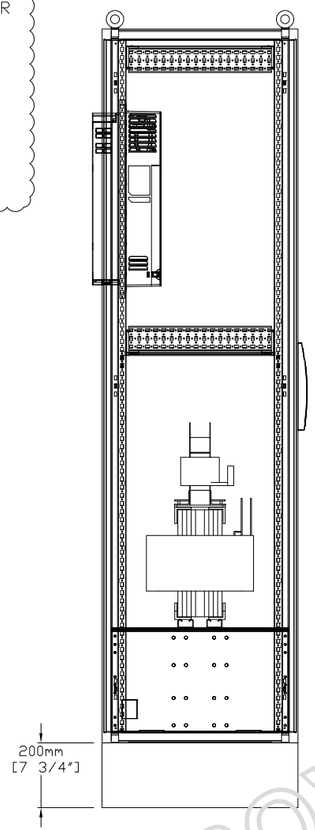
ROTATE THE FANS SO THAT THEY ARE NOT EXHAUSTING DOWN IN TO THE OPERATOR OCCUPIED AREA.

A) THE LEFT FAN NEEDS TO ROTATE 90° CLOCKWISE
B) THE RIGHT FAN NEEDS TO ROTATE 90° COUNTER CLOCKWISE.

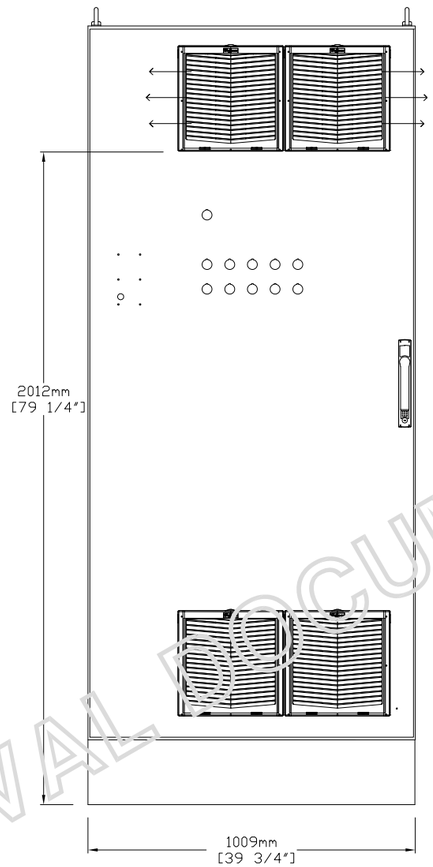
ENCLOSURE TOP VIEW



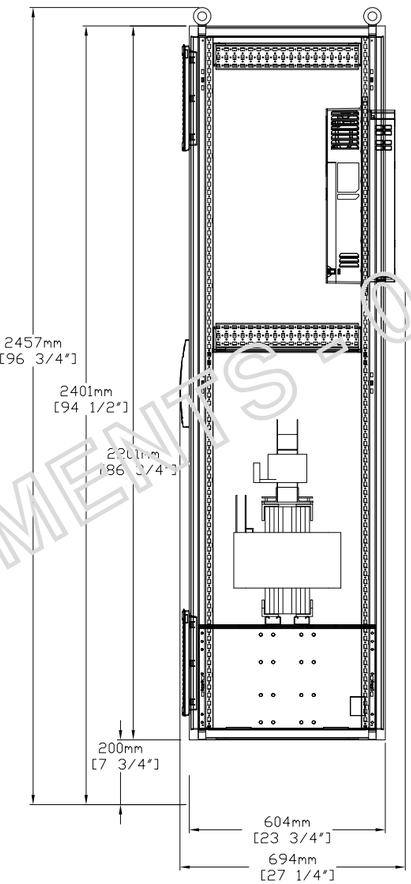
ENCLOSURE LEFT VIEW



ENCLOSURE FRONT VIEW

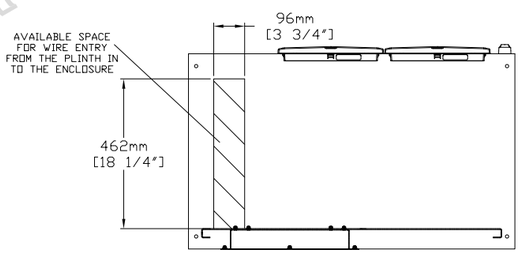


ENCLOSURE RIGHT VIEW



NOTE:
THE ENCLOSURE IS EQUIPPED WITH A 200MM SEALED PLINTH.

THE AVAILABLE SPACE FOR CONDUIT ENTRY IS 25.429 X 13.479 ON THE BASE AND TWO 13 X 2.75 SIDE WIREWAYS (LEFT/RIGHT).

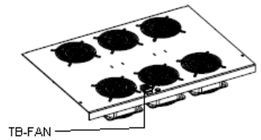


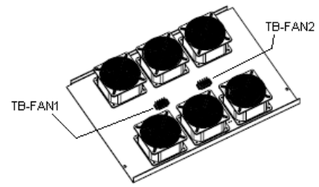
ENCLOSURE FANS

▲5MTR350
▲5MTR370

NOTE:
1. MOUNT TB-FAN ON THE TOP SIDE OF THE FAN TRAY ASSEMBLY.
2. MOUNT TB-FAN1 AND TB-FAN2 TO THE UNDERSIDE OF THE FAN TRAY ASSEMBLY. OTHERWISE IT DOESN'T PULL OUT PROPERLY.

TOP VIEW OF FAN TRAY ASSEM





BOTTOM VIEW OF FAN TRAY ASSEM

▲ENCL
▲UPPER_SUP
▲U_STRUT
▲UNISTRUT-NUT
▲XFMR_SUP-LH
▲XFMR_SUP-RH
▲XFMR_SUP-GUSSET
▲XFMR_BAFFLE_KIT
▲XFMR_SUP_BRK

4 FAN ASSEMBLY

▲FAN_TRAY_SUP
▲FAN_TRAY
▲5MTR210
▲5MTR230
▲5MTR270
▲5MTR280
▲5MTR_GUARD
▲TB-FAN
▲TB-FAN1
▲TB-FAN2
▲FAN-GROMMET

ENCLOSURE VENTS

▲BOT_INTAKE_VENTS

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Rockwell Automation

DIMENSION DRAWING FOR
ITEM 0002
PF753 60HP 18 PULSE VFD
Drawn by: JSP | Date: 04/13/2021

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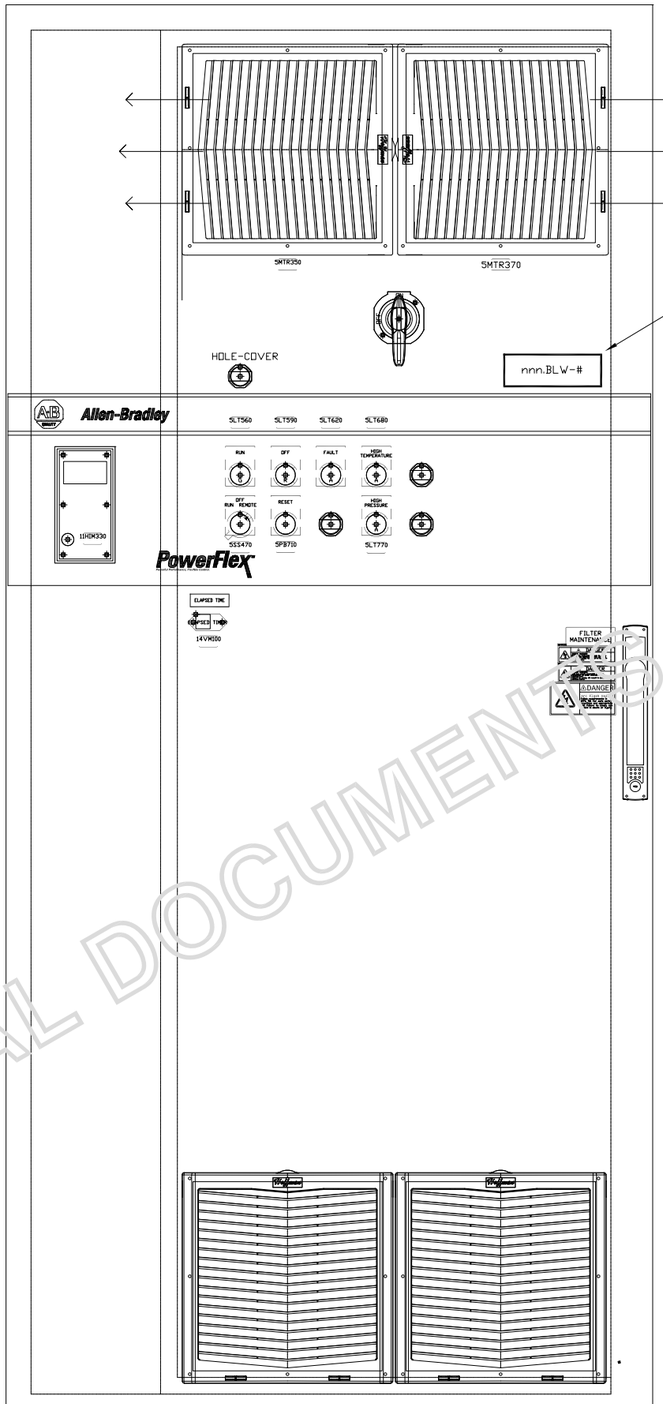

WHITE PHENOLIC
WITH BLACK
LETTERING

6"

V1 MIX.BLW-1 2"

V2 MIX.BLW-2

(MTD. ON BACK OF DOOR)

AFTER HOURS ASSISTANCE ON SITE FOR YOU. ~NG PARTS

(MTD. ON BACK OF DOOR)

Rockwell Automation

PROJECT#: R1USE01851-V?

DIAGRAM: R1USE01851-0002
INPUT 480VAC 74.1 AMPS 3PH 60Hz
OUTPUT 480VAC 77 AMPS
LARGEST MOTOR: 60HP, 77AMPS
SHORT CIRCUIT CURRENT RATING:
65 KA RMS. SYMMETRICAL, 480VOLTS MAXIMUM
ENCLOSURE RATING: TYPE 12

Local Solution Center, Edison NJ 08837 USA

(MOUNT ON INSIDE & OUTSIDE OF DOOR)

V? = 1,2

UL LISTED
ENCLOSED INDUSTRIAL CONTROL PANEL
No: Xxxxxxx

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LAYOUT DRAWING FOR DOOR
ITEM 0002
PF753 60HP 18 PULSE VFD
Drawn by: JSP Date: 04/13/2021

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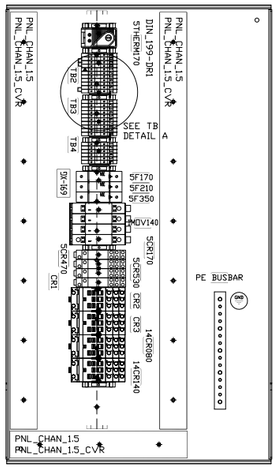
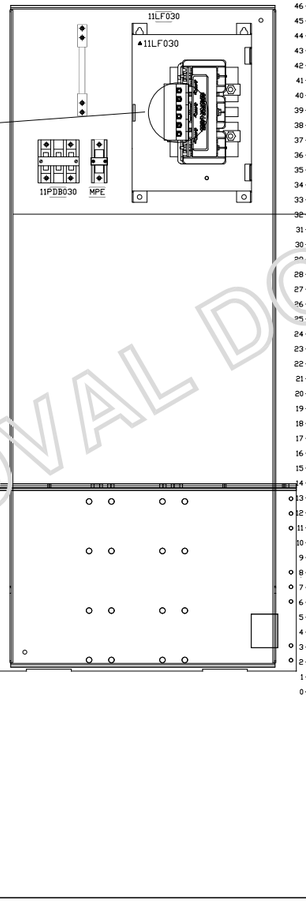
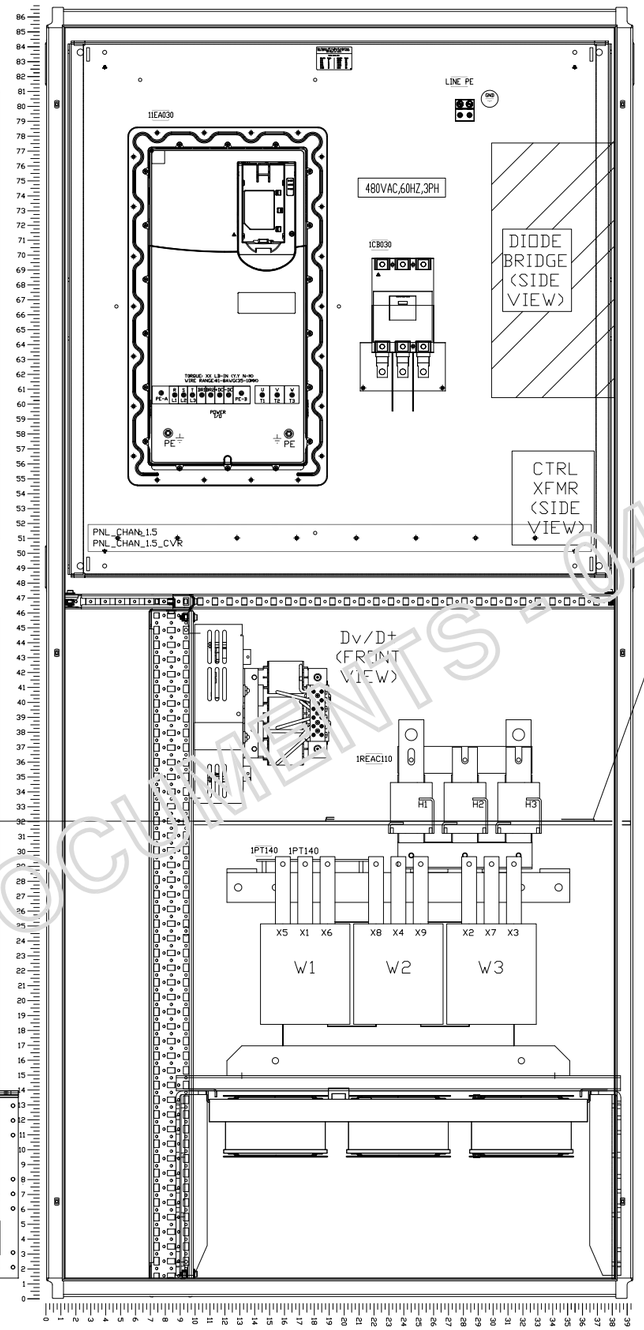
DETAIL A

STRIP-ID	TERM	WIRENO
TB1	X1	5100
TB1	X1	5100
TB1	X1	5100
TB1	X1	5100
TB1	X1	5100
TB1	N	5101
TB1	N	5101
TB1	N	5101
TB1	N	5101
TB1	N	5101
TB2	N	5101
TB2	X1	5100
TB2	X1	5100
TB2	X1	5100
TB2	1	5470
TB2	2	5500
TB2	3	5473
TB2	4	5650
TB2	5	5741
TB2	6	5100
TB2	7	11300
TB3	1	14630
TB3	2	14631
TB3	3	14632
TB3	4	14633
TB3	5	14710
TB3	6	14711
TB3	7	14712
TB3	8	14713
TB3	9	14714
TB3	10	14715
TB4	1	SY+
TB4	2	SY-
TB4	3	SHD
TB4	4	SI+
TB4	5	SI-
TB4	6	SHD



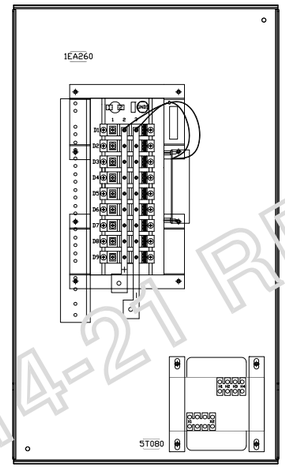


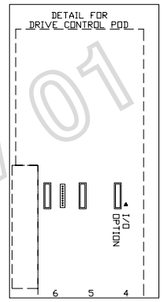


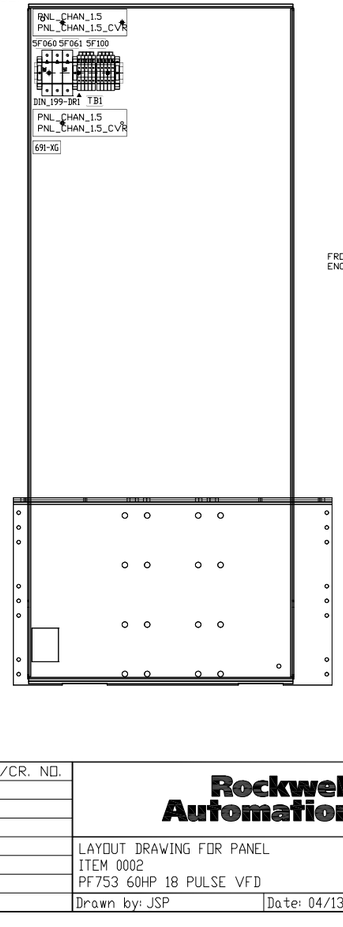
SHOP NOTE:
MOUNT INSIDE DOOR

FUSE REPLACEMENT TABLE
REPLACE FUSES ONLY WITH EXACT TYPE, CLASS, AND RATING AS LISTED IN TABLE.

TAG	CLASS	TYPE	VOLTAGE	CURRENT
5F060	CC	TIME DELAY	600V	5A
5F061	CC	TIME DELAY	600V	5A
5F100	M	TIME DELAY	250V	10A
5F170	M	TIME DELAY	250V	2A
5F210	M	TIME DELAY	250V	6A
5F350	M	TIME DELAY	250V	6A







1U.O
TRANSFORMER
REACTOR BAFFLE
PLATE ASSEMBLY

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LAYOUT DRAWING FOR PANEL
ITEM 0002
PF753 60HP 18 PULSE VFD
Drawn by: JSP | Date: 04/13/2021

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Rockwell Automation

NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF

POWERFLEX 40HP HD DRIVE, TYPE 12

RA PROJECT# R1USE01851-0003

UL 508A

SBR.BLW-1, -2, -3

MIX.BLW-3

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TITLE SHEET FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP | Date: 11/28/20

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DRAWING INDEX FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTFE
POWERFLEX 40HP HD DRIVE, TYPE 12
RA PROJECT# R1USE01851-0003

SH	SUBSEC	DRW_DESC1	DRW_DESC2	DRW_DESC3
N1	NOTES	TITLE SHEET FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N2	NOTES	INDEX FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N3	NOTES	GENERAL NOTES FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N4	NOTES	WIRE CLASSIFICATION FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
N5	NOTES	TORQUE VALUES FOR	NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF	R1USE01851
1	0003	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	POWER AND MOTOR INTERFACE	POWERFLEX 40HP HD DRIVE, TYPE 12
2	0003	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	120VAC CONTROL POWER	POWERFLEX 40HP HD DRIVE, TYPE 12
3	0003	SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE	PORT 4 - I/O INTERFACE	POWERFLEX 40HP HD DRIVE, TYPE 12
L0001	0003	ENCLOSURE DIMENSIONS	ITEM 0003	POWERFLEX 40HP HD DRIVE, TYPE 12
L0002	0003	LAYOUT DRAWING FOR DOOR	ITEM 0003	POWERFLEX 40HP HD DRIVE, TYPE 12
L0003	0003	LAYOUT DRAWING FOR PANEL	ITEM 0003	POWERFLEX 40HP HD DRIVE, TYPE 12

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INDEX FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

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DRAWING STANDARDS:

SYMBOLS:

- REFERS TO NOTE GIVEN BELOW
- ▲ LOW POWER CONTACT
- ARROW INDICATES FUNCTION INCREASE (ALWAYS CLOCKWISE)

4 **DANGER** – THIS EQUIPMENT MAY BE AT LINE VOLTAGE EVEN WHEN NOT IN OPERATION. TO AVOID ELECTRIC SHOCK, DISCONNECT.

5 **CAUTION** – NEVER REMOVE OR INSERT ANY MODULE OR CARD WHILE THE POWER IS ON.

9 REMOVE JUMPER IF ADDITIONAL INTERLOCK IS ADDED.

13 SEPARATELY MOUNTED, SUPPLIED BY OTHERS

14 SEPARATELY MOUNTED, SUPPLIED BY ROCKWELL AUTOMATION

32 MOTOR STABILIZING FIELD, S1 AND S2, IS NOT REQUIRED FOR NORMAL OPERATION. TAPE S1 AND S2 SEPARATELY AND DO NOT USE.

33 DRIVE MOTOR CONNECTIONS AS SHOWN ARE FOR INDICATED ROTATION FACING COMMUTATOR END. FOR OPPOSITE ROTATION, INTERCHANGE A1 AND A2 CONNECTIONS IN MOTOR CONDUIT BOX.

34 TACHOMETER LEADS MUST BE CONNECTED TO GIVE THE INDICATED POLARITY.

35 IF OPPOSITE ROTATION IS DESIRED, CHANGE POLARITY OF THE COSINE SIGNAL BY INTERCHANGING THE COSINE INPUT LEADS.

36 USE TWISTED TWO - CONDUCTOR CABLE. THIS CABLE MUST BE IN A SEPARATE SIGNAL CONDUIT. IT CANNOT BE RUN WITH OTHER CONDUCTORS OR CABLES. USE RELIANCE PART NUMBER 417900-76EAD OR EQUIVALENT. REFER TO FIELD INSTALLATION AND WIRING TABLE ON NEXT SHEET FOR WIRE SPECIFICATIONS.

38 SIGNAL WIRE CABLES WITH THIS NOTE NUMBER CAN BE IN THE SAME SIGNAL CONDUIT. THEY CANNOT BE RUN WITH NON-SIGNAL WIRES. REFER TO FIELD INSTALLATION AND WIRING TABLE ON NEXT SHEET FOR WIRE SPECIFICATIONS.

38-1 REFER TO NOTE 38. THE NUMBER FOLLOWING THE NOTE 38 IDENTIFIES THE CABLES THAT MAY BE GROUPED TOGETHER IN THE SAME SIGNAL CONDUIT. FOR EXAMPLE, CABLES REFERENCED WITH NOTE 38-1 CANNOT BE RUN IN THE SAME SIGNAL CONDUIT WITH NOTE 38-2 CABLES.

40 COAXIAL CABLES WITH THIS NOTE CAN BE IN THE SAME SEPARATE SIGNAL CONDUIT. THEY CANNOT BE RUN WITH OTHER CONDUCTORS OR CABLES. FOR RECOMMENDED CABLE TYPE, REFER TO PRODUCT'S NETWORK MANUAL.

TYPE	CABLE P/N (BELDEN P/N)	CONNECTOR P/N (AMPHENOL P/N)
RG59	417900-148A (9259)	405504-74A (31-212-1005)
RG11	417900-149A (8238)	612293-B (6775)

TERMINATOR 75 OHM
RELIANCE P/N 707204-20A
AMPHENOL P/N 46650-75

41 **DANGER** – DO NOT OPEN DISCONNECT SWITCH WHILE THE MOTOR IS ENERGIZED.

47 RESOLVER WIRES: LOW LEVEL SIGNAL WIRING. MUST BE RUN IN SEPARATE SIGNAL CONDUIT OR TRAY.

BELDEN P/N	NO. OF TWISTED PAIRS		AWG #	RECOMMENDED MAXIMUM DIST. FOR EACH RESOLVER TYPE a> X1	a> X2	a> X5
9730	3		24	1000 FT.	1000 FT.	600 FT.

a> DISTANCES BEYOND THOSE RECOMMENDED MAY REQUIRE ADDITIONAL TUNING. USE RELIANCE CUSTOM PANEL 0-58801

b> MAY ONLY BE RUN IN CONDUIT, PER NEC

c> NOTE: CONNECT CABLE SHIELD TO GROUND AT CABINET ONLY

48 FIBER-OPTIC CABLES WITH THIS NOTE MAY BE RUN WITH ANY LEVEL 1 SIGNAL WIRING. IF NECESSARY THESE CABLES MAY BE RUN WITH ANY LEVEL WIRING. SEE INSTALLATION MANUAL FOR RESTRICTIONS.

52 REFER TO TRANSFORMER NAMEPLATE FOR CONNECTIONS OF PRIMARY LEADS.

53 **DANGER** – TRANSFORMER IS CONNECTED TO LINE VOLTAGE EVEN WHEN THE A-C DISCONNECT IS OPEN.

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99 USER SUPPLIED PROTECTION MUST INCLUDE A DISCONNECTING DEVICE ON THE PRIMARY SIDE OF THE TRANSFORMER. PRIMARY AND SECONDARY WIRE PROTECTION FOR THE ISOLATION TRANSFORMER MUST BE PROVIDED PER NEC.

D MOUNTED ON DOOR.

H MOUNTED ON CABINET HOOD

R MOUNTED ON CONTROL HOUSE ROOF

T MOUNTED ON CABINET TRIM

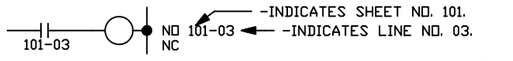
E EXISTING EQUIPMENT

N NEW EQUIPMENT

USE EXAMP. LOCATION CODES	DESCRIPTION
REM_NS	REMOTE MOUNTED - NOT SUPPLIED BY ROCKWELL AUTOMATION.
REM_S	REMOTE MOUNTED - SUPPLIED BY ROCKWELL AUTOMATION.
REM	REMOTE MOUNTED.
OS_2	MTD. ON OPERATORS STATION No. 2
PB_3	MTD. ON PUSHBUTTON STATION No. 3

GENERAL NOTES:

1. FOR FURTHER DRIVE INFORMATION ON INSTRUCTION MANUALS, SEE RESPECTIVE SCHEMATIC SECTIONS.
2. – BUILDING GROUND TO BE GROUNDED BY CUSTOMER.
   – SYSTEM ZERO POTENTIAL NODE (TE)
   – POWER EQUIPMENT GROUND (PE)
   – PANEL (CHASSIS) GROUND
3. THE INTERNAL WIRING SELECTED MEETS OR EXCEEDS NEC, UL, AND CSA. INTERNAL POWER AND CONTROL WIRE HAS INSULATION RATED AT 105°C OR HIGHER.
4. * -INDICATES COMPONENTS SUPPLIED BY OTHERS.
5. (4) INDICATES FIELD INSTALLED WIRES AS WELL AS THE WIRING LEVEL. WHEN ACCOMPANIED WITH THE DESIGNATION (FWC) THE WIRES/CABLE ARE PRE-SUPPLIED AT THE SOURCE CONNECTION BY ROCKWELL FOR CUSTOMER INSTALLATION AT SITE. (FWC) INDICATES FURNISHED WITH CABINET.
6. -INDICATES OUTGOING TERMINAL.
   -INDICATES TERMINAL ON ELECTRONIC ASSEMBLY PRINTED CIRCUIT BOARD (IEA) ETC.
   CR -INDICATES RELAY OR CONTACTOR WITH SUPPRESSOR.
7. COIL AND CONTACT CROSS REFERENCING - NUMBERS ADJACENT TO COIL AND UNDER CONTACT INDICATE SHEET AND LINE NUMBERS.

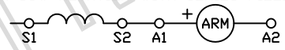


OFF-PAGE CROSS REFERENCING - NUMBERS ADJACENT TO SOURCE AND DESTINATION SYMBOLS INDICATE SHEET AND LINE NUMBERS.

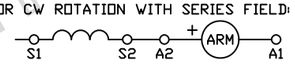
REV DATE: 5-18-2017

8. WIRE # GENERATION
   11242
   - INDICATES WIRE NUMBER.
   - INDICATES SEQUENCE (1,2,, 3 . . . etc.).
   - INDICATES LINE NUMBER 24.
   - INDICATES SHEET NUMBER 11.
   INTERNAL WIRE NUMBERS MAY BE "FIXED" WITH A LINE AND SEQUENCE, BUT MAY SCHEMATICALLY SHOW A PREFIX.
9. TYPICAL DUAL VOLTAGE MOTOR FIELD CONNECTIONS ARE SHOWN BELOW. CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.

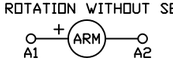
10. DC MOTOR ROTATION - CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.
    FOR CCW ROTATION FACING COMMUTATOR END:
    A1 IS POSITIVE
    F1 IS POSITIVE
    FOR CW ROTATION FACING COMMUTATOR END:
    A2 IS POSITIVE
    F1 IS POSITIVE
    FOR CCW ROTATION WITH SERIES FIELD:



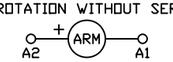
    FOR CW ROTATION WITH SERIES FIELD:



    FOR CCW ROTATION WITHOUT SERIES FIELD:



    FOR CW ROTATION WITHOUT SERIES FIELD:



11. AC MOTOR ROTATION - CONSULT THE MOTOR MANUFACTURER'S INSTRUCTIONS FOR CORRECT CONNECTIONS.
    FOR CW ROTATION VIEWED FROM MOTOR SHAFT:
    INVERTER OUTPUT U2 TO T1 (EUROPEAN MARKING U1)
    V2 TO T2 (EUROPEAN MARKING V1)
    W2 TO T3 (EUROPEAN MARKING W1)
    FOR CCW ROTATION VIEWED FROM MOTOR SHAFT:
    INVERTER OUTPUT U2 TO T1 (EUROPEAN MARKING U1)
    V2 TO T3 (EUROPEAN MARKING W1)
    W2 TO T2 (EUROPEAN MARKING V1)

NOTE: NOT ALL AC MOTOR SUPPLIERS COMPLY WITH THE ABOVE CONVENTIONS.

COMBINATION MOTOR CONTROLLER WITH MOTOR CIRCUIT PROTECTOR

DANGER: To maintain overcurrent, short circuit and ground fault protection, the manufacturer's instructions for selecting current elements and setting the instantaneous-trip circuit breaker must be followed.

AVERTISSEMENTPour assurer une protection continue contre les surintensités, les court-circuits et une mise à la terre accidentelle, Il est essentiel de choisir les ?el?ements thermiques et de régler le disjoncteur à déclenchement instantané selon la notice technique du fabricant.

Determine motor full load current and motor design type identifier from motor nameplate.

For Design B, C an D motors adjust motor circuit protector to operate at a current setting between ten (10) and thirteen (13) times the full load current. For Design E and N motors adjust motor circuit protector to operate at a current setting between thirteen (13) and seventeen (17) times the full load current.

NOTE: Motor circuit protector is set at minimum current setting when shipped from factory.

DANGER: Tripping of the instantaneous-trip circuit breaker is an indication that a fault current has been interrupted. Current carrying components of the magnetic motor controller should be examined and replaced if damaged, to provide continued protection against a risk of fire or electric shock. If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced. (Refer to NEMA Standards Publication No. ICS 2.2 titled: 'Maintenance of Motor Controllers After a Fault Condition' Ñ also published as NEMA Standard Publication No. ICS 2, Part ICS 2-302.)

AVERTISSEMENTL'ouverture du disjoncteur à déclenchement instantané indique qu'un courant de défaut a été interrompu. Les composants conducteurs de la commande magnétique du moteur doivent être inspectés et remplacés s'ils ont subi des dommages, afin d'assurer une protection continue contre le risque d'incendie et de choc électrique. En cas de défaillance de l'élément thermique d'un relais de surcharge, celui-ci doit être remplacé dans sa totalité.

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Rockwell Automation

GENERAL NOTES FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP | Date: 11/28/20

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APPROVAL DOCUMENTS - 04-14-21 REV 01

FIELD INSTALLATION AND WIRING

CATEGORY	WIRING LEVEL	SUB-GROUP	SIGNAL DEFINITION	SIGNAL EXAMPLES	CABLE TYPE	MINIMUM SPACING IN INCHES BETWEEN LEVELS (STEEL CONDUIT/TRAY) 4S	4	3	3S	2	2S	1	SPACING NOTES
POWER (SEE NOTE 2-C FOR SPACING BELOW)	4	S	AC POWER (> 1000VAC)	2.3KV 3 PHASE AC LINES	PER NEC AND LOCAL CODES	SEE NOTE: 7	SEE NOTE: 7	SEE NOTE: 7		SEE NOTE: 7		SEE NOTE: 7	1 2 5
			AC POWER (TO 1000VAC)	480V 3 PHASE AC LINES	PER NEC AND LOCAL CODES								
			DC POWER	DC MOTOR ARMATURE	PER NEC AND LOCAL CODES		0	3/6		3/12		3/9	
			DC POWER	REGULATED DC MOTOR FIELD	PER NEC AND LOCAL CODES								
CONTROL (300V MAX OR 20 AMPS)	3		115VAC/VDC LOGIC	RELAY LOGIC, PLC I/O	PER NEC AND LOCAL CODES	SEE NOTE: 7	3/6	0		3/9		1/3	
			115VAC POWER	POWER SUPPLIES, INSTRUMENTS									
		S	24VAC/VDC LOGIC	PLC I/O	PER NEC AND LOCAL CODES								
MEDIUM LEVEL SIGNAL (PROCESS)	2		ANALOG SIGNALS DC SUPPLIES	REF/FEEDBACK SIGNAL, 5 TO 24VDC SUPPLIES	SHIELDED CABLE BELDEN 8770, 9418	SEE NOTE: 7	3/12	3/9		0		1/1	2 3 4 5 6
			DIGITAL (LOW SPEED)	TTL									
		S	DIGITAL (HIGH SPEED)	RESOLVER, ENCODER/COUNTER I/O, PULSE TACH FEEDBACK	SHIELDED CABLE BELDEN 9730, 9773, 9892 (SEE USER MANUAL)								
		SHLD	ANALOG SIGNALS	REF/FEEDBACK SIGNALS	SHIELDED CABLE, TWISTED CONDUCTORS BELDEN 8760, 9729								
LOW LEVEL SIGNAL (COMM.)	1		SERIAL COMMUNICATION	RS232, 422 TO TERMINALS, PRINTERS	SHIELDED CABLE RS232-BELDEN 8770,8760 RS422-BELDEN 9729,9730	SEE NOTE: 7	3/9	1/3		1/1		0	
		S	PLC SERIAL COMMUNICATION (> 20K BAUD)	PLC REMOTE I/O, PLC DATA HIGHWAY	TWINAXIAL CABLE BELDEN 9463 R-A 1770-CD								
		C	PLC SERIAL COMMUNICATION (> 5MB)	CONTROL NET	RG-6 QUAD SHIELD, COAX CABLE; A-B 1786-RG6 BELDEN 3092A								
		D	CAN COMMUNICATION	DEVICE - NET DRIVE - DRIVE	R-A 1485C-P1-C								
		E	ETHERNET	ETHERNET	R-A 1585								
		F	COMMUNICATION (> 5MB)	CONTROLNET ETHERNET	FIBER OPTIC		N/A	N/A		N/A		N/A	N/A

EXAMPLE: SPACING RELATIONSHIP BETWEEN 480VAC INCOMING LEADS
a. 480VAC LEADS ARE LEVEL 4.
b. 24VDC LEADS ARE LEVEL 3.
c. FOR SEPARATE STEEL CONDUITS, THE CONDUITS ARE TO BE 3 INCHES APART.
d. IN A CABLE TRAY THE TWO GROUPS OF LEADS ARE TO BE 6 INCHES APART.

SHIELDED CABLES RECOMMENDATIONS:

BELDEN	8770	18 AWG - 3 CONDUCTOR SHIELDED
BELDEN	8760	18 AWG - 2 CONDUCTOR SHIELDED
BELDEN	9418	18 AWG - 4 CONDUCTOR SHIELDED
BELDEN	9728	24 AWG - 4 SHIELDED PAIRS (8 COND.)
BELDEN	9729	24 AWG - 2 SHIELDED PAIRS (4 COND.)
BELDEN	9730	24 AWG - 3 SHIELDED PAIRS (6 COND.)
BELDEN	9892	20 AWG - 4 SHIELDED PAIRS (8 COND.)
BELDEN	9773	18 AWG - 3 SHIELDED PAIRS (6 COND.)
BELDEN	9463	75 OHM - TWINAXIAL (2 COND.)

REV DATE: 04-19-2019

DATE	BY	APPROVAL
04/14/21	JSP	DESIGN REVIEW
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FIELD WIRING INSIDE ROCKWELL ENCLOSURE:

1. CONNECTIONS WILL BE ONLY TO TERMINALS PROVIDED.
2. WIRE LENGTH FROM ENTRY POINT TO TERMINAL BOARD TO BE AS SHORT AS POSSIBLE.
3. SIGNAL WIRE MUST NOT BE LACED OR RUN WITH NON-SIGNAL WIRE AFTER ENTRY INTO THE ENCLOSURE.
4. INCOMING WIRE MUST NOT BE ROUTED IN WIRE CHANNELS OR THROUGH AREAS OF POWER AND CONTROL COMPONENTS AND WIRING.
5. USE LASHING BARS WHEN PROVIDED FOR CUSTOMER CONVENIENCE.

FIELD INSTALLATION GROUNDING GUIDELINES

1. FOR DRIVES INSTALLATION, REFER TO 'WIRING AND 'GROUNDING GUIDELINES', PUBLICATION DRIVES-IN001
2. FOR POWERFLEX SAR INSTALLATION, REFER TO 'POWERFLEX DC 'STANDALONE REGULATOR AND GATE AMPLIFIER USER MANUAL', PUBLICATION 23P-UM001_-EN-P
3. FOR PLC AND I/O INSTALLATION, REFER TO 'INDUSTRIAL AUTOMATION WIRING AND GROUNDING GUIDELINES', PUBLICATION 1770-4.1
4. NEC ARTICLE 250, GROUNDING AND BONDING
5. LOCAL CODE REQUIREMENTS

GENERAL NOTES:

1. STEEL CONDUIT IS RECOMMENDED FOR LEVELS 1 AND 2. FOR AC MOTOR CABLES, SEE NOTE 5.
   ALL CONDUITS CONNECTED TO THE CABINETS SHOULD BE PROPERLY SEALED TO MINIMIZE AIR OR WATER ENTRY INTO THE CABINETS. IF ALUMINUM CONDUIT IS USED.
   A. IT REQUIRES THE SAME MINIMUM SPACING IS USED AS THAT SHOWN FOR CABLE TRAYS.
   OR
   B. INDIVIDUAL STEEL JACKETED (STEEL MESH) CABLES ARE TO BE USED IF THE CONDUIT SPACINGS NEED BE THE SAME AS STEEL CONDUIT.
2. SPACING SHOWN BETWEEN LEVELS IS THE MINIMUM REQUIRED FOR PARALLEL RUNS ≤ 400 FEET. GREATER SPACINGS SHOULD BE USED WHERE POSSIBLE.
3. SHIELDS FOR SHIELDED CABLES MUST BE CONNECTED AT ONE END ONLY. THE OTHER END SHOULD BE CUT BACK AND INSULATED. SHIELDS FOR CABLES FROM A CABINET TO AN EXTERNAL DEVICE MUST BE CONNECTED AT CABINET END. SHIELDS FOR CABLES FROM ONE CABINET TO ANOTHER MUST BE CONNECTED AT THE SOURCE END CABINET. SPLICING OF SHIELDED CABLES, IF ABSOLUTELY NECESSARY, SHOULD BE DONE SUCH THAT SHIELD(S) REMAIN CONTINUOUS AND INSULATED FROM GROUND.
4. NO. 16 AWG WIRE IS THE MINIMUM RECOMMENDED SIZE FOR CONTROL (LEVEL 3). POWER WIRE IS SELECTED BY LOAD, USING 75 DEG C WIRE RATING (LEVELS 4 AND 4S).
5. ARMORED CABLE WITH A PVC OUTER JACKET IS REQUIRED TO PROVIDE THE NECESSARY ELECTRICAL SHIELDING FOR AC MOTOR CABLES CONNECTED TO A PWM INVERTER.
   RECOMMENDATIONS:
   METALLIC ARMOR:
   BEST PERFORMANCE: SHIELDED BELDEN CABLE PER TABLE BELOW, OR CONTINUOUS CORRUGATED ALUMINUM
   ACCEPTABLE PERFORMANCE: INTERLOCKED ALUMINUM, OR INTERLOCKED STEEL
   CONDUCTORS:
   BEST PERFORMANCE: PHASE CONDUCTORS - 3, GROUND CONDUCTORS - 3
   ACCEPTABLE PERFORMANCE: PHASE CONDUCTORS - 3, GROUND CONDUCTORS - 1
   THE CABLE CONNECTOR SELECTED MUST PROVIDE A GOOD ELECTRICAL CONNECTION BETWEEN THE ARMOR AND THE PE GROUND PLANE AT EACH END OF THE CABLE.
   SHIELDED CABLE RECOMMENDATIONS:

BELDEN	29500	#16 AWG
BELDEN	29501	#14 AWG
BELDEN	29502	#12 AWG
BELDEN	29503	#10 AWG
BELDEN	29504	#8 AWG
BELDEN	29505	#6 AWG
BELDEN	29506	#4 AWG
BELDEN	29507	#2 AWG

   DESCRIPTION - 4 CONDUCTOR TINNED COPPER, XLPE INSULATION, 600VRMS MAX, SPECIFICALLY DESIGNED FOR IGBT DRIVE APPLICATIONS. THE SHIELD SHOULD BE CONNECTED TO THE PE GROUND PLANE
6. SEE A-B PUBLICATION AG2.2 FOR ADDITIONAL CONTROLNET COAX CABLE RECOMMENDATIONS.

SPACING NOTES:

1. BOTH OUTGOING & RETURN CURRENT CARRYING CONDUCTORS ARE TO BE PULLED IN THE SAME CONDUIT OR LAYERED ADJACENT IN CABLE TRAY.
2. ROUTE CABLES OF THE FOLLOWING LEVELS AS INDICATED:
   A. LEVELS MUST BE RUN IN SEPARATE CONDUITS OR TRAYS.
   B. INTERMIXING OF LEVELS IS NOT ALLOWED.
   C. SPECIAL LEVELS 4S AND 3S MAY EXIST THAT REQUIRE SPECIFIC WIRES TO BE GROUPED FOR SPECIAL HANDLING.
   NOTE: FOR LEVELS 3 AND 4, THE AMPACITY RATINGS OF CONDUCTORS IN A BUNDLE MAY NOT EXCEED THE DERATING GUIDELINES OF NEC 310.15(2), AND TABLE 310.15(B)(2)a.
   D. LEVELS 1 AND 2 MAY HAVE THEIR RESPECTIVE CIRCUITS (WITHIN A GIVEN LEVEL) PULLED IN THE SAME CONDUIT OR LAYERED ADJACENT IN THE SAME CABLE TRAY.
   NOTE: THE RESPECTIVE CIRCUITS IN A GIVEN BUNDLE MAY EXPERIENCE SOME AMOUNT OF EMI COUPLING. SOME CIRCUIT APPLICATIONS MAY DICTATE SEPARATE SPACING.
3. CONDUCTORS OF LEVELS 1 AND 2 MUST BE SHIELDED WHERE INDICATED PER THE RECOMMENDATIONS OR EQUIVALENT.
4. IN CABLE TRAYS, STEEL SEPARATORS ARE ADVISABLE BETWEEN THE LEVELS.
5. IF CONDUIT IS USED IT IS REQUIRED THAT IT BE CONTINUOUS AND COMPOSED OF MAGNETIC STEEL. (SEE GENERAL NOTE 1 ABOVE)
6. FOR FURTHER INFORMATION ON SPACING OF PLC COMMUNICATION CABLES TO LEVEL 4, SEE R-A PLC INSTALLATION MANUAL.
7. PER NEC ARTICLE 300-3(C)(2) , CONDUCTORS OF CIRCUITS RATED OVER 1000V, NOMINAL, SHALL NOT OCCUPY THE SAME WIRING ENCLOSURE, CABLE, OR RACEWAY WITH CONDUCTORS 1000V NOMINAL OR LESS UNLESS PERMITTED BY NEC 300.3(C)(2)(a) THROUGH 300.3(C)(2)(D).

COIL AND SOLENOID SUPPRESSION:

BEFORE UTILIZING THE CONTROL CIRCUIT POWER AVAILABLE FOR OPERATION OF CUSTOMER SUPPLIED DEVICES, THE COILS OR SOLENOIDS OF SUCH DEVICES MUST BE SUPPRESSED. THE EXTERNAL CONTROL CIRCUIT WIRING MUST BE RUN IN A SEPARATE CONDUIT THAT DOES NOT HAVE VARIABLE SIGNAL VOLTAGES OR POWER CIRCUIT VOLTAGES PRESENT. ELECTRICAL TRANSIENTS MAY CAUSE OCCASIONAL DRIVE MALFUNCTIONING.

APPROVAL DOCUMENTS - CRM 4-21 REV 01

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WIRE CLASSIFICATION FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP Date: 11/23/2020

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WIRE TERMINATION TORQUE VALUES

BULLETIN 1492 TERMINAL BLOCKS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1492-H4	7.1	0.8	30-12 AWG
1492-H5	7.1	0.8	30-12 AWG
1492-H6	7.1	0.8	30-12 AWG
1492-H7	7.1	0.8	30-12 AWG
1492-J3	4.5-7.1	0.5-0.8	22-12 AWG
1492-JD3	4.5-7.1	0.5-0.8	22-12 AWG
1492-J4	9.0	1.0	22-10 AWG
1492-JD4	4.5	0.5	26-10 AWG
1492-J6	14.2	1.6	22-8 AWG
1492-J10	20.4	2.3	18-6 AWG
1492-J16	35.0	4.0	18-6 AWG
1492-J35	51.0	5.8	12-1/0 AWG
1492-J50	31.5	3.6	10-1/0 AWG
1492-J70	87.0	9.8	6-2/0 AWG
1492-J120	141.6	16.0	4-250MCM AWG
1492-JG3	7.1	0.8	22-12 AWG
1492-JG4	9.0	1.0	22-10 AWG
1492-JG6	14.2	1.6	22-8 AWG
1492-JG10	20.4	2.3	16-6 AWG
1492-JG16	35.0	4.0	24-4 AWG
1492-JG35	51.0	5.8	12-1 AWG
1492-JG50	31.5	3.6	10-1/0 AWG
1492-JG70	87.0	9.8	6-2/0 AWG
1492-JG120	88.5	10	4-3/0 AWG

BULLETIN 1492 FUSE BLOCKS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1492-FB1C30 (-L)	22	2.5	18-8 AWG
1492-FB1C30 (-L)	26	2.5	6-4 AWG
1492-FB2C30 (-L)	22	2.5	18-8 AWG
1492-FB2C30 (-L)	26	2.5	6-4 AWG
1492-FB3C30 (-L)	22	2.5	18-8 AWG
1492-FB3C30 (-L)	26	2.5	6-4 AWG
1492-FB1M30 (-L)	22	2.5	18-8 AWG
1492-FB1M30 (-L)	26	2.5	6-4 AWG
1492-FB2M30 (-L)	22	2.5	18-8 AWG
1492-FB2M30 (-L)	26	2.5	6-4 AWG
1492-FB3M30 (-L)	22	2.5	18-8 AWG
1492-FB3M30 (-L)	26	2.5	6-4 AWG
1492-FB1J30 (-L)	35	4	18-1 AWG
1492-FB2J30 (-L)	35	4	18-1 AWG
1492-FB3J30 (-L)	35	4	18-1 AWG
1492-FB1J60 (-L)	35	4	14-1 AWG
1492-FB2J60 (-L)	35	4	14-1 AWG
1492-FB3J60 (-L)	35	4	14-1 AWG

BULLETIN 100 CONTACTORS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
100-C09	13-22	1.5-2.5	(2) 16-10 AWG
100-C12	13-22	1.5-2.5	(2) 16-10 AWG
100-C16	13-22	1.5-2.5	(2) 16-10 AWG
100-C23	13-22	1.5-2.5	(2) 16-10 AWG
100-C30	22-31	2.5-3.5	14-6 AWG
100-C37	22-31	2.5-3.5	14-6 AWG
100-C43	22-31	2.5-3.5	14-6 AWG
100-C60	40-53	4.5-6.0	14-1 AWG
100-C72	40-53	4.5-6.0	14-1 AWG
100-C85	40-53	4.5-6.0	14-1 AWG
100-C97	40-53	4.5-6.0	14-1 AWG

BULLETIN 140G CIRCUIT BREAKERS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
140G-G-TLC1_	62	7.0	(1) 14-1/0 AWG
140G-G-MTL6_	62	7.0	(6) 14-2 AWG
140G-H-TLC1_	62	7.0	(1) 14-1/0 AWG
140G-H-MTL6_	62	7.0	(6) 14-2 AWG
140G-I-TLA1_	50	5.6	(1) 14-1/0 AWG
140G-I-TLA1A_	200	22.6	(1) 4-300 MCM AWG
140G-I-TLC1_	124	14.0	(1) 10-250 MCM AWG
140G-I-MTL6_	62	7.0	(6) 12-2 AWG
140G-J-TLA1_	50	5.6	(1) 14-1/0 AWG
140G-J-TLA1A_	200	22.6	(1) 4-300 MCM AWG
140G-J-TLC1_	124	14.0	(1) 10-250 MCM AWG
140G-J-MTL6_	62	7.0	(6) 12-2 AWG
140G-K-TLA1_	380	43	(1) 250-500 MCM AWG
140G-K-TLA2_	380	43	(2) 2/0-250 MCM AWG
140G-K-TLC1_	380	43	(1) 250-500 MCM AWG
140G-K-TLC2_	380	43	(2) 2/0-250 MCM AWG
140G-K-MTL6_	62	7	(6) 6-1/0 AWG
140G-M-TLA2_	274	31	(2) 250-500 MCM AWG
140G-M-TLA3_	380	43	(3) 2/0-400 MCM AWG
140G-M-TLC2_	274	31	(2) 3/0-350 MCM AWG
140G-M-TLC3_	380	43	(3) 2/0-350 MCM AWG
140G-N-TLA4_	380	43	(4) 4/0-500 MCM AWG
140G-N-TLC4_	380	43	(4) 4/0-500 MCM AWG

'_' IS EITHER 3 OR 4 DEPENDING ON HOW MANY POLES THE BREAKER HAS

BULLETIN 194R TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
194R-30-MTL3	14	1.6	14-8 AWG
194R-60-MTL3	24	2.8	14-4 AWG
194R-TL1	275	31	6-300 MCM AWG
194R-TL2	275	31	6-300 MCM AWG
194R-TL3	550	62	4-600 MCM AWG
194R-TL4	550	62	4-600 MCM AWG
194R-TL5	200	22.6	6-2 AWG
194R-TL6	375	42.4	1-350 MCM AWG
194R-TL7	375	42.4	2-600 MCM AWG
194R-TL8	375	42.4	2-600 MCM AWG
194R-TL9	375	42.4	2-600 MCM AWG
194R-TL10	375	42.4	2-600 MCM AWG

BULLETIN 1489-M CIRCUIT BREAKERS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1489-M_	13.3	1.5	18-16 AWG
1489-M_	17.7	2	14-10 AWG
1489-M_	39.8	4.5	8-4 AWG

BULLETIN 1321 OPEN REACTORS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1321-3R1-A	4.5	0.51	22-14 AWG
1321-3R1-B	4.5	0.51	22-14 AWG
1321-3R1-C	4.5	0.51	22-14 AWG
1321-3R2-A	4.5	0.51	22-14 AWG
1321-3R2-B	4.5	0.51	22-14 AWG
1321-3R2-C	4.5	0.51	22-14 AWG
1321-3R4-A	4.5	0.51	22-14 AWG
1321-3R4-B	4.5	0.51	22-14 AWG
1321-3R4-C	4.5	0.51	22-14 AWG
1321-3R8-A	4.5	0.51	22-14 AWG
1321-3R8-B	4.5	0.51	22-14 AWG
1321-3R8-C	4.5	0.51	22-14 AWG
1321-3R12-A	16	1.81	22-6 AWG
1321-3R12-B	16	1.81	22-6 AWG
1321-3R12-C	16	1.81	22-6 AWG
1321-3R18-A	16	1.81	22-6 AWG
1321-3R18-B	16	1.81	22-6 AWG
1321-3R18-C	16	1.81	22-6 AWG
1321-3R25-A	16	1.81	22-6 AWG
1321-3R25-B	16	1.81	22-6 AWG
1321-3R25-C	16	1.81	22-6 AWG
1321-3R35-A	16	1.81	22-6 AWG
1321-3R35-B	16	1.81	22-6 AWG
1321-3R35-C	20	2.26	18-4 AWG
1321-3R45-A	20	2.26	18-4 AWG
1321-3R45-B	20	2.26	18-4 AWG
1321-3R45-C	20	2.26	18-4 AWG
1321-3R55-A	45	5.09	6-1/0 AWG
1321-3R55-B	45	5.09	6-1/0 AWG
1321-3R55-C	45	5.09	6-1/0 AWG
1321-3R80-A	45	5.09	6-1/0 AWG
1321-3R80-B	45	5.09	6-1/0 AWG
1321-3R80-C	45	5.09	6-1/0 AWG
1321-3R100-A	150	16.95	2-4/0 AWG
1321-3R100-B	150	16.95	2-4/0 AWG
1321-3R100-C	150	16.95	2-4/0 AWG
1321-3R130-A	150	16.95	2-4/0 AWG
1321-3R130-B	150	16.95	2-4/0 AWG
1321-3R130-C	150	16.95	2-4/0 AWG
1321-3R160-A	150	16.95	2-4/0 AWG
1321-3R160-B	150	16.95	2-4/0 AWG
1321-3R160-C	150	16.95	2-4/0 AWG

POWERFLEX 750 SERIES AC DRIVES POWER TERMINAL BLOCKS

FRAME SIZE	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1,2	5	0.57	24-10 AWG
3	10.6	1.2	20-6 AWG
4	24	2.7	14-3 AWG
5	35	4.0	8-1 AWG
6	100	11.3	M8 x 1.25STUD
7	100	11.3	M8 x 1.25STUD

BULLETIN 1494R TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
1494R-N1	45	5.09	14-4 AWG
1494R-N2	150	16.95	8-1/0 AWG
1494R-N3	275	31	6-4/0 AWG
1494R-N10	325	36.72	(2) 1/0-350 AWG
1494R-N11	325	36.72	(2) 1/0-350 AWG
1494R-N12	375	42.37	1/0-500 AWG
1494R-N14	303	34.23	(2) 1/0-250 AWG
1494R-N15	415	46.89	4-500 AWG

BULLETIN 199 TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
199-LE1	150	16.9	8-1/0 AWG
199-LF1	275	31	6-250MCM AWG
199-LG1	375	42	4-500MCM AWG
199-LH1	275	31	1/0-350MCM AWG
199-LJ1	275	31	1/0-500MCM AWG

BULLETIN 100 TERMINAL LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
100-DL110	70-90	8.0-10	14-2/0 AWG
100-DLE110	70-90	8.0-10	8-2/0 AWG
100-DL180	90-110	10-12	6-300MCM AWG
100-DL420	375	42	4-350MCM AWG
100-DL630	400	45	2/0-500MCM AWG
100-DL860	400	45	2/0-500MCM AWG

HOFFMAN GROUND BAR

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
P-GS2K	40	4.5	- AWG
P-GS4K	40	4.5	- AWG
P-GS6K	40	4.5	- AWG

BURNDY GROUND LUGS

PART NUMBER	TORQUE IN-LBS	TORQUE N-m	WIRE RANGE
KPA8CTP	12	1.36	14-6 AWG
KA26U	120	13.6	6-2/0 AWG
KA31U	375	42.4	6-350MCM AWG
KA34U	500	56.5	4-500MCM AWG

USE COPPER, 60°C WIRE IF RATED LESS THAN 100 AMPS
OR 75°C WIRE IF RATED 100 AMPS OR MORE

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TORQUE VALUES FOR
NORTHEAST ELECTRICAL / ORLEANS DOWNTOWN WWTF
R1USE01851

Drawn by: JSP Date: 11/23/2020

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APPROVAL DOCUMENT - 04-14-21 REV 01

480VAC, 3PH, 60Hz
FLA= 49.7
SCCR= 65KA

1BCP030 — 480VAC USER SUPPLIED BRANCH CIRCUIT PROTECTION — REM

L1 / L2 / L3 — 1CB030 — ROTARY OPERATOR — 70A

INSTALL NOTE:
LINE TERMINATION WIRE RANGE:
(1) #14...1/0AWG MECH. CONNECTION.

BLK_8AWG

1030 / 1050 / 1060

1RX030 — 5% — 55A

1031 / 1051 / 1061

(FLA = 47.7A)

PE — PE — GND

INSTALL NOTE:
PE TERMINATION WIRE RANGE:
(2) #14...00AWG MECH. CONNECTION.

TO 1-28

POWERFLEX 753
MODULE - 20F11ND065JA0NNNNN
1EA030

HEAVY DUTY
CONT RGT: 52 AMP
FRAME SIZE 4

R/L1, S/L2, T/L3 — AC TO DC CONVERTER — DC TO AC INVERTER — U/T1, V/T2, W/T3

DC(+), DC(-)

PE — PE — PE — MPE

FILTERING
PE-A
CHASSIS
CM CAP
PE-B
SEE USER MANUAL

PORT 0

PE-A FILTER	X	IN	OUT
PE-B CM CAP	X	IN	OUT

J1 ENABLE		X IN	OUT
J2 SAFETY		X IN	OUT

SETTINGS AS SHIPPED

BR1
BR2

TB1
- AO0-
- AO0+
- 10VC
- +10V
- AI0-
- AI0+
- PTC-
- PTC+
- TO
- 24VC — DIGITAL INPUT COMMON
- +24V — +24VDC POWER
- DI C
- DI 1
- DI 2

TB3
- DI 0DC — DIGITAL INPUT 0 24VDC
- DI C — DIGITAL INPUT 0 COMMON
- DI 0AC — DIGITAL INPUT 0 120VAC

DPI PORT 1

TB2
- R0NC
- R0C
- R0NO

DPI PORT 2

STS

USER NOTE:
REFER TO DRIVE INSTRUCTION MANUAL TO SET JUMPERS PE-A, & PE-B BASED ON MAIN INCOMING POWER DISTRIBUTION GROUNDING SCHEME

BLK_#6AWG

1032 (L1) A1 / 1052 (L2) B1 / 1062 (L3) C1 — LINE

TCI: V1K55A00

BLK — QT1 — RL1 — QT4 — BLK/WHITE — A2 (T1) 1T1
RED — QT2 — RL2 — QT5 — RED/WHITE — B2 (T2) 1T2
BLUE — QT3 — RL3 — QT6 — BLU/WHITE — C2 (T3) 1T3

RC1 C1, RC2 C2, RC3 C3

GRD.

1LF030

LOAD

1PDB030 (L1) (L2) (L3)

LOAD TERMINATION WIRE RANGE
(1)#14-#2AWG

SEE LOCAL CODES

1MTR050 — T1, T2, T3 — M — GND

40 HP
460 VAC
52 FLA

MPE — MPE

VERIFY MOTOR NAMEPLATE DATA AT COMMISSIONING

SHOP NOTE:
USE FERRULES ON 1LF030, 1PDB030 MOTOR TB AND MPE CONNECTIONS

L1 — 1F190 5A 600V CLASS CC — L2 — 1F191 5A 600V CLASS CC

SEE N/P

H1 H3 H2 H4 — 480 VAC 500VA — 1T180 — 120 VAC

TB1 X1 — 1220 — XF — 1F220 6.25A 250V TYPE FNM — X2 — 1221 — TB1 N

DOOR FAN 1MTR270 — D

1T270 — 1270 — TB1-PE — FROM 1-10 — 1-2 — 300 CFM 0.8 FLA

1JMP310 JUMPER — TB2 6 — TB2 7

1310

NOTE:
TO INSTALL E-STOP OR CUSTOMER INTERLOCKS, REMOVE WIRE JUMPER BETWEEN TB2 6 & 7

??

??

KIT #: 20-HIM-C6S — 1HIM330
DOOR MOUNTED HUMAN INTERFACE MODULE — D

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U.L. 508A LABEL REQUIRED

REV.	DATE	BY	ECN/CR. NO.

Rockwell Automation

SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
POWER AND MOTOR INTERFACE
POWERFLEX 40HP HD DRIVE, TYPE 12

Drawn by: JSP — Date: 11/28/20

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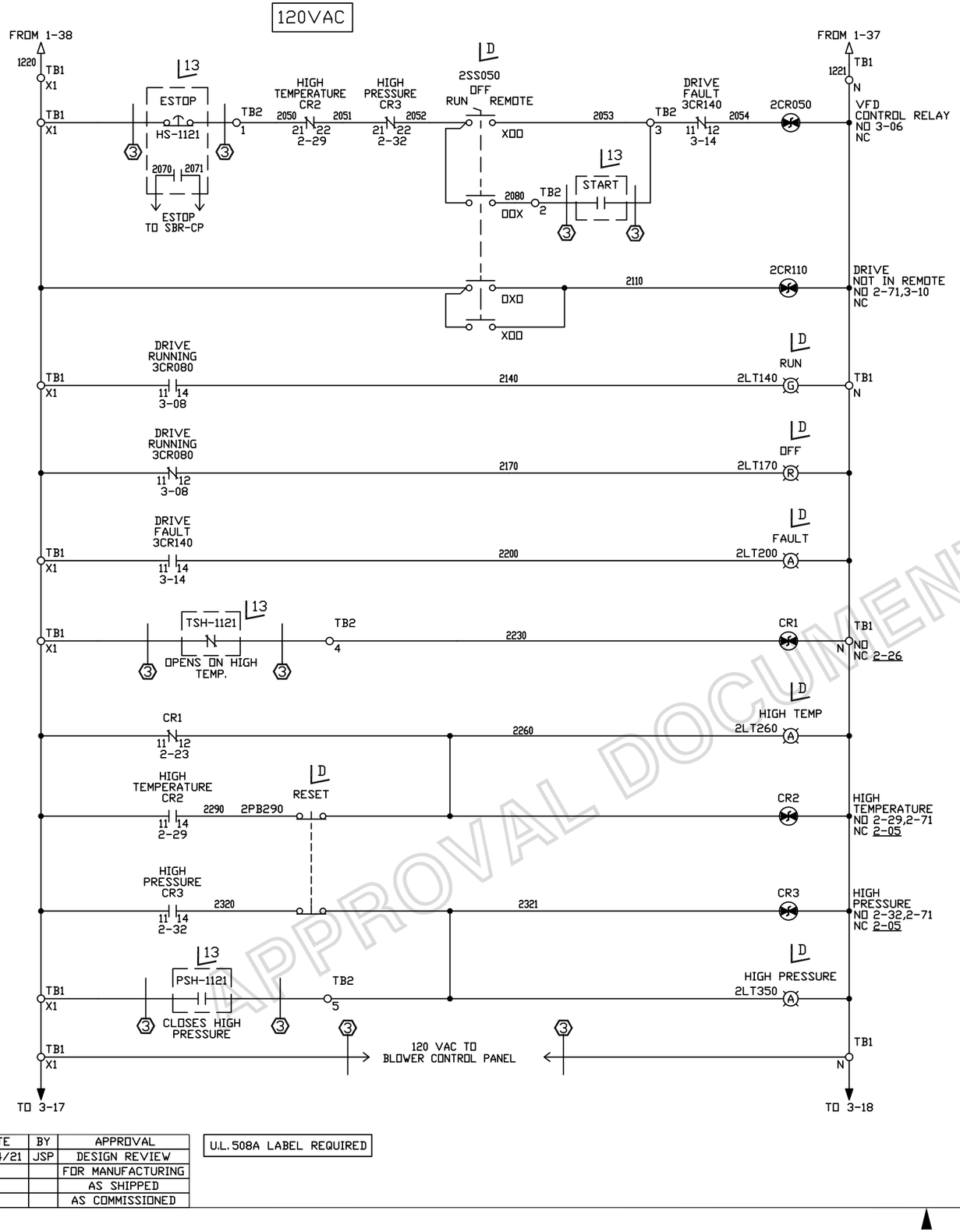

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U.L. 508A LABEL REQUIRED

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Rockwell Automation

SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
120VAC CONTROL POWER
POWERFLEX 40HP HD DRIVE, TYPE 12

Drawn by: JSP | Date: 11/28/20

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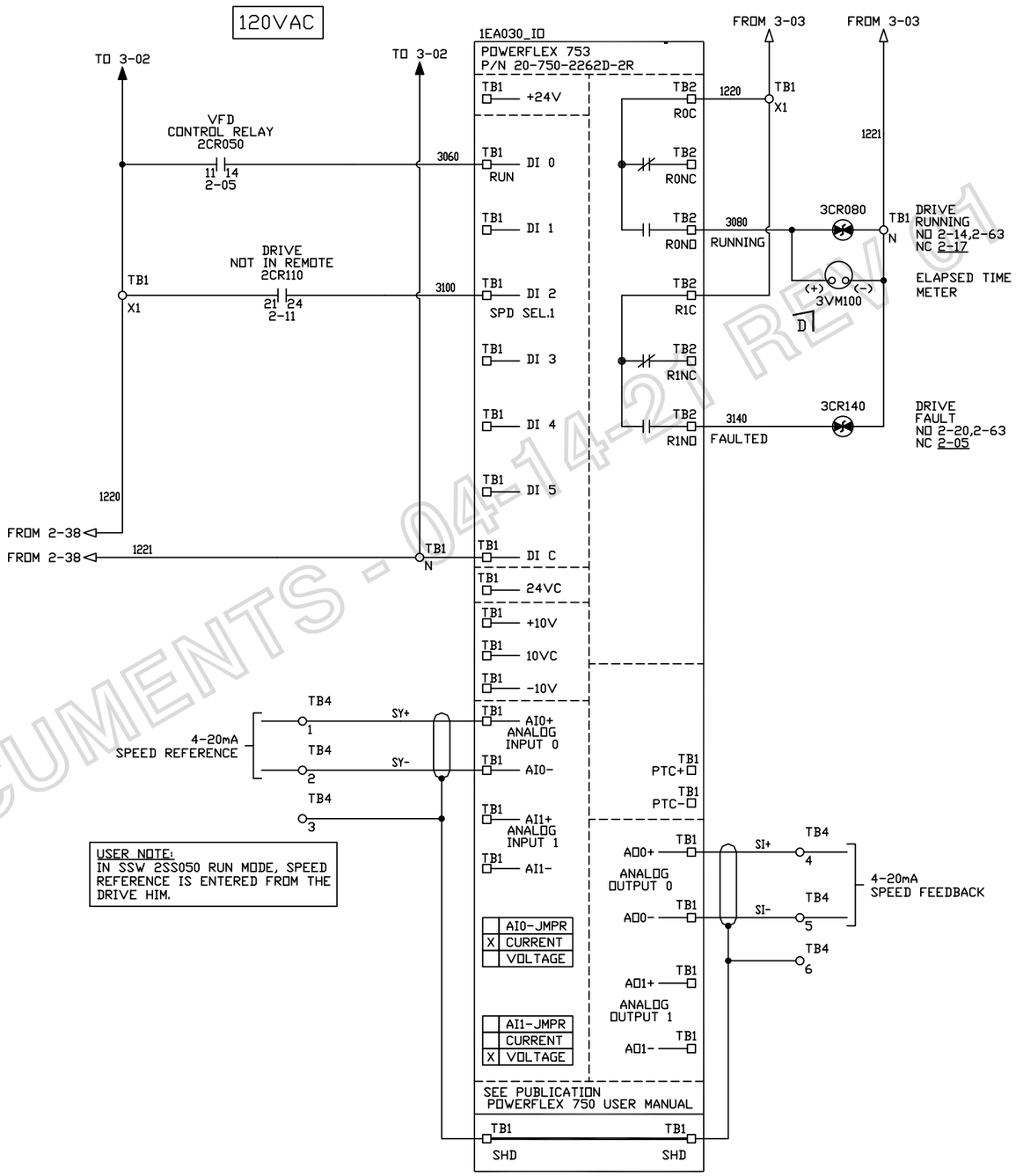

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Rockwell Automation

SCHEMATIC DIAGRAM FOR POWERFLEX 753 DRIVE
PORT 4 - I/O INTERFACE
POWERFLEX 40HP HD DRIVE, TYPE 12
Drawn by: JSP Date: 11/28/20

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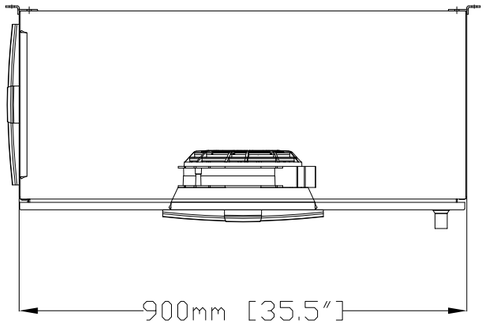
E0033.DWG

ENCLOSURE TOP VIEW

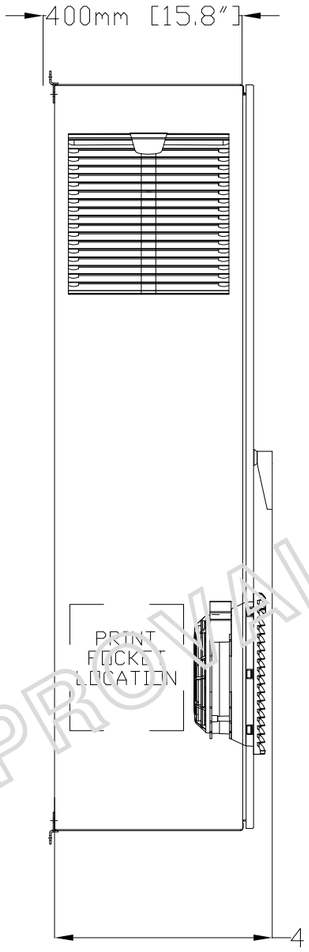


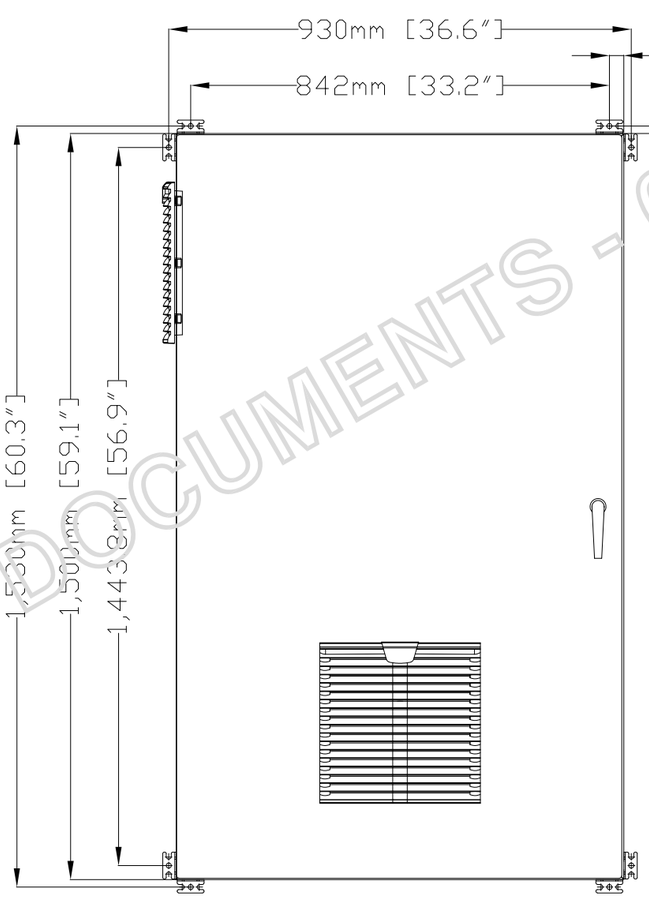
900mm [35.5"]

TYPE 12 ENCLOSURE DESIGN
COLOR: RAL 7035 (GRAY)

U.L.508A LABEL REQUIRED

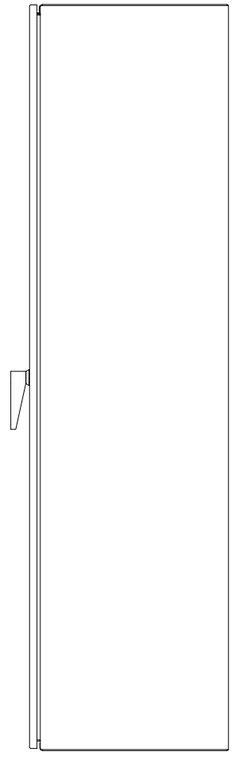
ENCLOSURE LEFT VIEW





ENCLOSURE FRONT VIEW

ENCLOSURE RIGHT VIEW



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ENCLOSURE DIMENSIONS
ITEM 0003
POWERFLEX 40HP HD DRIVE, TYPE 12
Drawn by: JSP | Date: 11/28/20

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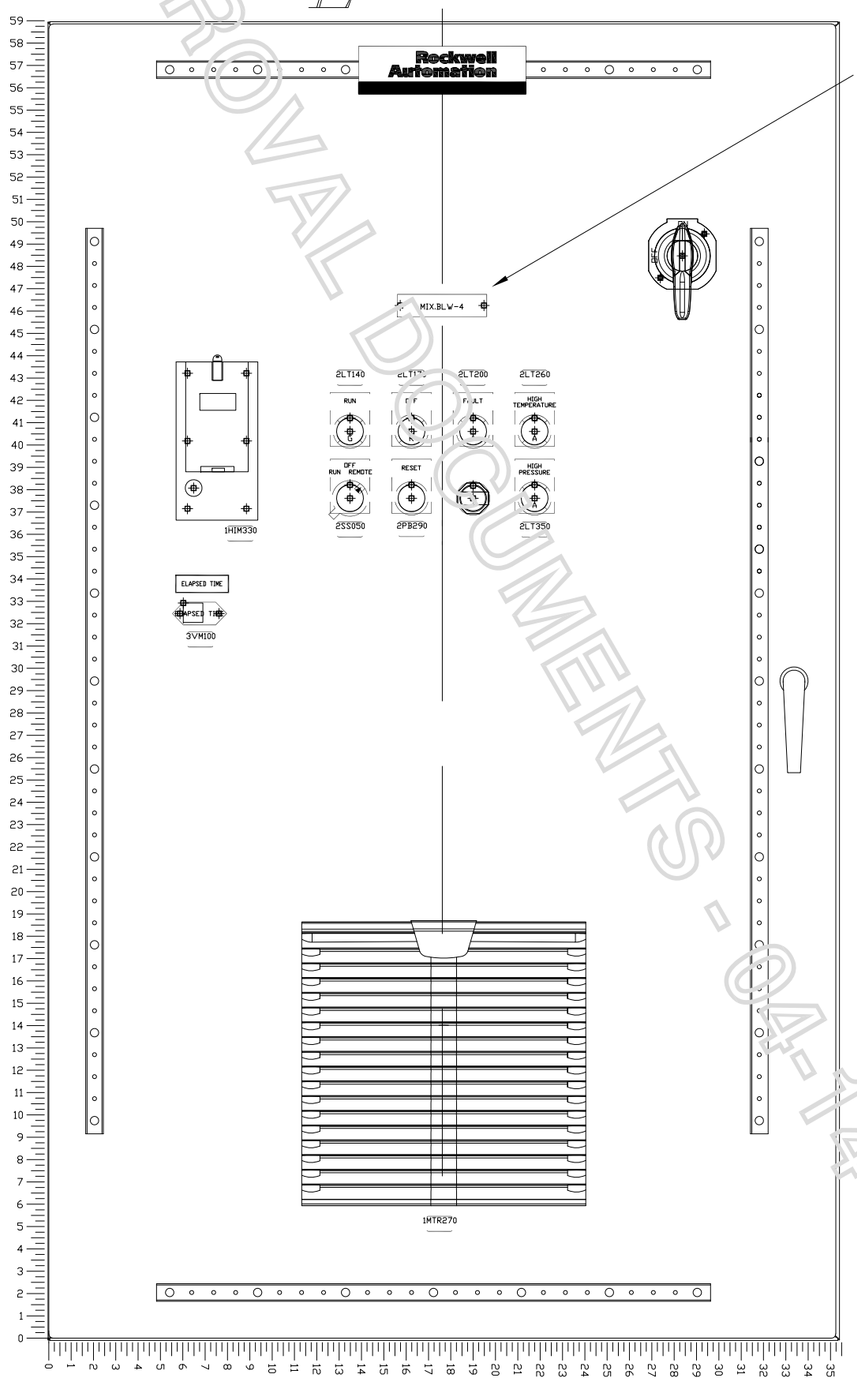
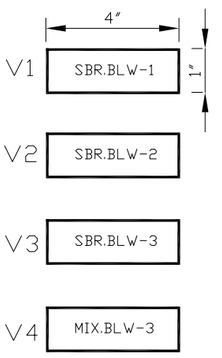
℄ OF DOOR



WHITE PHENOLIC
WITH BLACK
LETTERING



(MTD. ON BACK OF DOOR)

AFTER HOURS EMERGENCY ON SITE SERVICE AND PARTS

(MTD. ON BACK OF DOOR)

Rockwell Automation

PROJECT#: R1USE01851-0003-V?

DIAGRAM: R1USE01851-0003
INPUT 480VAC 49.7 AMPS 3PH 60Hz
OUTPUT 480VAC 52 AMPS
LARGEST MOTOR: 40HP, 52AMPS
SHORT CIRCUIT CURRENT RATING:
65 KA RMS. SYMMETRICAL, 480VOLTS MAXIMUM
ENCLOSURE RATING: TYPE 12

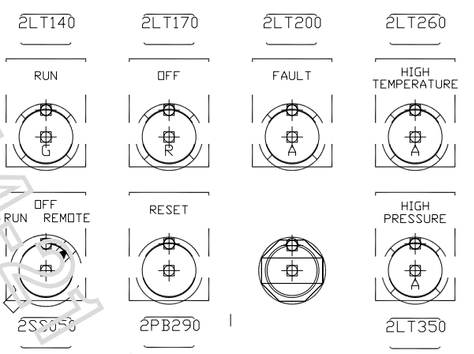
Local Solution Center, Edison NJ 08837 USA

(MOUNT ON INSIDE & OUTSIDE OF DOOR)

V? = 1,2,3,4

UL LISTED
ENCLOSED INDUSTRIAL CONTROL PANEL
No: Xxxxxxx

DETAIL



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LAYOUT DRAWING FOR DOOR
ITEM 0003
POWERFLEX 40HP HD DRIVE, TYPE 12
Drawn by: JSP
Date: 11/28/20

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R1USE01851-0003

40HP "H.D." PANEL

STRIP-ID	TERM	WIRENO
TB1	X1	1220
TB1	X1	1220
TB1	X1	1220
TB1	X1	1220
TB1	X1	1220
TB1	N	1221
TB1	N	1221
TB1	N	1221
TB1	N	1221
TB1	N	1221
TB2	1	2050
TB2	2	2080
TB2	3	2053
TB2	4	2230
TB2	5	2321
TB2	6	1220
TB2	7	1310
TB3	1	2630
TB3	2	2631
TB3	3	2632
TB3	4	2633
TB3	5	2710
TB3	6	2711
TB3	7	2712
TB3	8	2713
TB3	9	2714
TB3	10	2715
TB4	1	SY+
TB4	2	SY-
TB4	3	SHD
TB4	4	SI+
TB4	5	SI-
TB4	6	SHD

SHOP NOTE:
INSTALL DIN-RAIL WITH HIGH-SIDE TOWARD TOP.

▲ENCLOSURE ▲WALL_BRACKET

TB1 1T270 TB2 TB3 TB4

DIN-35G*1M

PNL_CHAN_1.5
PNL_CHAN_1.5_CVR

2CR050 CR1 CR2 CR3 3CR080 3CR140

DIN-35G*1M

2CR110

PNL_CHAN_1.5
PNL_CHAN_1.5_CVR

PNL_CHAN_1.5
PNL_CHAN_1.5_CVR

PE BUSBAR

LINE-PE

GND

HIGH FRAME

70A

1CB030

1T180

1T180

DX-169

▲1F190
▲1F191
▲1F220

1F190
1F191
1F220

1A030

▲1EA030_BATT

1EA030

1RX030

LABEL

1RX030

1FLT030

Front View

Top Of VLK

1PDB030

MPE

DETAIL FOR
DRIVE CONTROL POD

▲1EA030-ID

I/O OPTION

6 5 4

Dv/Dt UNIT SIDE-VIEW

Dv/Dt UNIT TERMINAL DETAIL

A1 A2 B1 B2 C1 C2

FUSE REPLACEMENT TABLE

REPLACE FUSES ONLY WITH EXACT TYPE, CLASS, AND RATING AS LISTED IN TABLE.

TAG	CLASS	TYPE	VOLTAGE	CURRENT
1F190	CC	TIME DELAY	600V	5A
1F191	CC	TIME DELAY	600V	5A
1F220	M	TIME DELAY	250V	6.25A

▲1CB030_LINESIDE LUGS
▲1CB030_LINESIDE_COVER

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LAYOUT DRAWING FOR PANEL
ITEM 0003
POWERFLEX 40HP HD DRIVE, TYPE 12
Drawn by: JSP Date: 11/28/20

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Technical Data

Original Instructions

PowerFlex 750-Series AC Drives

Catalog Numbers 20G, 20J

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Product Overview

The PowerFlex 750-Series is a robust family of AC drives that provide ease of use, flexibility, and performance for various industrial applications. PowerFlex 753 drives provide general-purpose control for applications up to 400 Hp and 270 kW. PowerFlex 755 drives provide maximum flexibility and performance up to 2000 Hp and 1500 kW.

Maximize your productivity by taking advantage of these key features that are offered in the PowerFlex 750-Series drives:

- **DeviceLogix**™ – Embedded control technology that supports the manipulation of discrete outputs and drive control functions, while using discrete inputs and drive status information onboard the drive.
- **Predictive Diagnostics** – Tracks information that affects the life of the drive cooling fans and relay outputs. The drive can also be programmed to monitor the runtime hours for machine or motor bearings.
- **Option Cards** – Each drive has a slot-based architecture. Supported hardware control options are available for both products, to help reduce your inventory and spare parts requirements.
- **Safe Torque Off**, **Safe Speed Monitor**, **Integrated Safety - Safe Torque Off**, and **Integrated Safety Functions Option** – Provides a choice for safety levels depending on your application requirements.
- **Communication** – The PowerFlex 755 drives come with a built-in Ethernet port. Ethernet can easily be added to the PowerFlex 753 drives with a communication module.
- **I/O** – Option cards are available for additional analog and digital I/O. The PowerFlex 753 drives come with built-in I/O that can also be expanded with option cards.
- **Packaging** – Factory and field-installable enclosure options are available to meet most environmental requirements. Options include Open Type and flange mount to support cabinet mount requirements, extra protection wall-mount for harsh environments, and debris hoods and conduit plate kits.
- **Standard Power Structure** – A common power structure is shared to provide the same physical size and power range.

PowerFlex 750-Series Drive Family

This section provides a brief introduction to the different PowerFlex 750-Series drives.

Wall Mount Frames 1…7
IP00/IP20, NEMA/UL Type Open Drive
Includes a DC link choke on all Frames and internal brake transistor, standard on Frames 1…5, and optional on Frames 6 and 7.

Floor Mount Frames 8…10
IP20, NEMA/UL Type 1 Drive (2500 MCC style cabinet)
Includes a DC link choke, integrated AC line fuses, and roll-out design.
Hood that is shown on top of cabinets is optional. To order the hood, see page 199 for information.

Floor Mount Frames 8…10
IP20, NEMA/UL Type 1 Drive with Options (2500 MCC style cabinet)
Includes a DC link choke, integrated AC line fuses, roll-out design, and option bay for control/protection devices.

Roll-out Design
(Frame 8 shown)
A roll-out cart is required for Frames 8…10 drives and Frame 9…10 option bay chassis. The roll-out cart has an adjustable curb height of 0…182 mm (0…7.2 in.) and curb offset/reach of 0…114 mm (0…4.5 in.).
See page 200 for information to order the roll-out cart.

F
N

1
4

077
096
065

Catalog Number Explanation

1…3	4	5	6	7	8…10	11	12	13	14	15	16	17	18	
20F	1			D		J	A	0	N	N	N	N	N	LD - P3 - P11…
a	*b*	*c*	*d*	*e*	*f1…f6*	*g*	*h*	*i*	*Positions 14…18 are not used.*					

a

Drive		
Code	Type	Frames
20F	PowerFlex® 753	1…7
20G	PowerFlex 755	1…10
21G	PowerFlex 755 Drive with Options	8…10

b

Future Use

c

MIX.BLW-3
SBR.BLW-1,
-2,-3

MIX.BLW-1,-
2,-4

Input Type		
Code	Description	Frames
1	AC Input with Precharge, includes DC Terminals	1…5 8…10
4	DC Input with Precharge	5…10
A	AC Input with Precharge, no DC Terminals	6…8 (1)

(1) The DC Bus Bar kit (20-750-DCBB1-Fx) is available for Frames 6…7 AC input drives that require DC bus terminals.

d

MIX.BLW-1,-2,-4

MIX.BLW-3
SBR.BLW-1,
-2,-3

Enclosure		
Code	Description	Frames
R	IP20, NEMA/UL Type Open, Frame 1	1
F (1)	Flange (NEMA/UL Type 4X/12 back)	2…5
G	IP54, NEMA/UL Type 12	2…7
N (2)	IP20/IP00, NEMA/UL Type Open	2…7
B (3)	IP20, NEMA/UL Type 1, 600 mm (23.6 in.) Deep, Standard Cabinet Color (RAL 7032)	8…10
J (3)	IP54, UL Type 12, 800 mm (31.5 in.) Deep, Standard Cabinet Color (RAL 7032)	8…10
K (3)	IP54, NEMA 12, 2500 MCC Style Cabinet and Options w/MCC Power Bus, 800 mm (31.5 in.) Deep, Standard Cabinet Color (RAL 7032)	8…10
L (3)	IP20, NEMA/UL Type 1, 800 mm (31.5 in.) Deep, Standard Cabinet Color (RAL 7032)	8…10
P (3)	IP20, NEMA/UL Type 1, 2500 MCC Style Cabinet and Options w/MCC Power Bus, 800 mm (31.5 in.) Deep, Standard Cabinet Color (RAL 7032)	8…10
W (3)	IP20, NEMA/UL Type 1, 2500 MCC Style Cabinet and Options w/MCC Power Bus, 800 mm (31.5 in.) Deep, CenterLine 2100 Gray (ASA49)	8…10
Y (3)	IP54, NEMA 12, 2500 MCC Style Cabinet and Options w/MCC Power Bus, 800 mm (31.5 in.) Deep, CenterLine 2100 Gray (ASA49)	8…10
T	IP00, UL Open Type without Control POD	8…10

(1) For Frames 6…7, a user installed flange kit (20-750-FLNG4-Fx) is available to convert a Code N drive that provides a NEMA/UL Type 4X/12 back.
(2) Frames 2…5 are IP20, Frames 6…7 are IP00.
(3) Available as a drive with options (21G).

e

Voltage Rating	
Code	Voltage
B	240V AC (208V AC) (1)/ 325V DC (281V DC) (1)
C	400V AC/540V DC
D	480V AC/650V DC
E	600V AC/810V DC
F	690V AC/932V DC (not UL Listed)

(1) Drive must be programmed to obtain low (208V AC) voltage rating.

f1

ND Rating								
208V (1), 60 Hz Input								
Code	Amps	kW	Frame					
			Enclosure Code					
			B, J, L, T	F	G	N	K, P, W, Y	R
2P2	2.5	0.37	–	–	–	–	–	1
4P2	4.8	0.75						
6P8	7.8	1.5						
9P6	11	2.2						
015	15.3	4						
2P2	2.5	0.37	–	2	2	2	–	–
4P2	4.8	0.75						
6P8	7.8	1.5						
9P6	11	2.2						
015	17.5	4						
022	22	5.5						
028	32.2	7.5	–	3	3	3	–	–
042	43	11						
054	60	15		4	4	4		
070	78.2	18.2		5	5	5		
080	92	22						
104	120	30		(2)	6	6		
130	150	37						
154	177	45						
192	221	55						
260	260	66			7			
312	359	90		(2)				
360	414	110						
477	477	132			–			

(1) Drive must be programmed to obtain low (208VAC) voltage rating.
(2) For Frames 6 and 7, a user-installed flange kit (20-750-FLNG4-Fx) is available to convert a Code N drive that provides a NEMA/UL Type 4X/12 back.

f2

ND Rating								
240V, 60 Hz Input								
Code	Amps	Hp	Frame					
			Enclosure Code					
			B, J, L, T	F	G	N	K, P, W, Y	R
2P2	2.2	0.5	–	–	–	–	–	1
4P2	4.2	1						
6P8	6.8	2						
9P6	9.6	3						
015	15.3	5						
2P2	2.2	0.5	–	2	2	2	–	–
4P2	4.2							
6P8	6.8	2						
9P6	9.6	3						
015	15.3	5						
022	22	7.5						
028	28	10		3	3	3		
042	42	15						
054	54	20		4	4	4		
070	70	25		5	5	5		
080	80	30						
104	104	40		(1)	6	6		
130	130	50						
154	154	60						
192	192	75						
260	260	100			7			
312	312	125		(1)		7		
360	360	150						
477	477	200			–			

(1) For Frames 6 and 7, a user-installed flange kit (20-750-FLNG4-Fx) is available to convert a Code N drive that provides a NEMA/UL Type 4X/12 back.

1…3	4	5	6	7	8…10	11	12	13	14	15	16	17	18	
20F	1			D		J	A	0	N	N	N	N	N	LD - P3 - P11…
a	*b*	*c*	*d*	*e*	*f1…f6*	*g*	*h*	*i*	*Positions 14…18 are not used.*					

f3

ND Rating								
400V, 50 Hz Input								
Code	Amps	kW	Frame					
			Enclosure Code					
			B, J, L, T	F	G	N	K, P, W, Y	R
2P1	2.1	0.75	–	2	2	2	8(2)	1
3P5	3.5	1.5						
5P0	5.0	2.2						
8P7	8.7	4						
011	11.5	5.5						
015	15.4	7.5						
022	22	11		3	3	3		
030	30	15						
037	37	18.5						
043	43	22						
060	60	30		4				
072	72	37						
085	85	45		5				
104	104	55						
140	140	75						
170	170	90						
205	205	110		(1)	7	7		
260	260	132						
302	302	160						
367	367	200						
456	456	250						
460	460	250	8	–	–	–	8(2)	–
477	477	270	–	(1)	–	7	–	
540	540	315	8	–	–	–	8(2)	
567	567	315						
650	650	355						
750	750	400						
770	770	400						
910	910	500	9				9(2)	
1K0	1040	560						
1K1	1090	630						
1K2	1175	710						
1K4	1465	800						
1K5	1480	850						
1K6	1590	900	10				10(2)	
2K1	2150	1250						

(1) For Frames 6…7, a user installed flange kit (20-750-FLNG4-Fx) is available to convert a Code N drive that provides a NEMA/UL Type 4X/12 back.
(2) Available as a drive with options (21G).

f4

ND Rating								
480V, 60 Hz Input								
Code	Amps	Hp	Frame					
			Enclosure Code					
			B, J, L, T	F	G	N	K, P, W, Y	R
2P1	2.1	1	–	2	2	2	–	1
3P4	3.4	2						
5P0	5.0	3						
8P0	8.0	5						
011	11	7.5		3	3	3		
014	14	10						
022	22	15						
027	27	20						
034	34	25						
040	40	30						
052	52	40		4	4	4		
065	65	50			5			
077	77	60		5		5		
096	96	75			6			
125	125	100		(1)		6		
156	156	125						
186	186	150						
248	248	200			7	7		
302	302	250						
361	361	300						
415	415	350						
430	430	350	8	–	–	–	8(2)	–
477	477	400	–	(1)	–	7	–	
485	485	400	8	–	–	–	8(2)	
545	545	450						
617	617	500						
710	710	600						
740	740	650						
800	800	700	9				9(2)	
960	960	800						
1K0	1045	900						
1K2	1135	1000						
1K3	1365	1100						
1K4	1420	1250						
1K5	1525	1350	10				10(2)	
2K0	2070	1750						

(1) For Frames 6…7, a user installed flange kit (20-750-FLNG4-Fx) is available to convert a Code N drive that provides a NEMA/UL Type 4X/12 back.
(2) Available as a drive with options (21G).

f5

ND Rating								
600V, 60 Hz Input								
Code	Amps	Hp	Frame					
			Enclosure Code					
			B, J, L, T	F	G	N	K, P, W, Y	R
1P7	1.7	1	–	3	3	3	–	–
2P7	2.7	2						
3P9	3.9	3						
6P1	6.1	5						
9P0	9	7.5						
011	11	10						
012(1)	12	10		–	6	6		
017	17	15		3	3	3		
018(1)	18	15		–	6	6		
022	22	20		3	3	3		
023(1)	23	20		–	6	6		
024(1)	24	20						
027	27	25		4	4	4		
028(1)	28	25		–	6	6		
032	32	30		4	4	4		
033(1)	33	30		–	6	6		
041	41	40		5	5	5		
042(1)	42	40		–	6	6		
052	52	50		5	–	5		
053(1)	53	50		(2)	6	6		
063	63	60						
077	77	75						
099	99	100						
125	125	125						
144	144	150						
192	192	200			7	7		
242	242	250						
289	289	300						
295	295	300	8	–	–	–	8(3)	
355	355	350						
395	395	400						
435	435	450						
460	460	500						
510	510	500						
595	595	600	9				9(3)	
630	630	700						
760	760	800						
825	825	900						
900	900	950						
980	980	1000						
1K1	1110	1100	10				10(3)	
1K4	1430	1400						

(1) Required for uncontrolled common DC bus applications. Optional for all AC applications.
(2) For Frames 6…7, a user installed flange kit (20-750-FLNG4-Fx) is available to convert a Code N drive that provides a NEMA/UL Type 4X/12 back.
(3) Available as a drive with options (21G).

1…3	4	5	6	7	8…10	11	12	13	14	15	16	17	18	
20F	1			D		J	A	0	N	N	N	N	N	LD - P3 - P11…
a	*b*	*c*	*d*	*e*	*f1…f6*	*g*	*h*	*i*	*Positions 14…18 are not used.*					

f6

ND Rating								
690V, 50 Hz Input (not UL Listed)								
Code	Amps	kW	Frame					
			Enclosure Code					
			B, J, L, T	F	G	N	K, P, W, Y	R
012	12	7.5	–	(1)	6	6	–	–
015	15	11						
020	20	15						
023	23	18.5						
030	30	22						
034	34	30						
046	46	37						
050	50	45						
061	61	55						
082	82	75						
098	98	90						
119	119	110						
142	142	132						
171	171	160			7	7		
212	212	200						
263	263	250						
265	265	250	8		–	–	8(2)	
330	330	315						
370	370	355						
415	415	400						
460	460	450						
500	500	500						
590	590	560	9	–			9(2)	
650	650	630						
710	710	710						
765	765	750						
795	795	800						
960	960	900						
1K0	1040	1000	10				10(2)	
1K4	1400	1400						

(1) For Frames 6…7, a user installed flange kit (20-750-FLNG4-Fx) is available to convert a Code N drive that provides a NEMA/UL Type 4X/12 back.
(2) Available as a drive with options (21G).

g

Filtering and CM Cap Configuration		
Code	Filtering	Default CM Cap Connection
A	Yes	Jumper Removed
J	Yes	Jumper Installed

h

Dynamic Braking(1)		
Code	Internal Resistor(2)	Internal Transistor(3)
A	No	Yes
N	No	No

(1) Not available on Frames 8…10, specify Code 'N'.
(2) Frames 1…2 only. Internal Resistor kits (20-750-DB1-Dx) sold separately.
(3) Standard on Frames 1…5, optional on 6…7.

i

Door Mounted HIM (Frames 8…10)	
Code	Operator Interface
0	No Door Mounted HIM
2	Enhanced LCD, Full Numeric, IP20
4	Enhanced LCD, Full Numeric, IP66 NEMA Type 4X/12

PowerFlex 755 w/Options (21G) Required Selections

Code	Option	Frames	Type
LD	Light Duty	8…10	System Overload Duty Cycle(1)
ND	Normal Duty		
HD	Heavy Duty		
P3	Input Thermal- magnetic Circuit Breaker	8…10	Power Disconnect(1)
P5	Input Non-Fused Molded Case Disconnect Switch	8 Only	
P14	Wiring Only Bay	8…10	Wiring Only Bay

(1) Only one option of this type can be selected.

PowerFlex 755 w/Options (21G) Additional Selections

Code	Option	Frames	Type
P11	Input Contactor	8 Only	Contactors(1)(2)
P12	Output Contactor		
L1	3% Input Reactor	8…9	Reactors(1)
L2	3% Output Reactor		
L3	5% Input Reactor	8 Only	
L4	5% Output Reactor		
P20	1200 A Bus	8…10	MCC Power Bus Capacity(1)
P22	2000 A Bus		
P24	3000 A Bus		
P30	UPS Control Bus, DC Input w/Precharge only	8…10	UPS Control Bus
X1	Auxiliary Transformer (500VA available), IP20 Cabinet Only	8 Only(3)	Auxiliary Power

(1) Only one option of this type can be selected.
(2) Contactor options are not available for systems with MCC power bus.
(3) Standard on all other cabinet configurations.

460…480V AC, Three-phase Drives

IP00/IP20, NEMA/UL Type Open (1)

Normal Duty				Heavy Duty				Cat. No. (2) (3)	Frame Size
Output Amps			Hp	Output Amps			Hp		
Cont.	1 min	3 s		Cont.	1 min	3 s			
2.1	2.3	3.2	1	1.1	2.3	3.2	0.5	20F11RD2P1JA0NNNNN	1
3.4	3.7	5.1	2	2.8	4.2	5.1	1	20F11RD3P4JA0NNNNN	
5	5.5	7.5	3	3.4	5.5	7.5	2	20F11RD5P0JA0NNNNN	
8	8.8	12	5	5	8.8	12	3	20F11RD8P0JA0NNNNN	
11	12.1	16.5	7.5	8	12.1	16.5	5	20F11RD011JA0NNNNN	
14	15.4	21	10	11	16.5	21	7.5	20F11RD014JA0NNNNN	
2.1	3.1	3.7	1	2.1	3.1	3.7	1	20F11ND2P1JA0NNNNN	2
3.4	5.1	6.1	2	3.4	5.1	6.1	2	20F11ND3P4JA0NNNNN	
5	7.5	9	3	5	7.5	9	3	20F11ND5P0JA0NNNNN	
8	12	14.4	5	8	12	14.4	5	20F11ND8P0JA0NNNNN	
11	16.5	19.8	7.5	11	16.5	19.8	7.5	20F11ND011JA0NNNNN	
14	15.4	21	10	11	16.5	21	7.5	20F11ND014JA0NNNNN	
22	24.2	33	15	14	24.2	33	10	20F11ND022JA0NNNNN	
27	29.7	40.5	20	22	33	40.5	15	20F11ND027JA0NNNNN	3
34	37.4	51	25	27	40.5	51	20	20F11ND034JA0NNNNN	
40	44	60	30	34	51	61.2	25	20F11ND040JA0NNNNN	
52	57.2	78	40	40	60	78	30	20F11ND052JA0NNNNN	4
65	71.5	97.5	50	52	78	97.5	40	20F11ND065JA0NNNNN	
77	84.7	116	60	65	97.5	116	50	20F14FD077JA0NNNNN	5
96	106	144	75	77	116	144	60	20F14FD096JA0NNNNN	
125	138	188	100	96	144	188	75	20F1AND125JN0NNNNN (4)	6
156	172	234	125	125	188	234	100	20F1AND156JN0NNNNN (4)	
186	205	279	150	156	234	281	125	20F1AND186JN0NNNNN (4)	
248	273	372	200	186	279	372	150	20F1AND248JN0NNNNN (4)	
302	332	453	250	248	372	453	200	20F1AND302JN0NNNNN (4)	7
361	397	542	300	302	453	535	250	20F1AND361JN0NNNNN (4)	
415	457	623	350	361	542	650	300	20F1AND415JN0NNNNN (4)	
477	525	716	400	361	542	650	300	20F1AND477JN0NNNNN (4)	

SBR.BLW-1,-2,-3
MIX.BLW-3

MIX.BLW-4

MIX.BLW-1,-2

(1) Frames 1…5 are IP20, NEMA/UL Type Open. Frames 6…7 are IP00, NEMA/UL Type Open. Frames 1…7 can be converted to IP20, NEMA/UL Type 1 with optional kit (20-750-NEMA1-Fx), where x is the frame size.

(2) The 5th character determines Input Type; "1" = AC input with precharge and DC terminals, and "A" = AC input with precharge and no DC terminals. For DC input drives, see DRIVES-SG001, the PowerFlex Common Bus Configuration Selection Guide.

(3) The 11th character determines default Filtering and Common Mode Cap jumper configuration; "J" = Installed, and "A" = Removed.

(4) The 12th character determines whether an internal dynamic braking IGBT is included; "A" = Internal dynamic braking transistor installed, and "N" = No internal dynamic braking transistor.

Certifications and Specifications

This section provides information for certifications and specifications.

Certifications

Certification	Description
ABS	American Bureau of Shipping Certificate 11-HS743429
c-UL-us	Listed to UL508C and CSA22.2 No. 14 (does not apply to 21G drives with enclosure code P or W).
CE	In conformity with these European Directives EMC Directive EN 61800-3 Low Voltage Directive EN 61800-5-1 ATEX Directive (94/9/EC and 2014/34/EU) EC-Type-Examination Certificate Number TÜV 12 ATEX 7328 X EN 50495
SEMI F47	Certified compliant with the following standards SEMI F47 IEC 61000-4-34
EAC	Low Voltage TP TC 004/2011 EMC TP TC 020/2011
Functional Safety	TÜV Rheinland – Certification applies to 20-750-S, 20-750-S1, 20-750-S3, and 20-750-S4 Safety Options when installed in drive. Standards applied EN 61800-3, EN 61508 PARTS 1-7 EN 61800-5-1, EN 62061 EN 61800-5-2, EN 60204-1 EN ISO 13849-1
KCC	KCC-REM-RAA-20F-A, KCC-REM-RAA-20G-A, MSIP-REM-RAA-20F-C KCC-REM-RAA-20F-B, KCC-REM-RAA-20G-B, MSIP-REM-RAA-20F-D KCC-REM-RAA-20G-C, MSIP-REM-RAA-20G-D MSIP-REM-RAA-20F-E, MSIP-REM-RAA-20G-E See the certificate of registration for specific drive catalog numbers that have this certification.(1)
Lloyd's Register	Lloyd's Register Type Approval Certificate 11/60008 (For drives manufactured before 6/28/2016)
RCM	Australian Communications and Media Authority In conformity with the following items Radiocommunications Act: 1992 Radiocommunications Standard: 2008 Radiocommunications Labeling Notice: 2008 Standards applied EN 61800-3
RINA	RINA Certificate ELE349811CS

(1) See the product certifications website, http://www.rockwellautomation.com/global/certification/overview.page, for declarations of conformity, certificates, and other certification details.

Environmental Specifications

<table>
<tr><th>Category</th><th>Specification</th></tr>
<tr><td>Altitude</td><td>Based on load. See derating guidelines on pages 70…91.
Based on voltage. See this table and the footnotes that are based on EN61800-5-1 (Electro-thermal Safety Standard for drives).
<table>
<tr><th rowspan="2">System and Ground Configuration</th><th rowspan="2">Overvoltage Category(3)</th><th colspan="4">Altitude Limit Above Sea Level, mm (ft) (4)(5)</th></tr>
<tr><th>208/240V AC</th><th>400/480V AC</th><th>600V AC</th><th>690V AC</th></tr>
<tr><td rowspan="2">Center grounded (Y neutral) (TT or TN-S)(1)</td><td>II (2)</td><td>9000 (29,527.5) (6)</td><td>9000 (29,527.5) (6)</td><td>7500 (24,606.3) (6)</td><td>7500 (24,606.3) (6)</td></tr>
<tr><td>III (3)</td><td>9000 (29,527.5) (6)</td><td>4800 (15,748.0)</td><td>4800 (15,748.0)</td><td>4800 (15,748.0)</td></tr>
<tr><td>Ungrounded, impedance (2) (IT)(1)</td><td>II (2)</td><td>9000 (29,527.5) (6)</td><td>4800 (15,748.0)</td><td>7500 (24,606.3) (6)</td><td>4800 (15,748.0)</td></tr>
<tr><td>Grounded, or corner grounded (2)</td><td>III (3)</td><td>4800 (15,748.0)</td><td>2000 (6,561.7)</td><td>4800 (15,748.0)</td><td>2000 (6,561.7)</td></tr>
</table>
(1) IEC Standard 60364
(2) In CE installations, Frame 1 drives do not support ungrounded or corner grounded configurations.
(3) Category II (Isolation Transformer Level) - Typically two levels of isolation or protection from outdoor power lines. Category III (most common) Distribution Level Inside a Building - Typically one level of isolation or protection from outdoor power lines.
(4) Excluding failure from cosmic radiation. Cosmic radiation increases rate of IGBT malfunction at altitudes greater than 3000 m (9842.6) above sea level. Concrete walls and ceilings or concrete walls and large bottles of water overhead are examples of ways to shield against cosmic radiation.
(5) Frame 1 drives are limited to a maximum of 2000 m (6,561.7 ft) thermally. See Derating Guidelines on page 62.
(6) Drive is limited to a maximum of 4800 m (15,748.0 ft) thermally. See Derating Guidelines on page 62.</td></tr>
<tr><td>Maximum surrounding air temperature</td><td></td></tr>
<tr><td>IP20, NEMA/UL Open Type</td><td>0…50 °C (32…122 °F) Frames 1…5, all ratings</td></tr>
<tr><td>IP00, NEMA/UL Open Type</td><td>0…50 °C (32…122 °F) Frames 6 and 7, 12…456 A ratings
0…40 °C (32…104 °F) Frame 7, 477 A rating</td></tr>
<tr><td>IP20, NEMA/UL Type 1 (with hood)</td><td>0…40 °C (32…104 °F) Frames 1…5, all ratings</td></tr>
<tr><td>IP20, NEMA/UL Type 1 (with label)</td><td>0…40 °C (32…104 °F) Frames 6 and 7, all ratings</td></tr>
<tr><td>IP00, NEMA/UL Open Type</td><td>0…40 °C (32…104 °F) (1) Frames 8…10, all ratings</td></tr>
<tr><td>IP20, NEMA/UL Type 1</td><td>0…40 °C (32…104 °F) (1) Frames 8…10, all ratings</td></tr>
<tr><td>IP54, NEMA 12</td><td>0…40 °C (32…104 °F) (1) Frames 8…10, all ratings</td></tr>
<tr><td>Flange mount – front</td><td></td></tr>
<tr><td>IP20, NEMA/UL Open Type</td><td>0…50 °C (32…122 °F) Frames 2…5, all ratings</td></tr>
<tr><td>IP00, NEMA/UL Open Type</td><td>0…50 °C (32…122 °F) Frames 6 and 7, 12…456 A ratings
0…40 °C (32…104 °F) Frame 7, 477 A rating</td></tr>
<tr><td>Back/Heat sink</td><td></td></tr>
<tr><td>IP66, NEMA/UL Type 4X</td><td>0…40 °C (32…104 °F Frames 2…7, all ratings</td></tr>
<tr><td>Stand-alone/Wall-mount</td><td></td></tr>
<tr><td>IP54, NEMA/UL Type 12</td><td>0…40 °C (32…104 °F) Frames 2…7, all ratings</td></tr>
<tr><td>Storage temperature (all constructions)</td><td>-40…70 °C (-40…158 °F)</td></tr>
<tr><td>Atmospheric protection</td><td>IMPORTANT: Do not install the drive in an area where the ambient atmosphere contains volatile or corrosive gas, vapors, or dust. If the drive is not going to be installed right away, store the drive in an area where it is not exposed to a corrosive atmosphere.</td></tr>
<tr><td>IEC</td><td>Conformity with IEC 60721-3-3, 3C3 and 3S2, for components manufactured by Rockwell Automation.
A suitable IP54, UL Type 12 Cabinet is required to meet the 3S2 requirement.</td></tr>
<tr><td>UV radiation</td><td>The HIM and IP54, NEMA/UL Type 12 drive plastics are not UV rated.</td></tr>
<tr><td>Relative humidity</td><td>5…95% noncondensing</td></tr>
</table>

Environmental Specifications (Continued)

Category	Specification			
Shock – operating	Frames 1…6 Frame 7 Frames 8…10	15 g peak for 11 ms duration (±1.0 ms) 10 g peak for 11 ms duration (±1.0 ms) Power core – 10 g peak for 11 ms duration (±1.0 ms) in cabinet with option bay – 5 g peak for 11 ms duration (±1.0 ms)		
Shock – packaged for shipment	Frames 1 and 2 Frames 3 and 4 Frame 5 Frames 6…10	381 mm (15 in.) drop height 330 mm (13 in.) drop height 305 mm (12 in.) drop height Meets International Safe Transit Association (ISTA) test procedure 2B		
Vibration – operating	Frames 1 and 2 Frames 3…5 Frames 6 and 7 Frames 8…10	1.000 mm (0.040 in.) displacement, 2 g peak 1.000 mm (0.040 in.) displacement, 1.5 g peak 1.000 mm (0.040 in.) displacement, 1 g peak Power core, drive in cabinet with option bay – 1.000 mm (0.040 in.) displacement, 1 g peak		
Vibration – packaged for shipment, sinusoidal loose load	Frames 1…5 Frames 6…10	20.0 mm (0.8 in.) peak to peak, 2…5.186 Hz; 1.1 g peak from 5.186…20 Hz Meets ISTA 2B packaging standards		
Vibration – packaged for shipment, random secured	Frames 1…5	Frequency (Hz) 1 4 16 40 80 200	PSD (g^2/Hz) 0.00005 0.01 0.01 0.001 0.001 0.00001	
	Frames 6…10	Meets International Safe Transit Association (ISTA) test procedure 2B.		
Required airflow	Frame 1 and 2 3 4 5 6	Total fan airflow 84.95 m^3/h (50 CFM) 135.92 m^3/h (80 CFM) 543.68 m^3/h (320 CFM) 883.49 m^3/h (520 CFM) 856.30 m^3/h (504CFM)	Frame 7 8 9 10	Total fan airflow 1284.45 m^3/h (756 CFM) 2293.67 m^3/h (1350 CFM) 4587.33 m^3/h (2700 CFM) 6880.99 m^3/h (4050 CFM)
Sound **IMPORTANT**: Sound pressure level is measured at 2 m (6.7 ft).	Frame 1 and 2 3 4 5 6	Sound level 63 dB 64 dB 72 dB 77 dB 73 dB	Frame 7 8 9 10	Sound level 74 dB 79 dB 79 dB 83 dB
Surrounding environment pollution degree Pollution Degree 1 and 2 Pollution Degree 3 and 4	See page 131 for descriptions of each pollution degree rating. All enclosures acceptable. Enclosure that meets or exceeds IP54, NEMA/UL Type 12 required.			

(1) Maximum surrounding air temperature of 50 °C (122 °F) with derating. See Derating Guidelines on page 62.

Technical Specifications

Category	Specification					
Protection		**Motor Voltage**					
		200/208V	**240V**	**380/400V**	**480V**	**600V**	**690V**
	AC input overvoltage trip	288V AC	288V AC	576V AC	576V AC	825V AC	825V AC
	AC input undervoltage trip	125V AC	150V AC	250V AC	300V AC	360V AC	430V AC
	Bus overvoltage trip	408V DC	408V DC	815V DC	815V DC	1172V DC	1172V DC
	Bus undervoltage shutoff Frames 1…7 Frames 8…10	150V DC —	150V DC —	200V DC 400V DC	200V DC 400V DC	200V DC (Frames 3…7) 400V DC	200V DC (Frames 6 and 7) 400V DC
	Nominal bus voltage (full load)	281V DC	324V DC	540V DC	648V DC	810V DC	932V DC
	Drive overcurrent trip Software overcurrent trip Instantaneous current limit Hardware overcurrent trip	200% of drive rated 100% of 3 s rating (158…210%) 143% of 3 s rating (215…287%)					
	Line transients	Up to 6000V peak per IEEE C62.41-1991					
	Control logic noise immunity	Showering arc transients up to 1500V peak					
	Power ride-through	15 ms at full load					
	Logic control ride-through	0.5 s min, 2 s typical					
	Ground fault trip	Phase-to-ground on drive output					
	Short circuit trip	Phase-to-phase on drive output					

Technical Specifications (Continued)

Category	Specification			
Electrical	AC input voltage tolerance	See Input Voltage Tolerance on page 57 for full power and operating range.		
	Frequency tolerance	47…63 Hz		
	Input phases	Three-phase input provides full rating for all drives. For Frames 1…7 (output current up to 456 A), single-phase operation provides up to 50% of rated current at 25 °C (77 °F) surrounding temperature. Single-phase operation is not recommended for Frames 8 and larger.		
	DC input voltage tolerance	±10% of nominal bus voltage (see Nominal bus voltage (full load) on page 54)		
	Displacement power factor	0.98 across entire speed range		
	DC link impedance	≤ 4%		
	Efficiency	97.5% at rated amps, nominal line volts		
	Maximum short circuit rating	200,000 A RMS symmetrical (20F and 20G drives only)		
	Actual short circuit rating	Determined by AIC rating of installed fuse/circuit breaker. See page 116 for 21G drives.		
	Drive to motor power ratio Min Max	 Recommended not less than 1:2 ratio Recommended not greater than 2:1 ratio		
	Brake IGBT rating	100% of motor-rated torque		
	Control POD current draw	5 A		
	Digital inputs Nominal Maximum High state Low state	DC 24V DC 30V DC 20…24V DC 0…5V DC	AC 120V AC 132V AC 100…132V AC 0…30V AC	
	PTC inputs Standard Trip resistance Nominal resistance Reset resistance Short circuit trip resistance	PowerFlex 753 MCB N/A (1) 3.1 kΩ 1.8 kΩ 2.2 kΩ N/A (2)	22-Series I/O option module DIN 44082 3.1 kΩ 1.8 kΩ 2.2 kΩ 80 Ω	ATEX option module for 11-Series I/O option module IEC 6094-8 3.2 kΩ 1.6 kΩ N/A (3) 100 Ω
	Battery	User-installed CR1220 lithium coin cell battery provides power to the real-time clock (optional, not supplied). Preserves the clock setting in the event power to the drive is lost or cycled. Approximate life is 4.5 years with drive unpowered, or lifetime if drive is powered.		

(1) Not designed to a standard.
(2) No short circuit fault.
(3) No hysteresis, fault is latched.

Technical Specifications (Continued)

Category	Specification	
Control	Method	Sine coded PWM with programmable carrier frequency. Ratings apply to all drives.
	Carrier frequency	Default settings Frames 1…3 4 kHz Frames 4…10 2 kHz Settings Frames 1…6 2, 4, 8, 12 kHz (1) (2) Frame 7 2, 4, 8 kHz (1) Frames 8…10 2, 4 kHz
	Output voltage range	0 to rated motor voltage
	Output frequency range	0…325 Hz at 2 kHz carrier 0…590 Hz at 4 kHz carrier
	Frequency accuracy Digital input Analog input	 Within ±0.01% of set output frequency Within ±0.4% of maximum output frequency
	Frequency control	Speed regulation – with slip compensation (V/Hz and Sensorless Vector modes) 0.5% of base speed across 40:1 speed range, 40:1 operating range
	Speed control	Without feedback (Flux Vector mode), 0.1% of base speed across 100:1 speed range, 120:1 operating range, 50 rad/s bandwidth
		With feedback (Flux Vector mode), 0.001% of base speed across 100:1 speed range, 1000:1 operating range, 190 rad/s bandwidth
	Torque regulation	Without feedback (Flux Vector mode), ±5%, 600 rad/s bandwidth
		With feedback (Flux Vector mode), ±2%, 2500 rad/s bandwidth
	Selectable motor control	• Standard V/Hz with full custom capability • Sensorless Vector mode with full tuning • Flux Vector mode with and without a feedback device • Induction motor control • Surface-mount permanent magnet motor control with encoder feedback (Frames 1…10)(3) • Surface-mount permanent magnet motor control without encoder feedback (Frames 1…7)(3) • Internal permanent-magnet motor control with encoder feedback (Frames 1…10) • Internal permanent-magnet motor control without encoder feedback (Frames 1…7)
	Stop modes	Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold, Fast Braking, and Current Limit Stop.
	Accel/Decel	Two independently programmable accel and decel times. Each time can be programmed from 0…3600 seconds in 0.1 second increments (0 to motor nameplate speed).
	S-curve time	Adjustable from 0…100% of ramp time (normal duty rating)
	Intermittent overload Light duty (only Frames 8…10)	 110% overload capability for up to 1 min out of 10 mins
	Normal duty	110% overload capability for up to 1 min out of 10 mins 150% overload capability for up to 3 s out of 60 s
	Heavy duty	150% overload capability for up to 1 min out of 10 mins 180% overload capability for up to 3 s out of 60 s
	Current limit capability	Proactive current limit programmable from 20…160% of rated output current. Independently programmable proportional and integral gain.
	Electronic motor overload protection	Class 10 motor overload protection according to NEC article 430 and motor over-temperature protection according to NEC article 430.126 (A)(2). UL 508C File E59272.

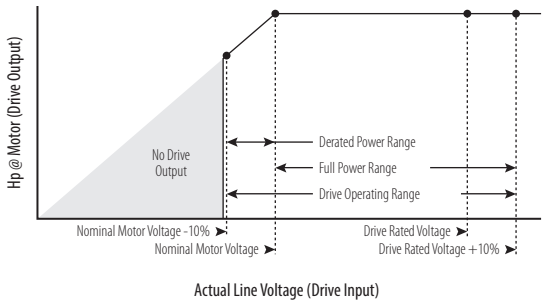
(1) Frames 6 and 7 600/690V AC input drives can be set to 2 kHz or 4 kHz.
(2) Frames 3…5 600/690V AC input drives can be set to 2, 4, or 8 kHz.
(3) Only PowerFlex 755 drives.

Design Considerations

This section provides information for design considerations.

Input Voltage Tolerance

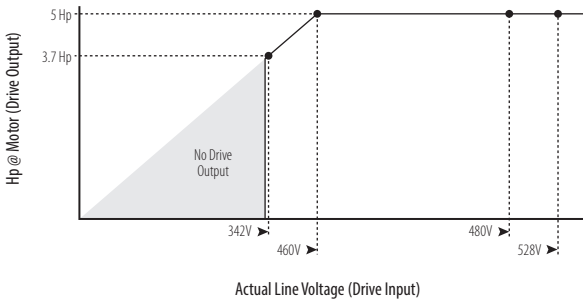
Drive Rating	Nominal Line Voltage	Nominal Motor Voltage	Drive Full Power Range	Drive Operating Range
200…240	200	200	200…264	180…264
	208	208	208…264	
	240	230	230…264	
380…480	380	380	380…528	342…528
	400	400	400…528	
	480	460	460…528	
600…690	600	575	575…759	517…759
	690	660	660…759	
Drive full power range =	Nominal motor voltage to drive-rated voltage + 10%. Rated current is available across the entire drive full-power range.			
Drive operating range =	Lowest nominal motor voltage - 10% to drive-rated voltage + 10%. Drive output is linearly derated when actual line voltage is less than the nominal motor voltage			



EXAMPLE Calculate the maximum power of a 5.0 Hp, 460V motor connected to a 480V-rated drive supplied with 342V actual line voltage input.

- Actual line voltage/nominal motor voltage = 74.3%
- 74.3% x 5.0 Hp = 3.7 Hp
- 74.3% x 60 Hz = 44.6 Hz

At 342V actual line voltage, the maximum power the 5.0 Hp, 460V motor can produce is 3.7 Hp at 44.6 Hz.



IMPORTANT For maximum protection of the drive and its internal components, we recommend the use of semiconductor fuses to other methods of circuit protection. Semiconductor fuses reduce the risk of drive damage from power quality events and improves machine and process utilization.

Watts Loss for 400/480V Drives

Drive Cat. No. [1][2]	Normal Duty		External Watts [3]	Internal Watts [3]	Total Watts [3]	Drive Cat. No. [1][2]	Normal Duty		External Watts [3]	Internal Watts [3]	Total Watts [3]
	kW	Continuous Output Amps					Hp	Continuous Output Amps			
400 Volt						**480 Volt**					
20x…C2P1	0.75	2.1	16 (16)	55 (56)	71 (72)	20x…D2P1	1.0	2.1	17 (21)	60 (61)	77 (82)
20x…C3P5	1.5	3.5	26 (33)	57 (60)	83 (93)	20x…D3P4	2.0	3.4	27 (39)	61 (64)	88 (103)
20x…C5P0	2.2	5	39 (44)	58 (62)	97 (106)	20x…D5P0	3.0	5	41 (54)	63 (67)	104 (121)
20x…C8P7	4.0	8.7	75 (79)	64 (80)	139 (159)	20x…D8P0	5.0	8	71 (91)	68 (82)	139 (173)
20x…C011	5.5	11.5	108 (107)	70 (85)	178 (192)	20x…D011	7.5	11	108 (118)	74 (88)	182 (206)
20x…C015	7.5	15.4	161 (166)	80 (80)	241 (246)	20x…D014	10	14	149 (152)	81 (81)	230 (233)
20x…C022	11	22	225	86	311	20x…D022	15	22	237	91	328
20x…C030	15	30	300	103	403	20x…D027	20	27	273	101	374
20x…C037	18.5	37	362	115	477	20x…D034	25	34	368	115	483
20x…C043	22	43	505	126	631	20x…D040	30	40	503	126	629
20x…C060	30	60	487	130	617	20x…D052	40	52	422	125	547
20x…C072	37	72	615	147	762	20x…D065	50	65	559	144	703
20x…C085	45	85	705	162	867	20x…D077	60	77	646	158	804
20x…C104	55	104	928	201	1129	20x…D096	75	96	855	189	1044
20x…C140	75	140	1239	319	1558	20x…D125	100	125	1109	299	1408
20x…C170	90	170	1381	300	1681	20x…D156	125	156	1299	294	1593
20x…C205	110	205	1893	381	2274	20x…D186	150	186	1718	358	2076
20x…C260	132	260	2449	502	2951	20x…D248	200	248	2384	492	2876
20x…C302	160	302	2566	461	3027	20x…D302	250	302	2704	491	3195
20x…C367	200	367	3322	586	3908	20x…D361	300	361	3409	606	4015
20x…C456	250	456	3922	743	4665	20x…D415	350	415	3604	683	4287
2xG…C460	250	460	4779	1090	5869	2xG…D430	350	430	4385	971	5356
20x…C477	270	477	4199	793	4992	20x…D477	400	477	4392	828	5220
2xG…C540	315	540	5316	1216	6532	2xG…D485	400	485	5091	1126	6217
2xG…C567	315	567	5652	1298	6950	2xG…D545	450	545	5649	1253	6902
2xG…C650	355	650	7011	1577	8588	2xG…D617	500	617	6942	1489	8431
2xG…C750	400	750	7577	1726	9303	2xG…D710	600	710	7631	1659	9290
2xG…C770	400	770	8086	1848	9934	2xG…D740	650	740	8133	1776	9909
2xG…C910	500	910	9155	2251	11406	2xG…D800	700	800	8710	2216	10926
2xG…C1K0	560	1040	9732	2357	12089	2xG…D960	800	960	9696	2391	12087
2xG…C1K1	630	1090	10745	2548	13293	2xG…D1K0	900	1045	10784	2589	13373
2xG…C1K2	710	1175	13778	2978	16756	2xG…D1K2	1000	1135	13378	2899	16277
2xG…C1K4	800	1465	13959	3013	16973	2xG…D1K3	1100	1365	14055	3025	17080
2xG…C1K5	850	1480	15441	3308	18749	2xG…D1K4	1250	1420	15573	3314	18887
2xG…C1K6	900	1590	15569	3717	19286	2xG…D1K5	1350	1525	15619	3779	19398
2xG…C2K1	1250	2150	22320	4790	27110	2xG…D2K0	1750	2070	22495	4802	27297

(1) Select the watts loss based on the catalog number.

(2) Frames 8…10, enclosure codes B, J, L, P, and W.

(3) Frame 1 watts loss in parentheses.

Fuse and Circuit Breaker Ratings

The tables in this section provide recommended AC line input fuse and circuit breaker information. See Fusing on page 96 and Circuit Breakers on page 96 for UL and IEC requirements. The size recommendations are based on 40 °C (104 °F) and the U.S. NEC. Other country, state, or local codes can require different ratings. DC link fuse recommendations for DC input drives are also provided. In addition, Frame 8 and larger drives include AC line fuses (with blown fuse indicators) to provide drive short circuit protection.

Input Device Requirements

Frames	Enclosure Catalog Code	Enclosure Type	Installation Type	UL Certification Required	UL Certification Not Required
1	R	IP20 NEMA/UL Open Type	Installed in a ventilated or non-ventilated cabinet.	All devices that are listed on pages 97, 99, 101 and 105 are acceptable. When installed in a ventilated cabinet, time delay fuses, circuit breakers, and 140M combination motor controllers must meet or exceed the listed minimum enclosure volume on pages 101 and 105.	All devices that are listed on pages 97 through 113 are acceptable.
			Installed outside of cabinet by using NEMA Type 1 kit or in a ventilated cabinet.	Only non-time delay fuses that are listed on pages 97, 99, 101 and 105, excluding maximum value, are acceptable.	
2…5	N	IP20 NEMA/UL Open Type	Installed in a ventilated or non-ventilated cabinet. Heat sink is inside or outside of cabinet.	All devices that are listed on pages 97, 99, 101, 105, and 109 are acceptable. When installed in a ventilated cabinet, time delay fuses, circuit breakers, and 140M combination motor controllers must meet or exceed the listed minimum enclosure volume on pages 97, 99, 101, 105, and 109.	
	F	Flange			
	N	IP20 NEMA/UL Open Type	Installed outside of cabinet by using NEMA Type 1 kit or in a ventilated cabinet.	208V AC/281V DC or 240V AC/324V DC drives. Only non-time delay fuses that are listed on pages 97 and 99, excluding maximum value, are acceptable. 400V AC/540V DC or 480V AC/650V DC drives. Only non-time delay fuses that are listed on pages 101 and 105, excluding maximum value, are acceptable. 600V AC/810V DC drives. Only non-time delay fuses that are listed on page 109 are acceptable, with maximum value of 40 A (Frame 3), 60 A (Frame 4), and 100 A (Frame 5).	
	F	Flange			
	G	IP54 NEMA/UL Type 12	Installed inside or outside of any cabinet.	All devices that are listed on pages 97, 99, 101, 105, and 109 are acceptable.	
6 and 7	N	IP00 NEMA/UL Open Type	Installed in any cabinet. Heat sink is inside or outside of cabinet.	208V AC/281V DC or 240V AC/324V DC drives. Only non-time delay fuses that are listed on pages 97 and 99, excluding maximum value, are acceptable. 400V AC/540V DC or 480V AC/650V DC drives. All devices that are listed on pages 101 and 105 are acceptable. 600V AC/810V DC drives. Only time delay and non-time delay fuses that are listed on page 109 are acceptable.	
			Installed outside of cabinet by using NEMA Type 1 kit.		
	G	IP54 NEMA/UL Type 12	Installed inside or outside of any cabinet.	All devices that are listed on pages 97, 99, 101, 105, and 109 are acceptable.	
8…10	B, L, P, W	IP20 NEMA/UL Type 1	Installed inside of any cabinet.	All devices that are listed on pages 103, 107, and 111 are acceptable.	
	J, K, Y	IP54 NEMA 12	Installed inside or outside of any cabinet.	All devices that are listed on pages 103, 107, and 111 are acceptable.	

IMPORTANT For maximum protection of the drive and its internal components, we recommend the use of semiconductor fuses to other methods of circuit protection. Semiconductor fuses reduce the risk of drive damage from power quality events and improves machine and process utilization.

Fusing

The recommended fuse types are listed here. If available current ratings do not match the ratings that are listed in these tables, choose the next higher fuse rating.

- IEC – BS88 (British Standard) Parts 1 & 2, EN60269-1, Parts 1 & 2[(1)], type gG or equivalent must be used.
- UL – UL Class CC, T, RK1, J, or L must be used.

Circuit Breakers

The non-fuse listings in the following tables include inverse time circuit breakers, instantaneous trip circuit breakers (motor circuit protectors), and 140M self-protected combination motor controllers. If one of these methods are chosen for protection, the following requirements apply:

- IEC – Both types of circuit breakers and 140M self-protected combination motor controllers are acceptable for IEC installations.
- UL - Only inverse time circuit breakers and the specified 140M self-protected combination motor controllers are acceptable for UL installations.

(1) Typical designations include, but is not limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

Cable Considerations

This section provides information for cable types and routing.

Power Cable Types Acceptable for 200…600 Volt Installations

Various cable types are acceptable for drive installations. For an in-depth discussion of cable types, including a table of maximum motor cable lengths, see the Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-IN001.

Recommended Cable Design

Rating/Type	Description
600V 75 °C (167 °F)	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.

Wiring Considerations

This section provides information for power, signal, and I/O wiring.

Type		Wire Types	Description	Min Insulation Rating
Power (1) (2)	Standard	–	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.	600V, 75 °C (167 °F)
Signal (1) (3) (4)	Standard analog I/O	–	0.750 mm^2 (18 AWG), twisted pair, 100% shield with drain.	300V, 75…90 °C (167…194 °F)
	Remote pot	–	0.750 mm^2 (18 AWG), 3 conductor, shielded.	
	Encoder/ Pulse I/O < 30 m (100 ft)	Combined	0.196 mm^2 (24 AWG) individually shielded pairs.	
	Encoder/ Pulse I/O 30...152 m (100...500 ft)	Signal	0.196 mm^2 (24 AWG) individually shielded pairs.	
		Power	0.750 mm^2 (18 AWG) individually shielded pairs	
		Combined	0.330 mm^2 (22 AWG), power is 0.500 mm^2 (20 AWG) individually shielded pairs.	
	Encoder/ Pulse I/O 152...259 m (500...850 ft)	Signal	0.196 mm^2 (24 AWG) individually shielded pairs.	
		Power	0.750 mm^2 (18 AWG) individually shielded pairs.	
		Combined	0.750 mm^2 (18 AWG) individually shielded pairs.	
Digital I/O **Safety inputs** **Homing inputs** (1) (3) (4)	Unshielded	–	Per US NEC or applicable national or local code.	300V, 60 °C (140 °F)
	Shielded	Multi-conductor shielded cable	0.750 mm^2 (18 AWG), 3 conductor, shielded.	

(1) Separate control and signal wires from power wires by at least 0.3 m (1 ft).

(2) The use of shielded wire for AC input power is not always necessary, but is recommended.

(3) If the wires are short and contained within a cabinet that has no sensitive circuits, the use of shielded wire is not always necessary, but is recommended.

(4) I/O terminals that are labeled (–) or common are not referenced to earth ground and are designed to reduce common mode interference. Grounding these terminals can cause signal noise. For CE installations, 115V I/O must use shielded cable or have a cable length less than 30 m (98 ft).

Dimensions and Weights

This section provides Frame and rating cross-references.

208V AC and 240V AC

Cat. No.	Light Duty kW Output	Normal Duty kW Output	Heavy Duty kW Output	Cat. No.	Light Duty Hp Output	Normal Duty Hp Output	Heavy Duty Hp Output	Enclosure Code/Frame Size			
								F	G	N	R
208 Volt				**240 Volt**							
20x…B2P2		0.37 (0.37)[1]	0.37 (0.37)[1]	20x…B2P2	–	0.5(0.5)[1]	0.5(0.5)[1]	2	2	2	1
20x…B4P2	–	0.75(0.75)[1]	0.75(0.37)[1]	20x…B4P2	–	1(1)[1]	1(0.5)[1]				
20x…B6P8	–	1.5(1.5)[1]	1.5(0.75)[1]	20x…B6P8	–	2(2)[1]	2(1)[1]				
20x…B9P6	–	2.2(2.2)[1]	2.2(1.5)[1]	20x…B9P6	–	3(3)[1]	3(2)[1]				
20x…B015	–	4(4)[1]	2.2(2.2)[1]	20x…B015	–	5(5)[1]	3(3)[1]				
20x…B022	–	5.5	4	20x…B022	–	7.5	5				–
20x…B028	–	7.5	5.5	20x…B028	–	10	7.5	3	3	3	
20x…B042	–	11	7.5	20x…B042	–	15	10				
20x…B054	–	15	11	20x…B054	–	20	15	4	4	4	
20x…B070	–	18.5	15	20x…B070	–	25	20	5	5	5	
20x…B080	–	22	18.5	20x…B080	–	30	25		6		
20x…B104	–	30	22	20x…B104	–	40	30	6[2]		6	
20x…B130	–	37	30	20x…B130	–	50	40				
20x…B154	–	45	37	20x…B154	–	60	50				
20x…B192	–	55	45	20x…B192	–	75	60				
20x…B260	–	66	55	20x…B260	–	100	75		7		
20x…B312	–	90	66	20x…B312	–	125	100	7[2]		7	
20x…B360	–	110	90	20x…B360	–	150	125				
20x…B477	–	132	90	20x…B477	–	200	125		–		

(1) Ratings in parenthesis are only applicable for Frame 1.

(2) For Frames 6 and 7, a user-installed flange kit (catalog number 20-750-FLNG4-Fx) is available to convert a code N drive that provides a NEMA/UL Type 4X/12 back.

400V AC and 480V AC

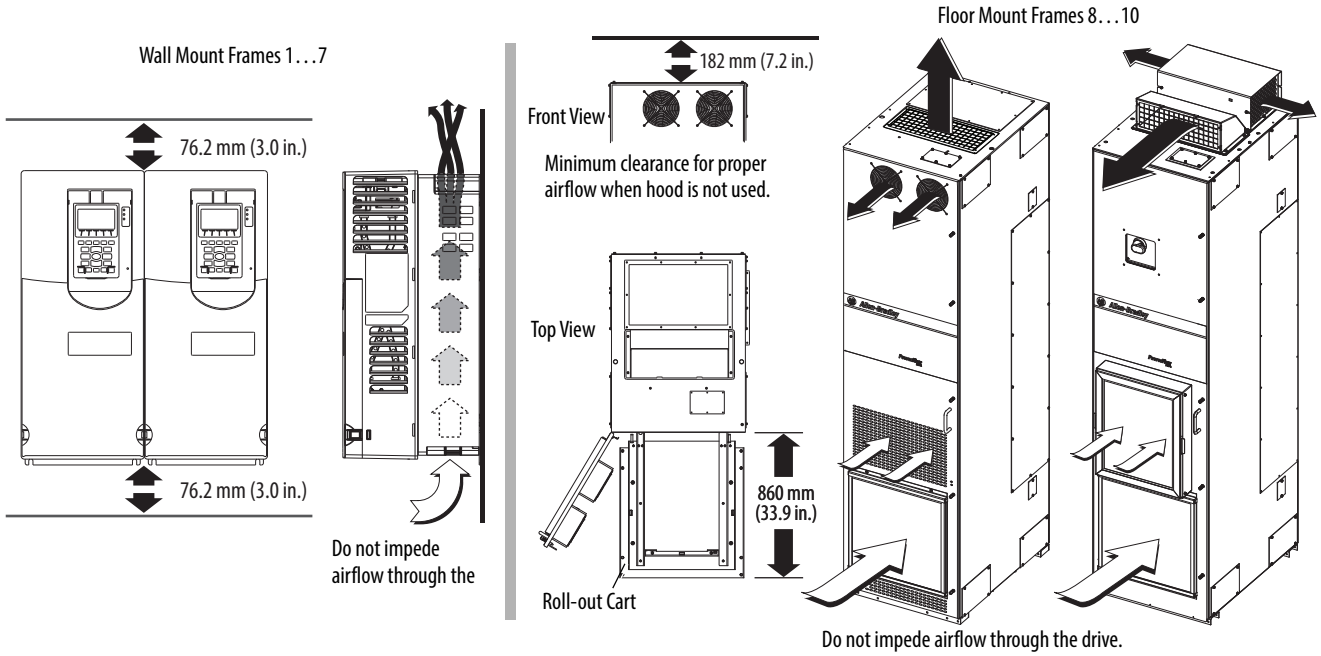
Cat. No.	Light Duty kW Output	Normal Duty kW Output	Heavy Duty kW Output	Cat. No.	Light Duty Hp Output	Normal Duty Hp Output	Heavy Duty Hp Output	Enclosure Code/Frame Size					
								B, J, L, T	F	G	N	K, P, W, Y	R
400 Volt				**480 Volt**									
20x…C2P1	–	0.75 (0.75) (1)	0.75 (0.37) (1)	20x…D2P1	–	1 (1) (1)	1 (0.5) (1)						
20x…C3P5	–	1.5 (1.5) (1)	1.5 (0.75) (1)	20x…D3P4	–	2 (2) (1)	2 (1.5) (1)						
20x…C5P0	–	2.2 (2.2) (1)	2.2 (1.5) (1)	20x…D5P0	–	3 (3) (1)	3 (2) (1)						
20x…C8P7	–	4 (4) (1)	4 (2.2) (1)	20x…D8P0	–	5 (5) (1)	5 (3) (1)		2	2	2		1
20x…C011	–	5.5 (5.5) (1)	5.5 (4) (1)	20x…D011	–	7.5 (7.5) (1)	7.5 (5) (1)						
20x…C015	–	7.5 (7.5) (1)	5.5 (5.5) (1)	20x…D014	–	10 (10) (1)	7.5 (7.5) (1)						
20x…C022	–	11	7.5	20x…D022	–	15	10						
20x…C030	–	15	11	20x…D027	–	20	15						
20x…C037	–	18.5	15	20x…D034	–	25	20		3	3	3		
20x…C043	–	22	18.5	20x…D040	–	30	25						
20x…C060	–	30	22	20x…D052	–	40	30	–	4	4	4	–	
20x…C072	–	37	30	20x…D065	–	50	40			5			
20x…C085	–	45	37	20x…D077	–	60	50		5		5		
20x…C104	–	55	45	20x…D096	–	75	60			6			
20x…C140	–	75	55	20x…D125	–	100	75		6 (2)		6		
20x…C170	–	90	75	20x…D156	–	125	100						
20x…C205	–	110	90	20x…D186	–	150	125						
20x…C260	–	132	110	20x…D248	–	200	150			7			
20x…C302	–	160	132	20x…D302	–	250	200		7 (2)		7		
20x…C367	–	200	160	20x…D361	–	300	250						
20x…C456	–	250	200	20x…D415	–	350	300						–
2xG…C460	315	250	200	20x…D430	400	350	300	8	–	–	–	8	
2xG…C477	–	270	200	20x…D477	–	400	300	–	7 (2)	–	7	–	
2xG…C540	315	315	250	20x…D485	450	400	350						
2xG…C567	355	315	250	20x…D545	500	450	350						
2xG…C650	400	355	315	20x…D617	600	500	400	8				8	
2xG…C750	450	400	355	20x…D710	650	600	450						
2xG…C770	450	400	355	20x…D740	700	650	500						
2xG…C910	560	500	400	20x…D800	800	700	600						
2xG…C1K0	630	560	500	20x…D960	900	800	700		–	–	–		
2xG…C1K1	710	630	500	20x…D1K0	1000	900	750	9				9	
2xG…C1K2	800	710	560	20x…D1K2	1100	1000	800						
2xG…C1K4	850	800	630	20x…D1K3	1250	1100	900						
2xG…C1K5	900	850	710	20x…D1K4	1350	1250	1000						
2xG…C1K6	1000	900	710	20x…D1K5	1500	1350	1100	10				10	
2xG…C2K1	1400	1250	1000	20x…D2K0	2000	1750	1650						

(1) Ratings in parenthesis are only applicable for Frame 1.

(2) For Frames 6 and 7, a user-installed flange kit (catalog number 20-750-FLNG4-Fx) is available to convert a code N drive that provides a NEMA/UL Type 4X/12 back.

Minimum Mounting Clearances

Specified vertical clearance requirements are intended to be from the drive to the closest object that can restrict airflow through the drive heat sink and chassis. The drive must be mounted in a vertical orientation as shown and must make full contact with the mounting surface. Do not use standoffs or spacers. In addition, inlet air temperature must not exceed the product specification.



Approximate Weights

Drive		Frame Size	Drive Rating		Enclosure Code/Weight, kg (lb)			
			kW (208V[1], 400V, 690V)	Hp (240V[1], 480V, 600V)	F	G	N	R
Standard (20F, 20G)	AC input and common DC input	1	0.37…7.5	0.5…10				7 (15)
		2	0.37…11	0.5…15	9 (20)	10 (22)	8 (18)	
		3	7.5…22	0.5…30	13 (29)	14 (31)	11 (25)	
		4	15…37	20…50	17 (37)	18 (39)	16 (35)	
		5	18.5…55	25…70	24 (54)	26 (57)	24 (52)	
		6	5.5…75	7.5…100	37 (82)	89 (197)	37 (82)	
			45…132	50…200	38 (84)	116 (256)	39 (85)	
		7	132…200	150…300	69 (152)	135 (297)	79 (174)	
			200…270	300…400	96 (212)	162 (357)	106 (234)	
					B, L	P, W	J	K, Y
Standard (20G)	AC input	8	250…400	350…650	623 (1374)	1145 (2525)	644 (1419)	1166 (2570)
		9	500…850	700…1250	1246 (2748)	2290 (5051)	1287 (2838)	2332 (5141)
		10	900…1250	1350…1750	1869 (4122)	3435 (7576)	1931 (4257)	3498 (7711)
	Common DC input	8	250…400	350…650	566 (1248)	1088 (2400)	586 (1293)	1109 (2445)
		9	500…850	700…1250	1132 (2497)	2176 (4799)	1173 (2587)	2218 (4889)
		10	900…1250	1350…1750	1698 (3745)	3264 (7199)	1760 (3880)	3327 (7334)
With options (21G)	AC input	8	250…400	350…650	1145 (2525)	1675 (3694)	1166 (2570)	1696 (3739)
		9	500…850	700…1250	1730 (3815)	2820 (6219)	1771 (3905)	2862 (6309)
		10	900…1250	1350…1750	2315 (5106)	3965 (8745)	2377 (5241)	4028 (8880)

(1) Only Frame 1…7 available for 208V, 240V input drives.

Maximum Component Weights - Frames 8…10

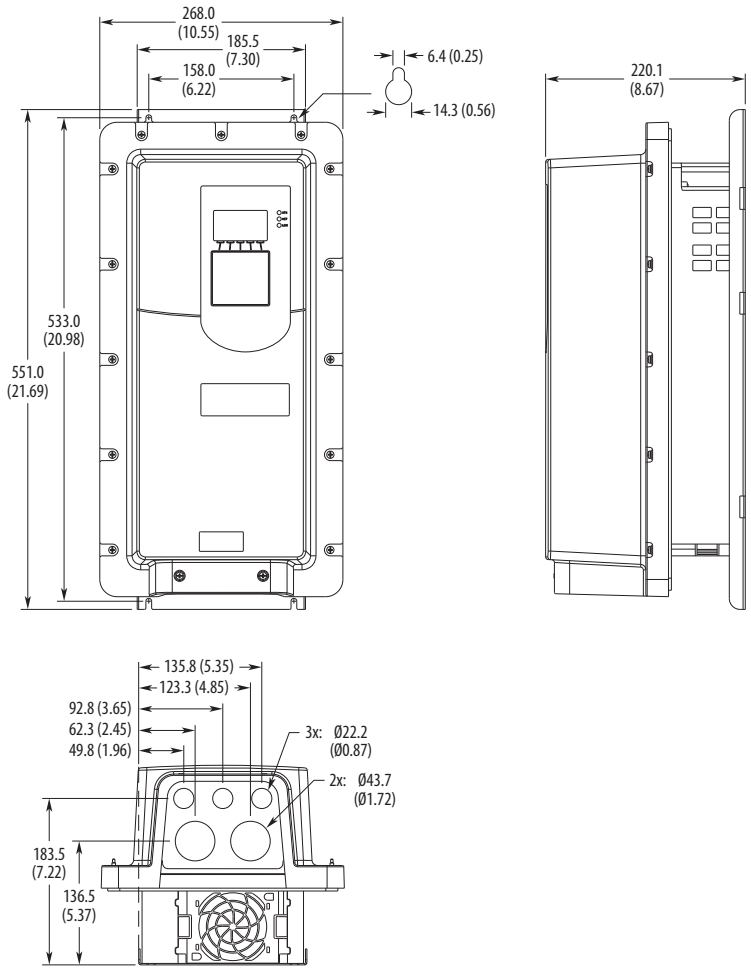
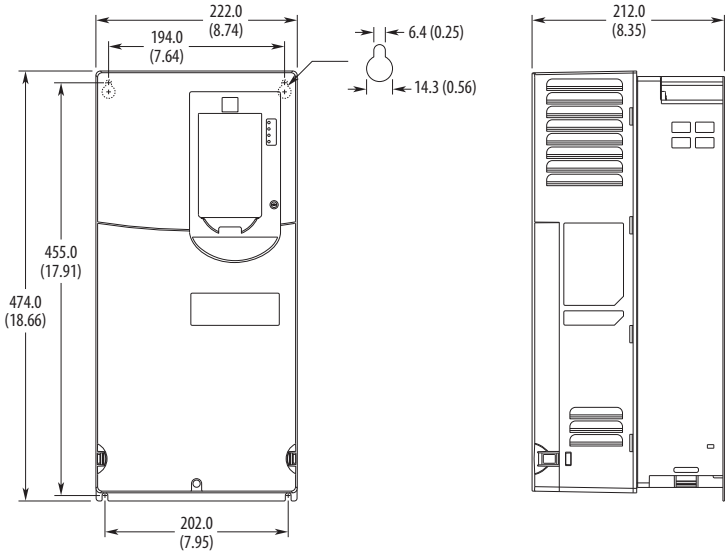
Component	AC Input, kg (lb)	Common DC Input, kg (lb)
Converter/DC input with precharge	64 (140)	64 (140)
Inverter	222 (490)	165 (363)
Drive assembly (Open, IP00)	329 (725)	229 (504)

Approximate Dimensions

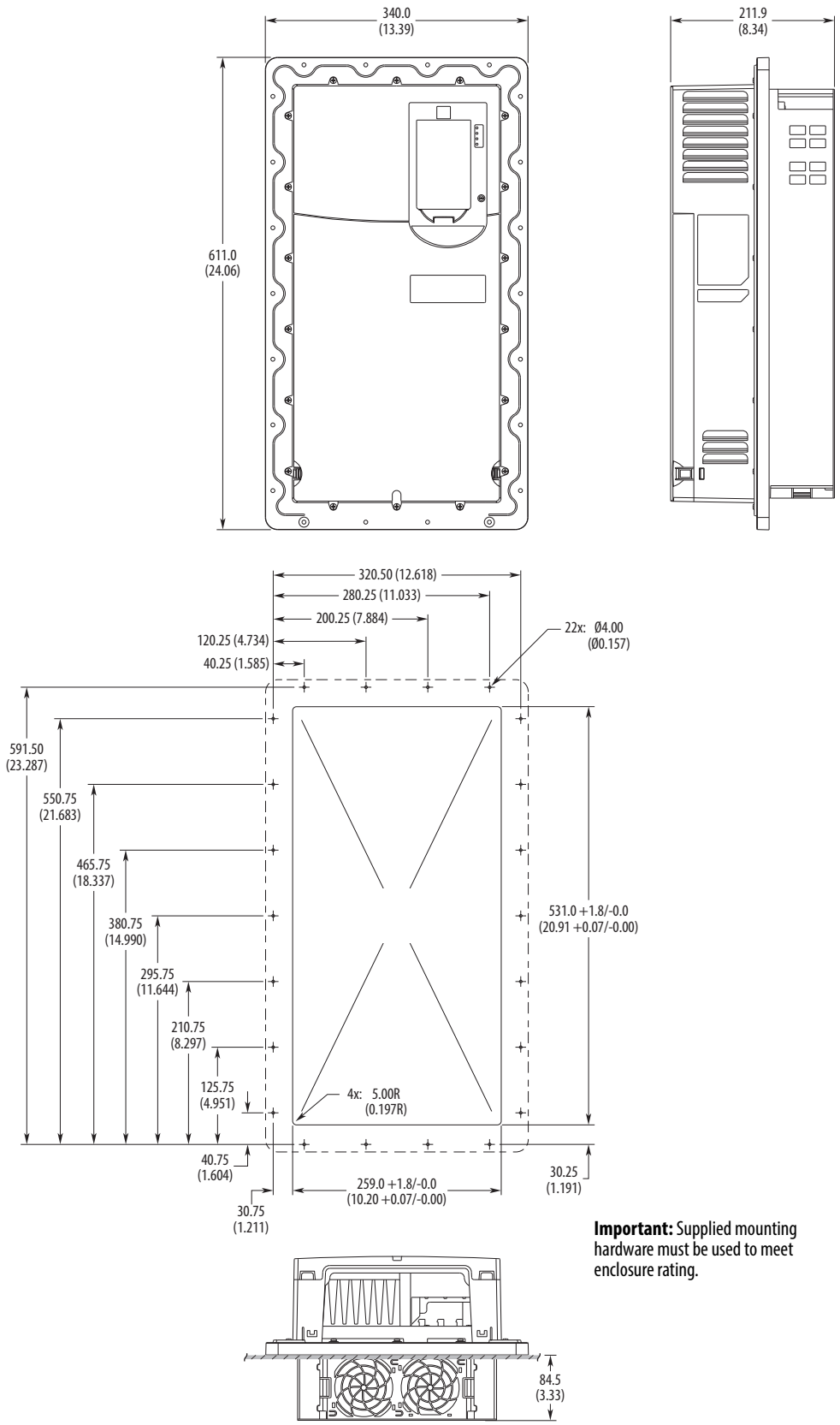
This section provides the approximate dimensions for the drives.

Dimension Drawing Index

Frame	Description	Page
1	IP20, NEMA/UL Type Open	134
2	IP20, NEMA/UL Type Open	134
	Flange Mount	135
	IP54, NEMA/UL Type 12	136
3	IP20, NEMA/UL Open Type	136
	Flange Mount	137
	IP54, NEMA/UL Type 12	138
4	IP20, NEMA/UL Open Type	138
	Flange Mount	139
	IP54, NEMA/UL Type 12	140
5	IP20, NEMA/UL Open Type	140
	Flange Mount	141
	IP54, NEMA/UL Type 12	142
6	IP00, NEMA/UL Open Type	143
	Flange Mount	144
	IP54, NEMA/UL Type 12	145
7	IP00, NEMA/UL Open Type	146
	Flange Mount	147
	NEMA/UL Type 1	148
	IP54, NEMA/UL Type 12	149
8	MCC Style Cabinet, 600 mm (23.6 in.) Deep - IP20	150
	MCC Style Cabinet with Wiring Bay, 600 mm (23.6 in.) Deep - IP20	151
	MCC Style Cabinet with Cabinet Option Bay, 600 mm (23.6 in.) Deep - IP20	152
	MCC Style Cabinet with Wiring Bay and Cabinet Option Bay, 600 mm (23.6 in.) Deep - IP20	153
	MCC Style Cabinet, 800 mm (31.5 in.) Deep - IP20	154
	MCC Style Cabinet with Wiring Bay, 800 mm (31.5 in.) Deep - IP20	155
	MCC Style Cabinet with Cabinet Option Bay, 800 mm (31.5 in.) Deep - IP20	156
	MCC Style Cabinet with Wiring Bay and Cabinet Option Bay, 800 mm (31.5 in.) Deep - IP20	157
	MCC Style Cabinet, 800 mm (31.5 in.) Deep - IP54	158
	MCC Style Cabinet with Wiring Bay, 800 mm (31.5 in.) Deep - IP54	159
	MCC Style Cabinet with Cabinet Option Bay, 800 mm (31.5 in.) Deep - IP54	160
	MCC Style Cabinet with Wiring Bay and Cabinet Option Bay, 800 mm (31.5 in.) Deep - IP54	161
	Open Style - AC Input	162
	Open Style - DC Input	163

Frame	Type	Approximate Dimensions – mm (in.)
3	IP54, NEMA/UL Type 12	
4	IP20, NEMA/UL Open Type	

Frame	Type	Approximate Dimensions – mm (in.)
5	Flange Mount	



Important: Supplied mounting hardware must be used to meet enclosure rating.

Drive Options

This section provides information for the drive options.

Human Interface Modules

This section provides information for the human interface modules.

Blank Plate

20-HIM-A6

20-HIM-C6S

Cat. No.	Description
20-HIM-A0	No HIM (blank plate)
20-HIM-A6	Enhanced, LCD, full numeric, handheld/local, NEMA Type 1
20-HIM-C6S	Enhanced, LCD, full numeric, IP66 NEMA Type 4X/12 (for indoor use only) (1)

(1) Includes a 3 m (9.8 ft) catalog number 1202-C30 interface cable for connection to drive.

Human Interface Modules Specifications

Attribute	20-HIM-A6 (1)	20-HIM-C6S (1)
Drive Protocol Data rates	 Drive Peripheral Interface (DPI™) 125 Kbps or 500 Kbps	
Consumption Drive (DPI)	 140 mA at 12V DC supplied by the host drive	
Dimensions, H x W x D 20-HIM-A6 20-HIM-C6S	 116 x 70 x 16 mm (4.57 x 2.75 x 0.63 in.) 180 x 93 x 25 mm (7.08 x 3.66 x 0.98 in.)	
Weight	91 g (3.2 oz)	173 g (5.7 oz)
Temperature Operating Storage	 0…50 °C (32…122 °F) -40…+85 °C (-40…+185 °F)	
Relative humidity	5…95% noncondensing	
Atmosphere	**IMPORTANT:** Do not install the module in an area where the ambient atmosphere contains volatile or corrosive gas, vapors, or dust. If the module is not going to be installed right away, store the module in an area where it is not exposed to a corrosive atmosphere.	
UV radiation	The HIM is not UV rated.	
Vibration Operating Nonoperating	 2.5 G at 5…2000 Hz 5 G at 5…2000 Hz	
Shock Operating Nonoperating	 30 G peak acceleration, 11 (±1) ms pulse width 50 G peak acceleration, 11 (±1) ms pulse width	
UL c-UL CE C-Tick FCC ID IC	UL508C CAN / CSA C22.2 No. 14 EN61800-3 EN61800-3 – –	

(1) **IMPORTANT**: These HIMs are a product of category C2 according to IEC 61800-3. In a domestic environment, this product can cause radio interference in which case supplementary mitigation measures can be required.

Human Interface Module Accessories

Cat. No.	Description
20-HIM-B1	Bezel kit for LCD HIMs, NEMA Type 1 (1)
20-HIM-H10	PowerFlex HIM interface cable, 1 m (39 in.) (2)
	Comm option cable kit (male-male)
1202-C03	0.33 m (1.1 ft)
1202-C10	1 m (3.3 ft)
1202-C30	3 m (9.8 ft)
1202-C90	9 m (29.5 ft)
	Cable kit (male-female) (3)
1202-H03	0.33 m (1.1 ft)
1202-H10	1 m (3.3 ft)
1202-H30	3 m (9.8 ft)
1202-H90	9 m (29.5 ft)
1202-CBL-KIT-100M	DPI cable kit with connectors, tools, and 100 m (328 ft) cable
1202-TB-KIT-SET	DPI cable connector kit
1203-S03	DPI/SCANport™ one-to-two-port splitter cable

(1) Includes a 3 m (9.8 ft) catalog number 1202-C30 interface cable for connection to drive.
(2) Required only when HIM is used as hand-held or remote.
(3) Required with catalog number 20-HIM-H10 for distances up to a total maximum of 10 m (32.8 ft).

Communication Option Kits and Accessories

This section provides information for communication option kits and accessories.

Communication Option Kits and Accessories

Cat. No.	Description (see page 192 for specifications)
20-750-BNETIP	BACnet/IP option module
20-750-CNETC	Coaxial ControlNet option module
20-COMM-C (1)	ControlNet communication adapter (coax)
20-750-DNET	DeviceNet option module
20-COMM-D (1)	DeviceNet communication adapter
20-750-ENETR	Dual-port EtherNet/IP option module
20-COMM-E (1)	EtherNet/IP communication adapter
20-COMM-H (1)	HVAC communication adapter (only Modbus RTU can be used)
20-COMM-K (1)	CANopen communication adapter
20-COMM-L (1)	LonWorks communication adapter
20-COMM-M (1)	Modbus/TCP communication adapter
20-750-PBUS	PROFIBUS DPV1 option module
20-750-PNET	Single-port Profinet I/O option module
20-750-PNET2P	Dual-port Profinet I/O option module
20-COMM-P (1)	PROFIBUS DP communication adapter
20-COMM-Q (1)	ControlNet communication adapter (fiber)
20-COMM-R (1) (2)	Remote I/O communication adapter
20-COMM-S (1)	RS-485 DF1 communication adapter
20-XCOMM-AC-PS1	External communication kit power supply

Communication Option Kits and Accessories (Continued)

Cat. No.	Description (see page 192 for specifications)
20-XCOMM-DC-BASE	DPI external communication kit (3)
20-XCOMM-IO-OPT1	External DPI I/O option board(4)
1769-SM1	Compact I/O™ module (3-channel)
1203-SNM	Serial null modem adapter
1203-SSS	Smart Self-powered serial converter (RS-232) includes 1203-SFC and 1202-C10 cables
1203-USB	Universal serial bus (USB) converter includes 2 m (6.6 ft) USB, 20-HIM-H10, and 22-HIM-H10 cables
1786-TPS	ControlNet T-tap straight
20-750-20COMM-F1	Communication carrier card for PowerFlex 750-Series Frame 1 drives
20-750-20COMM	Communication carrier card for PowerFlex 750-Series Frame 2 or higher drives

(1) Requires a communication carrier card (catalog number 20-750-20COMM or 20-750-COMM-F1). See page 190 for compatibility details.
(2) This product is discontinued.
(3) Only compatible with the following communication options: catalog number 20-COMM-E EtherNet/IP; 20-COMM-C ControlNet (coax); 20-COMM-Q ControlNet (fiber); 20-COMM-D DeviceNet (Series B or later); and 20-COMM-M Modbus/TCP.
(4) For use only with DPI external communications kit, catalog number 20-XCOMM-DC-BASE.

PowerFlex 755 System Resource Allocation

Some drive configurations that use certain communication options can exceed the available resources of the processor on the main control board. This issue is a consideration for PowerFlex 755 drives with firmware revision 2.000 (or later). See the PowerFlex 750-Series Programming Manual, publication 750-PM001, for details.

PowerFlex 750-Series Legacy Communication Options

Most legacy communication adapters (20-COMM) can be used with the PowerFlex 755 drives (with these restrictions):

- **Frame 1** - We recommend that you install catalog number 20-750-20COMM-F1 communication carrier card in port 4. Port 5 is not accessible when this module is installed.
- **Frames 2 and larger** - We recommend that you install catalog number 20-750-20COMM communication carrier card in port 6. If you use port 4 or 5, the adjacent left port is inaccessible to other option modules and can interfere with network cable connections. For details, contact Rockwell Automation technical support.

Adapter		Accesses Ports 0…6 for I/O Connections (implicit and Explicit Messaging)	Accesses Ports 7 and Higher (I/O, Explicit Messaging)	Supports Drive Add-on Profiles	Supports Asian Languages [6]
Cat. No.	Type				
20-COMM-B	BACnet MS/TP	Not compatible			
20-COMM-C	ControlNet (Coax)	Revision 3.001 [4]	Revision 3.001 [4]	See footnote [5]	Revision 3.001 [4]
20-COMM-D	DeviceNet	See footnote [2]	Not compatible		
20-COMM-E	EtherNet/IP	Revision 4.001 [4]	Revision 4.001 [4]	See footnote [5]	Revision 4.001 [4]
20-COMM-H	RS-485 HVAC	Revision 2.009 [3] [4]	Not compatible		
20-COMM-K	CANopen	Revision 1.001 [4]			
20-COMM-L	LonWorks	Revision 1.007 [4]			
20-COMM-M	Modbus/TCP	Revision 2.001 [4]	Revision 2.001 [4]	Not compatible	Revision 2.001 [4]
20-COMM-P	PROFIBUS DP	Revision 1.006 [4]	Revision 1.006 [4]		Not compatible
20-COMM-Q	ControlNet (Fiber)	Revision 3.001 [4]	Revision 3.001 [4]	See footnote [5]	Revision 3.001 [4]
20-COMM-R [1]	Remote I/O	See footnote	Not compatible		
20-COMM-S	RS-485 DF1	See footnote			

(1) This product is discontinued.
(2) Controller must be able to read/write 32-bit floating point (REAL) values.
(3) Supports all three modes of operation (RTU, P1, and N2).
(4) Requires this adapter firmware revision or higher.
(5) Requires firmware revision 1.05 or later of the drive Add-on Profiles for Studio 5000 Logix Designer application.
(6) Chinese, Japanese, and Korean languages are supported at the time of publication.

Environmental Specifications – Communication Modules

Attribute	Description
Temperature Operating Storage	 -10…+50 °C (14…122 °F) -40…+85 °C (-40…+185 °F)
Relative humidity	5…95% noncondensing
Atmosphere	**IMPORTANT:** Do not install the module in an area where the ambient atmosphere contains volatile or corrosive gas, vapors, or dust. If the module is not going to be installed right away, store the module in an area where it is not exposed to a corrosive atmosphere.

Communication Options and Accessories Specifications

Attribute	20-750-BNETIP	20-750-CNETC	20-COMM-C	20-750-DNET	20-COMM-D	20-750-ENETR	20-COMM-E
Network Protocol Data rate	BACnet/IP 10/100 Mbps	ControlNet 5 Mbps (fixed)	ControlNet 5 Mbps	DeviceNet 125 Kbps, 250 Kbps, and 500 Kbps	DeviceNet 125 Kbps, 250 Kbps, and 500 Kbps	EtherNet/IP 10/100 Mbps, Half/Full Duplex	EtherNet/IP 10/100 Mbps, Half/Full Duplex
Drive Protocol Data rates	DPI 500 Kbps	DPI 500 Kbps	DPI 125 Kbps or 500 Kbps	DPI 500 Kbps	DPI 125 Kbps or 500 Kbps	DPI 500 Kbps	DPI 125 Kbps or 500 Kbps
Consumption Drive (DPI) Network	250 mA at 14V DC None	250 mA at 14V DC None	275 mA at 5V DC None	50 mA at 14V DC 60 mA at 24V DC	150 mA at 5V DC 60 mA at 24V DC	250 mA at 14V DC None	370 mA at 5V DC —
Dimensions H x L x W mm (in)	16.0 x 130.0 x 83.0 (0.63 x 5.12 x 3.27)	68.0 x 150.0 x 26.0 (2.70 x 5.90 x 1.00)	16.0 x 103.0 x 80.0 (0.63 x 4.00 x 3.13)	68.0 x 150.0 x 26.0 (2.70 x 5.90 x 1.00)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)	68.0 x 150.0 x 26.0 (2.70 x 5.90x 1.00)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)
Weight g (oz)	60 (2.0)	62 (2.1)	85 (3.0)	62 (2.1)	85 (3.0)	62 (2.1)	85 (3.0)
Compliance UL c-UL CE C-Tick	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3
Consumption Drive (DPI) Network	250 mA at 14V DC None	250 mA at 14V DC None	275 mA at 5V DC None	50 mA at 14V DC 60 mA at 24V DC	150 mA at 5V DC 60 mA at 24V DC	250 mA at 14V DC None	370 mA at 5V DC —
Dimensions H x L x W mm (in)	16.0 x 130.0 x 83.0 (0.63 x 5.12 x 3.27)	68.0 x 150.0 x 26.0 (2.70 x 5.90 x 1.00)	16.0 x 103.0 x 80.0 (0.63 x 4.00 x 3.13)	68.0 x 150.0 x 26.0 (2.70 x 5.90 x 1.00)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)	68.0 x 150.0 x 26.0 (2.70 x 5.90x 1.00)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)
Weight g (oz)	60 (2.0)	62 (2.1)	85 (3.0)	62 (2.1)	85 (3.0)	62 (2.1)	85 (3.0)
Compliance UL c-UL CE C-Tick	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3

Communication Options and Accessories Specifications (continued)

Attribute	20-COMM-H	20-COMM-K	20-COMM-L	20-COMM-M	20-750-PBUS	20-750-PNET 20-750-PNET2P	20-COMM-P
Network Protocol Data rate	Modbus RTU, Metasys N2, or Siemens P1 FLN RTU: 4800…38400 bps N2: 9600 bps P1: 4800 bps or 9600 bps	CANopen 10 Kbps…1 Mbps	LonWorks 78 Kbps	Modbus/TCP 10/100 Mbps, Half/Full Duplex	PROFIBUS 9600 bps…12 Mbps (autobauds)	Profinet 10/100 Mbps	PROFIBUS 10 Kbps…12 Mbps
Drive Protocol Data rates	DPI 125 Kbps or 500 Kbps	DPI 125 Kbps or 500 Kbps	DPI 125 Kbps or 500 Kbps	DPI 125 Kbps or 500 Kbps	DPI 500 Kbps	DPI 500 Kbps	DPI 125 Kbps or 500 Kbps
Consumption Drive (DPI) Network	150 mA at 5V DC —	500 mA at 5V DC None	200 mA on DPI —	350 mA at 5V DC —	250 mA at 14V DC None	250 mA at 14V DC None	370 mA at 5V DC —
Dimensions H x L x W mm (in)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)	20.0 x 86.0 x 78.5 (0.79 x 3.39 x 3.09)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)	16.0 x 130.0 x 83.0 (0.63 x 5.12 x 3.27)	16.0 x 130.0 x 83.0 (0.63 x 5.12 x 3.27)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)
Weight g (oz)	85 (3.0)	85 (3.0)	85 (3.0)	85 (3.0)	57 (2.0)	60 (2.0)	57 (2.0)
Compliance UL c-UL CE C-Tick	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 – –	UL508C – – –	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3	UL508C CAN/ CSA C22.2 No.14 IEC61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 – –

Communication Options and Accessories Specifications (continued)

Attribute	20-COMM-Q	20-COMM-R(1)	20-COMM-S	1203-SSS	1203-USB	1769-SM1
Network Protocol Data rate	ControlNet 5 Mbps	Remote I/O 57.6 Kbps, 115.2 Kbps, or 230.4 Kbps	DF1 1200…38400 bps	DF1 9600…38400 bps	Universal Serial Bus (USB) 115.2 Kbps	–
Drive Protocol Data rates	DPI 125 Kbps or 500 Kbps	DPI 125 Kbps or 500 Kbps	DPI 125 Kbps or 500 Kbps	DPI or SCANport™ 125 Kbps or 500 Kbps (only DPI)	SCANport, DPI, or DSI 125, 125/500, 19.2 Kbps	DPI or SCANport 125 Kbps or 500 Kbps (only DPI)
Consumption Drive (DPI) Network	275 mA at 5V DC —	250 mA at 5V DC —	150 mA at 5V DC —	130 mA at 12V DC —	130 mA at 12V DC 170 mA at +5V DC (DSI)	Module: 280 mA at 5V DC Channel: 60 mA at 12V DC
Dimensions H x L x W mm (in)	16.0 x 103.0 x 80.0 (0.63 x 4.00 x 3.13)	19.0 x 86.0 x 78.5 (0.75 x 3.39 x 3.09)	16.0 x 86.0 x 81.0 (0.63 x 3.34 x 3.16)	103.5 x 73.4 x 23.6 (4.08 x 2.89 x 0.93)	103.5 x 73.4 x 23.6 (4.08 x 2.89 x 0.93)	103.5 x 73.4 x 23.6 (4.08 x 2.89 x 0.93)
Weight g (oz)	85 (3.0)	85 (3.0)	60 (2.0)	71 (2.5)	71 (2.5)	71 (2.5)
Compliance UL c-UL CE C-Tick	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 EN61800-5-1, EN61800-3 EN61800-3	UL508C CAN/CSA C22.2 No. 14 – –	UL508C CAN/CSA C22.2 No. 14 – –

(1) This product is discontinued.

Communication Options and Accessories Specifications (continued)

Attribute	20-XCOMM-DC-BASE	20-XCOMM-IO-OPT1	20-XCOMM-AC-PS1
Network Protocol Data rate	 Dependent on installed adapter Dependent on installed adapter	–	–
Drive Protocol Data rates	 DPI 125/500 Kbps	–	–
Number of inputs	–	6 (single common)	–
Input voltage type	–	24V DC source load	–
Maximum input voltage	–	27V DC	–
Rated input voltage	–	–	100…240V AC
Operating input voltage	–	–	90…264V AC
AC input frequency	–	–	47…63 Hz
Maximum input current	–	8 mA (each input)	–
Guaranteed ON-state voltage	–	10…27V DC (3 mA minimum)	–
Guaranteed OFF-state voltage	–	0…5V DC (2 mA maximum)	–
Reverse polarity protected	–	-30V DC	–
Input response time	–	25 ms + network update time (2)	–
Number of outputs	–	Two relay outputs (individually isolated) • One form C contact • One form A (NO) contact	–
Maximum output contact voltage	–	27V DC/125V AC	–
Maximum output contact current	–	2 A	–
Output voltage	–	–	24V DC
Output current	–	–	830 mA
Expected contact life	–	1,000,000 cycles resistive at < 0.5 A 500,000 cycles inductive at < 0.5 A 500,000 cycles resistive at 1 A 300,000 cycles inductive at 1 A 300,000 cycles resistive at 2 A 150,000 cycles inductive at 2 A	–
Output response time	–	25 ms + network update time (3)	–
Consumption Module Network	 60 mA at 12V DC supplied from drive via DPI cable Ethernet: None ControlNet: None DeviceNet: 60 mA at 24V DC	–	–
DC power supply requirement	20-COMM-C: 105 mA at 24V DC (1) 20-COMM-D: 60 mA at 24V DC (1) 20-COMM-E: 140 mA at 24V DC (1) 20-COMM-Q: 135 mA at 24V DC (1) 20-COMM-M: 140 mA at 24V DC (1)	–	–
Dimensions (H x W x D)	108 x 108 x 75 (4.25 x 4.25 x 2.95) With I/O terminal block attached	–	–
Weight	340 g (12.0 oz)	–	–
Certifications UL c-UL CE C-Tick	 UL508C CAN/CSA C22.2 No. 14 – –	–	–

(1) The communication kit is powered by a nominal 24V DC. The current consumption that is listed in this table differs from the value that is shown on the label of the communication adapter. The label of the communication adapter is based on the adapter being powered by 5V DC from the drive.

(2) The I/O board is not designed for fast I/O response times. Do not use with input devices that transition (OFF-ON-OFF) faster than the response time. Potential inputs include auxiliary contact inputs from relays or overload, push buttons, and so on.

(3) The I/O board is not designed for fast I/O response times. Do not use with output devices that must transition (OFF-ON-OFF) faster than the response time. Potential output devices include pilot lights or a contact closure reset to another hardware device.

I/O Option Kits

This section provides information for the I/O option kits.

Cat. No.	Description[1]
20-750-ATEX	ATEX option module with 1 thermosensor input connection (requires 11-Series I/O module)
20-750-1132C-2R	24V DC 11-Series I/O module with 1 analog in, 1 analog out, 3 digital in and 2 relay outputs
20-750-1133C-1R2T	24V DC 11-Series I/O module with 1 analog In, 1 analog out, 3 digital in, 1 relay and 2 transistor outputs
20-750-1132D-2R	115V AC 11-Series I/O module with 1 analog In, 1 analog out, 3 digital in and 2 relay outputs
20-750-2262C-2R	24V DC 22-Series I/O module with 2 analog In, 2 analog out, 6 digital in and 2 relay outputs
20-750-2262D-2R	115V AC 22-Series I/O module with 2 analog In, 2 analog out, 6 digital in and 2 relay outputs
20-750-2263C-1R2T	24V DC 22-Series I/O module with 2 analog In, 2 analog out, 6 digital in, 3 digital out, 1 relay, and 2 transistor outputs

(1) I/O option kits are not allowed in Integrated Motion on the EtherNet/IP Network mode.

Safety Options

Four safety options are available for the PowerFlex 750-Series drives:

- Safe Torque Off
- Safe Speed Monitor
- Integrated Safety - Safe Torque Off
- Integrated Safety Functions

Safe Torque Off is ideal for safety-related applications that require the removal of rotational power to the motor without shutting down the drive. Safe Torque Off functionality offers the benefit of quick start-up after a demand on the safety system. Safe Torque Off helps reduce wear from repetitive start-up, and provides safety ratings up to and including SIL CL3, PLe, and category 3.

Safe Speed Monitor is ideal for applications where the speed is controlled and monitored. The Safe Speed Monitor option combines Safe Torque Off capability with integrated safety relay functionality and the Safe Speed control technology in one hardware option. The Safe Speed Monitor option provides safety ratings up to and including SIL CL3, PLe, and category 4.

With the Safe Speed Monitor option, you can safely monitor and control the speed of your application, which allows operators to perform process or maintenance work without stopping the machine.

The Integrated Safety - Safe Torque Off (STO) option module provides either a hardwired or a networked STO function via an Ethernet/IP network.

Input and Output Reactors

This section provides information for input and output reactors.

200…240V, 60 Hz, Three-phase, 3% Impedance

kW	Hp	Duty	Input Line Reactor		Output Load Reactor	
			IP00 (Open Style)	IP11 (NEMA/UL Type 1)	IP00 (Open Style)	IP11 (NEMA/UL Type 1)
			Cat. No.	Cat. No.	Cat. No.	Cat. No.
0.37	0.5	Normal	1321-3R2-D	1321-3RA2-D	1321-3R2-D	1321-3RA2-D
		Heavy	1321-3R2-D	1321-3RA2-D	1321-3R4-A	1321-3RA4-A
0.75	1	Normal	1321-3R4-A	1321-3RA4-A	1321-3R4-A	1321-3RA4-B
		Heavy	1321-3R4-A	1321-3RA4-A	1321-3R8-A	1321-3RA8-A
1.5	2	Normal	1321-3R8-A	1321-3RA8-A	1321-3R8-A	1321-3RA8-A
		Heavy	1321-3R8-A	1321-3RA8-A	1321-3R12-A	1321-3RA12-A
2.2	3	Normal	1321-3R12-A	1321-3RA12-A	1321-3R12-A	1321-3RA12-A
		Heavy	1321-3R12-A	1321-3RA12-A	1321-3R18-A	1321-3RA18-A
4	5	Normal	1321-3R18-A	1321-3RA18-A	1321-3R18-A	1321-3RA18-A
		Heavy	1321-3R18-A	1321-3RA18-A	1321-3R25-A	1321-3RA25-A
5.5	7.5	Normal	1321-3R25-A	1321-3RA25-A	1321-3R25-A	1321-3RA25-A
		Heavy	1321-3R25-A	1321-3RA25-A	1321-3R35-A	1321-3RA35-A
7.5	10	Normal	1321-3R35-A	1321-3RA35-A	1321-3R35-A	1321-3RA35-A
		Heavy	1321-3R35-A	1321-3RA35-A	1321-3R45-A	1321-3RA45-A
11	15	Normal	1321-3R45-A	1321-3RA45-A	1321-3R45-A	1321-3RA45-A
		Heavy	1321-3R45-A	1321-3RA45-A	1321-3R55-A	1321-3RA55-A
15	20	Normal	1321-3R55-A	1321-3RA55-A	1321-3R55-A	1321-3RA55-A
		Heavy	1321-3R55-A	1321-3RA55-A	1321-3R80-A	1321-3RA80-A
18.5	25	Normal	1321-3R80-A	1321-3RA80-A	1321-3R80-A	1321-3RA80-A
		Heavy	1321-3R80-A	1321-3RA80-A	1321-3R80-A	1321-3RA80-A
22	30	Normal	1321-3R80-A	1321-3RA80-A	1321-3R80-A	1321-3RA80-A
		Heavy	1321-3R80-A	1321-3RA80-A	1321-3R100-A	1321-3RA100-A
30	40	Normal	1321-3R100-A	1321-3RA100-A	1321-3R100-A	1321-3RA100-A
		Heavy	1321-3R100-A	1321-3RA100-A	1321-3R130-A	1321-3RA130-A
37	50	Normal	1321-3R130-A	1321-3RA130-A	1321-3R130-A	1321-3RA130-A
		Heavy	1321-3R130-A	1321-3RA130-A	1321-3R160-A	1321-3RA160-A
45	60	Normal	1321-3R160-A	1321-3RA160-A	1321-3R160-A	1321-3RA160-A
		Heavy	1321-3R160-A	1321-3RA160-A	1321-3R200-A	1321-3RA200-A
55	75	Normal	1321-3R200-A	1321-3RA200-A	1321-3R200-A	1321-3RA200-A
		Heavy	1321-3R200-A	1321-3RA200-A	1321-3RB320-A	1321-3RAB320-A
66	100	Normal	1321-3RB320-A	1321-3RAB320-A	1321-3RB320-A	1321-3RAB320-A
		Heavy	1321-3RB320-A	1321-3RAB320-A	1321-3RB320-A	1321-3RAB320-A
90	125	Normal	1321-3RB320-A	1321-3RAB320-A	1321-3RB320-A	1321-3RAB320-A
		Heavy	1321-3RB320-A	1321-3RAB320-A	1321-3RB400-A	1321-3RAB400-A
110	150	Normal	1321-3RB400-A	1321-3RAB400-A	1321-3RB400-A	1321-3RAB400-A
132	200	Normal	1321-3R500-A	1321-3RA500-A	1321-3R500-A	1321-3RA500-B

380…480V, 50/60 Hz, Three-phase, 5% Impedance

kW	Hp	Duty	Input Line Reactor		Output Load Reactor	
			IP00 (Open Style)	IP11 (NEMA/UL Type 1)	IP00 (Open Style)	IP11 (NEMA/UL Type 1)
			Cat. No.	Cat. No.	Cat. No.	Cat. No.
0.75	1	Normal	1321-3R2-B	1321-3RA2-B	1321-3R2-B	1321-3RA2-B
1.1	1.5	Heavy	1321-3R4-D	1321-3RA4-D	1321-3R4-D	1321-3RA4-D
1.5	2	Normal	1321-3R4-D	1321-3RA4-D	1321-3R4-D	1321-3RA4-D
		Heavy	1321-3R4-D	1321-3RA4-D	1321-3R8-D	1321-3RA8-D
2.2	3	Normal	1321-3R8-D	1321-3RA8-D	1321-3R8-D	1321-3RA8-D
		Heavy	1321-3R8-D	1321-3RA8-D	1321-3R8-C	1321-3RA8-C
4	5	Normal	1321-3R8-C	1321-3RA8-C	1321-3R8-C	1321-3RA8-C
		Heavy	1321-3R8-C	1321-3RA8-C	1321-3R12-C	1321-3RA12-C
5.5	7.5	Normal	1321-3R12-C	1321-3RA12-C	1321-3R12-C	1321-3RA12-C
		Heavy	1321-3R12-C	1321-3RA12-C	1321-3R18-C	1321-3RA18-C
7.5	10	Normal	1321-3R18-C	1321-3RA18-C	1321-3R18-C	1321-3RA18-C
		Heavy	1321-3R18-C	1321-3RA18-C	1321-3R25-C	1321-3RA25-C
11	15	Normal/Heavy	1321-3R25-C	1321-3RA25-C	1321-3R25-C	1321-3RA25-C
15	20	Normal	1321-3R35-C	1321-3RA35-C	1321-3R25-C	1321-3RA25-C
		Heavy	1321-3R35-C	1321-3RA35-C	1321-3R35-C	1321-3RA35-C
18.5	25	Normal	1321-3R35-C	1321-3RA35-C	1321-3R35-C	1321-3RA35-C
		Heavy	1321-3R35-C	1321-3RA35-C	1321-3R45-C	1321-3RA45-C
22	30	Normal	1321-3R45-C	1321-3RA45-C	1321-3R45-C	1321-3RA45-C
		Heavy	1321-3R45-C	1321-3RA45-C	1321-3R55-C	1321-3RA55-C
30	40	Normal	1321-3R55-C	1321-3RA55-C	1321-3R55-C	1321-3RA55-C
		Heavy	1321-3R55-C	1321-3RA55-C	1321-3R80-C	1321-3RA80-C
37	50	Normal	1321-3R80-C	1321-3RA80-C	1321-3R80-C	1321-3RA80-C
		Heavy	1321-3R80-C	1321-3RA80-C	1321-3R80-C	1321-3RA80-C
45	60	Normal/Heavy	1321-3R80-C	1321-3RA80-C	1321-3R80-C	1321-3RA80-C
55	75	Normal/Heavy	1321-3R100-C	1321-3RA100-C	1321-3R100-C	1321-3RA100-C
75	100	Normal/Heavy	1321-3R130-C	1321-3RA130-C	1321-3R130-C	1321-3RA130-C
90	125	Normal/Heavy	1321-3R160-C	1321-3RA160-C	1321-3R160-C	1321-3RA160-C
110	150	Normal	1321-3R200-C	1321-3RA200-C	1321-3R200-C	1321-3RA200-C
		Heavy	1321-3R200-C	1321-3RA200-C	1321-3R200-C	1321-3RA200-C
–	200	Normal/Heavy	1321-3RB250-C	1321-3RAB250-C	1321-3RB250-C	1321-3RAB250-C
132	–	Normal/Heavy	1321-3RB320-C	1321-3RAB320-C	1321-3RB320-C	1321-3RAB320-C
160	250	Normal/Heavy	1321-3RB320-C	1321-3RAB320-C	1321-3RB320-C	1321-3RAB320-C
–	300	Normal/Heavy	1321-3RB400-C	1321-3RAB400-C	1321-3RB400-C	1321-3RAB400-C
200	–	Normal/Heavy	1321-3RB400-C	1321-3RAB400-C	1321-3RB400-C	1321-3RAB400-C
–	350	Normal/Heavy	1321-3R500-C	1321-3R500-C	1321-3R500-C	1321-3R500-C
250	–	Normal/Heavy	1321-3R500-C	1321-3RA500-C	1321-3R500-C	1321-3RA500-C
270	–	Normal/Heavy	1321-3R500-C	1321-3RA500-C	1321-3R500-C	1321-3RA500-C
–	400	Light/Normal/Heavy	1321-3R500-C	1321-3RA500-C	1321-3R500-C	1321-3RA500-C
315	–	Light/Normal/Heavy	1321-3R600-C	1321-3RA600-C	1321-3R600-C	1321-3RA600-C
336	450	Normal/Heavy	1321-3RA600-C	1321-3RA600-C	1321-3R500-C	1321-3RA500-C
–	450	Light/Normal/Heavy	1321-3R600-C	1321-3RA600-C	1321-3R600-C	1321-3RA600-C
355	–	Light/Normal/Heavy	1321-3R750-C	1321-3RA750-C	1321-3R750-C	1321-3RA750-C
–	500	Light	1321-3R600-C	1321-3RA600-C	1321-3R600-C	1321-3RA600-C

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
PowerFlex 750-Series Drive Installation Instructions, publication 750-IN001	Provides detailed information on how to install PowerFlex® 750-Series AC drives.
PowerFlex 750-Series Programming Manual, publication 750-PM001	Provides detailed information on I/O, control, and feedback options; parameters and programming; faults, alarms, and troubleshooting.
PowerFlex 20-HIM-A6 and 20-HIM-C6S HIM (Human Interface Module) User Manual, publication 20HIM-UM001	Provides detailed information on HIM components, operation, and features.
PowerFlex 755 Integrated Safety - Safe Torque Off Option Module User Manual, publication 750-UM004	Provides detailed information on how to install and use the Integrated Safety - Safe Torque Off option module.
PowerFlex 750-Series Safe Torque Off User Manual, publication 750-UM002	Provides detailed information on how to install and use the Safe Torque Off option module.
Safe Speed Monitor Option Module for PowerFlex 750-Series AC Drives Safety Reference Manual, publication 750-RM001	Provides detailed information on how to install and use the Safe Speed Monitor option module.
PowerFlex 7-Class Network Communication Adapter User Manuals, publication 750COM-UM	These publications provide detailed information on to configure, use, and troubleshoot PowerFlex 750-Series communication option modules and adapters. To display a list of the available adapters, enter 750com-um in the search field.
PowerFlex Dynamic Braking Resistor Calculator Application Technique, publication PFLEX-AT001	Provides information to help you understand dynamic braking and how to apply dynamic braking to drive systems.
Wiring and Grounding Guidelines for PWM AC Drives, publication DRIVES-IN001	Provides basic information to properly wire and ground PWM AC drives.
Preventive Maintenance of Industrial Control and Drive System Equipment Service Bulletin, publication DRIVES-TD001	Provides information for preventative maintenance and periodic inspection of drive systems.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control, publication SGI-1.1	Provides general guidelines for the application, installation, and maintenance of solid-state control.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
PowerFlex 750-Series Service Cart Frames 8...10 Conversion Kit, publication 750-IN017	Provides information on installing the frames 8...10 conversion kit to the PowerFlex 750-Series Service Cart.
PowerFlex 750-Series Service Cart and DCPC Lift Renewal Parts, publication 750-PC106	Provides additional information to acquire spare parts for the PowerFlex 750-Series.
PowerFlex 750-Series Service Cart and DCPC Module Lift Installation Instructions, publication 750-IN105	Provides instructions to setup and use the PowerFlex 750-Series Service Cart and DCPC Lift. Includes spare parts for the service cart and for the high power conversion kit.
PowerFlex 750-Series Spare Parts Installation Instructions, publication 750-IN013	Provides additional information to acquire spare parts for the PowerFlex 750-Series.
Product Certifications website rok.auto/certifications	Provides declarations of conformity, certificates, and other certification details.
EtherNet/IP Network Devices User Manual, ENET-UM006	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
System Security Design Guidelines Reference Manual, SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at rok.auto/literature.

Rockwell Automation Support

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Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	rok.auto/pcdc

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Publication 750-TD001L-EN-P - October 2020
Supersedes Publication 750-TD001K-EN-P - October 2017

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Table 24 - PowerFlex 750 Series, 480V Shielded/Unshielded Cable - Meters (Feet)

Drive Frame		Rating		No Solution				Reactor Only				Reactor + Damping Resistor or 1321-RWR				Reactor/RWR (see page 113)	Resistor		Available Options			
70	700	Hp	kHz	1000V	1200V	1488V	1600V	1000V	1200V	1488V	1600V	1000V	1200V	1488V	1600V	Cat. No.	Ohms	Watts	TFA1	TFB2	RWR2	RWC
A	0	0.5	2	7.6 (25)	12.2 (40)	53.3 (175)	53.3 (175)	7.6 (25)	91.4 (300)	121.9 (400)	121.9 (400)	121.9 (400)	121.9 (400)	121.9 (400)	121.9 (400)				●		●	●
			4	7.6 (25)	12.2 (40)	53.3 (175)	53.3 (175)	7.6 (25)	12.2 (40)	121.9 (400)	121.9 (400)	121.9 (400)	121.9 (400)	121.9 (400)	121.9 (400)						●	●
		1	2	7.6 (25)	12.2 (40)	83.8 (275)	83.8 (275)	7.6 (25)	91.4 (300)	152.4 (500)	152.4 (500)	152.4 (500)	152.4 (500)	152.4 (500)	152.4 (500)				●		●	●
			4	7.6 (25)	12.2 (40)	76.2 (250)	76.2 (250)	7.6 (25)	12.2 (40)	121.9 (400)	152.4 (500)	152.4 (500)	152.4 (500)	152.4 (500)	152.4 (500)						●	●
		2	2	7.6 (25)	12.2 (40)	83.8 (275)	83.8 (275)	7.6 (25)	91.4 (300)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)				●	●	●	●
			4	7.6 (25)	12.2 (40)	76.2 (250)	76.2 (250)	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)						●	●
B		3	2	7.6 (25)	12.2 (40)	129.5 (425)	129.5 (425)	7.6 (25)	91.4 (300)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)				●	●	●	●
			4	7.6 (25)	12.2 (40)	121.9 (400)	121.9 (400)	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)	182.9 (600)						●	●
		5	2	7.6 (25)	12.2 (40)	137.2 (450)	182.9 (600)	7.6 (25)	91.4 (300)	243.8 (800)	243.8 (800)	182.9 (600)	243.8 (800)	243.8 (800)	243.8 (800)	1321-RWR8-DP			●	●	●	●
			4	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	7.6 (25)	12.2 (40)	121.9 (400)	243.8 (800)	182.9 (600)	243.8 (800)	243.8 (800)	243.8 (800)	1321-RWR8-DP					●	●
C		7.5	2	7.6 (25)	12.2 (40)	137.2 (450)	182.9 (600)	7.6 (25)	91.4 (300)	304.8 (1000)	304.8 (1000)	182.9 (600)	304.8 (1000)	304.8 (1000)	304.8 (1000)	1321-RWR12-DP				●		●
			4	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	7.6 (25)	12.2 (40)	121.9 (400)	304.8 (1000)	182.9 (600)	304.8 (1000)	304.8 (1000)	304.8 (1000)	1321-RWR12-DP						●
	1	10	2	7.6 (25)	12.2 (40)	137.2 (450)	182.9 (600)	7.6 (25)	91.4 (300)	365.8 (1200)	365.8 (1200)	182.9 (600)	365.8 (1200)	365.8 (1200)	365.8 (1200)	1321-RWR18-DP				●		●
			4	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	7.6 (25)	12.2 (40)	121.9 (400)	304.8 (1000)	182.9 (600)	304.8 (1000)	365.8 (1200)	365.8 (1200)	1321-RWR18-DP						●
D		15	2	7.6 (25)	12.2 (40)	137.2 (450)	182.9 (600)	7.6 (25)	91.4 (300)	365.8 (1200)	365.8 (1200)	182.9 (600)	365.8 (1200)	365.8 (1200)	365.8 (1200)	1321-RWR25-DP				●		
			4	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	7.6 (25)	12.2 (40)	121.9 (400)	304.8 (1000)	182.9 (600)	304.8 (1000)	365.8 (1200)	365.8 (1200)	1321-RWR25-DP						
	2	20	2	7.6 (25)	12.2 (40)	137.2 (450)	182.9 (600)	7.6 (25)	91.4 (300)	365.8 (1200)	365.8 (1200)	182.9 (600)	365.8 (1200)	365.8 (1200)	365.8 (1200)	1321-RWR35-DP				●		
			4	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	7.6 (25)	12.2 (40)	121.9 (400)	304.8 (1000)	182.9 (600)	304.8 (1000)	365.8 (1200)	365.8 (1200)	1321-RWR35-DP						
		25	2	7.6 (25)	12.2 (40)	137.2 (450)	182.9 (600)	7.6 (25)	76.2 (250)	365.8 (1200)	365.8 (1200)	182.9 (600)	365.8 (1200)	365.8 (1200)	365.8 (1200)	1321-RWR35-DP				●		
			4	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	7.6 (25)	12.2 (40)	121.9 (400)	274.3 (900)	152.4 (500)	304.8 (1000)	365.8 (1200)	365.8 (1200)	1321-RWR35-DP						
	3	30	2	7.6 (25)	12.2 (40)	137.2 (450)	182.9 (600)	7.6 (25)	76.2 (250)	365.8 (1200)	365.8 (1200)	182.9 (600)	365.8 (1200)	365.8 (1200)	365.8 (1200)	1321-RWR45-DP				●		
			4	7.6 (25)	12.2 (40)	121.9 (400)	182.9 (600)	7.6 (25)	12.2 (40)	121.9 (400)	243.8 (800)	152.4 (500)	304.8 (1000)	365.8 (1200)	365.8 (1200)	1321-RWR45-DP						
E		40	2	7.6 (25)	12.2 (40)	137.2 (450)	182.9 (600)	7.6 (25)	76.2 (250)	365.8 (1200)	365.8 (1200)	152.4 (500)	365.8 (1200)	365.8 (1200)	365.8 (1200)	1321-RWR55-DP				●		
			4	7.6 (25)	12.2 (40)	106.7 (350)	152.4 (500)	7.6 (25)	12.2 (40)	106.7 (350)	228.6 (750)	121.9 (400)	243.8 (800)	365.8 (1200)	365.8 (1200)	1321-RWR55-DP						
		50	2	12.2 (40)	18.3 (60)	137.2 (450)	182.9 (600)	12.2 (40)	61.0 (200)	304.8 (1000)	365.8 (1200)	152.4 (500)	365.8 (1200)	365.8 (1200)	365.8 (1200)	1321-RWR80-DP				●		
			4	7.6 (25)	12.2 (40)	91.4 (300)	152.4 (500)	12.2 (40)	18.3 (60)	106.7 (350)	228.6 (750)	91.4 (300)	243.8 (800)	365.8 (1200)	365.8 (1200)	1321-RWR80-DP						
	4	60	2	12.2 (40)	18.3 (60)	137.2 (450)	182.9 (600)	12.2 (40)	61.0 (200)	304.8 (1000)	365.8 (1200)	137.2 (450)	365.8 (1200)	365.8 (1200)	365.8 (1200)	1321-RWR80-DP				●		
			4	7.6 (25)	12.2 (40)	91.4 (300)	152.4 (500)	12.2 (40)	24.4 (80)	91.4 (300)	228.6 (750)	76.2 (250)	213.4 (700)	365.8 (1200)	365.8 (1200)	1321-RWR80-DP						

continued

POWERS Andy

From: Terry Brundage <tbrundage@transcoil.com>
Sent: Monday, January 4, 2021 11:12 AM
To: POWERS Andy
Cc: KAZARIAN Kyle; SULLIVAN Keith
Subject: RE: Help with a basic harmonic analysis
Attachments: Report - MCC10-1 Bus A.rtf; Report - MCC10-1 Bus B.rtf; Report - MCC10-2 Bus A.rtf; Report - MCC10-2 Bus B.rtf

Importance: High

Andy,

I took a look at what you sent me. I also did a harmonic analysis calculation report for MCC 10-1 and MCC 10-2 for both Bus A and B on each. A few things I want to alert you to about my calculations and approach…

- The active harmonic filters are located to deal with the harmonics generated by the loads on MCC10-1. They are not there to deal with the entire system. If that is the intent, they would have to be relocated to be on the main bus system (on drawing 10 E-005.
- The size of the main transformer feeding the system is not listed on the prints but I am assuming 1,500 KVA and based calculations on that. The main bus is rated for 2,000 amps which would be approx. 1,662 KVA but we both know that according to the NEC, the conductor has to be oversized so I am maxing things out at 1,500 KVA.
- I also assumed that all VFDs had an internal DC link choke of 4% impedance (except of VFDs one HP and below which I assumed had none).

So here's what I found out….

- On BUS A of MCC 10-1, you would need a **50-amp active harmonic filter** (agrees with your note). Report is attached for reference. To be honest, I played things safe because on the print, there is a note that says a certain drive has a 5% line reactor. The print also shows line reactors on each VFD but since the note only is pointing to one VFD, I assumed the other VFDs had 3% line reactors. No impact on the filter sizing. Using a 50-amp active harmonic filter will certainly cover the 45.8 amps of corrective current needed and will let you end up with a 4.0% iTDD (goal was to be under 5.0%).
- On BUS B of MCC 10-1, my calculations show you need a **100-amp active harmonic filter** to deal with the 90.1 amps of corrective current needed. Report is attached for reference. The same assumptions were made on BUS B as were on BUS A when it came to the line reactors. Even if I had changed all the line reactors to 5%, it still would require a 100-amp filter as the corrective current needed would be around 84 amps. What is killing you is that on BUS B you have three 30 HP drives with no line reactors (listed as plant water pumps). Even if you added 5% reactors to these three VFDs, you would still need a 100-amp filter as you would need 65.1 amps of coercive current.

Now for MCC 10-2

- BUS A – Assuming all VFDs had 5% line reactors on them, you would end up with an iTDD of 27.2% and only needing 5.1 amps of corrective current. Since the impact is so low, it should not impact your system to any noticeable degree. Report is attached for reference.
- BUS B – With the same assumptions, you would end up with an iTDD of 28.2% and only need 7.3 amps of corrective current. Again, it should not impact your system to any noticeable degree. Report is attached for reference.

Hope this helps.

Terry

Terry Brundage
Eastern Regional Sales Manager

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Click here for the latest TCI updates on COVID-19

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From: POWERS Andy <Andy.Powers@needco.com>
Sent: Tuesday, December 29, 2020 10:19 AM
To: Terry Brundage <tbrundage@transcoil.com>
Cc: KAZARIAN Kyle <Kyle.Kazarian@needco.com>; SULLIVAN Keith <Keith.Sullivan@needco.com>
Subject: Help with a basic harmonic analysis
Importance: High

Terry:

I have this job and I just submitted on the MCC's.
Rockwell Automation Sales Order# 6505025406.

- All of the packaged drives on Drawing 10E-005 are either 18-pulse or have passive harmonic filters.
- MCC.10-1 on Drawing 10E-006 has a bunch of 6-pulse drives with 5% reactors, but we also have [2] TCI HGA ALC50A00H400 active filters ([2] because that lineup is double-ended M-T-M)
- MCC.10-2 on Drawing 10E-007 has a few small HP drives with 5% reactors and no other harmonic mitigation.

Full submittal can be downloaded if you'd like to see it:

https://www.dropbox.com/t/4CEGMG6efSqGL84a

I struggle with the new harmonics analysis tool. It would be great if you could bang something out so I can send along with the submittal (harmonics analysis is required for the MCC and VFD submittals).

ALSO, even though I sent the attached "*Pages from HGA-Manual*" to Rockwell and included the subtraction CT's in my workup, it would appear the factory ignored me and didn't include them.
I believe those subtraction CT's are required on a main-tie-main (or MLO-tie-MLO which is what I have here). Please confirm.

HARMONICGUARD® SOLUTION CENTER

Harmonic Solution Sizing Report

Project Name:	NEEDCO - Town of Orleans, MA - MCC 10-1 - Bus A
Project Location:	
Date:	Monday, January 4, 2021
Report By:	
Name	TERRY BRUNDAGE
Company	transcoil
Contact info	eMail: tbrundage@transcoil.com Phone: 414-357-2710
Version:	v2.1.4

========== IEEE-519 Compliance Summary ==========

System Harmonic Performance					
		Baseline System		Final Filtered System	
	I_{sc}/I_L	iTDD(%)	vTDD(%)	iTDD(%)	vTDD(%)
Harmonic Target	Manual	5		5	
Harmonic Actual	173.6	28.8	1.0	4.0	0.1
Harmonic Compliance		-- iTDD Non-Compliant --		----- iTDD Compliant -----	

Maximum Harmonic Current Distortion in Percent (TDD) per IEEE Std 519-2014 Table 2	
TDD(%)	I_{sc}/I_L
5.0	<20
8.0	20<50
12.0	50<100
15.0	100<1000
20.0	>1000

========== Final Filtered System Summary ==========
With 50 A HGA Active Filter

Description	Unit	Value
Active Filter Current Rating	Arms	50
Total Current THD	iTHD	4.0%
Total Secondary Voltage THD	vTHD	0.1%
System Voltage	Vrms	480
System Frequency	Hz	60
Source Transformer Rating	kVA	1500
Secondary Short Circuit Current (I_{sc})	Arms	31377.73
Secondary Short Circuit Current to Load Current Ratio (I_{sc}/I_L)		173.6
Maximum Demand Current (I_L)	Arms	180.8
Total Current	Arms	180.9
Fundamental Current	Arms	180.8
Harmonic Current	Arms	7.2
Displacement Power Factor	DPF	0.94
Distortion Power Factor	Dist PF	1.00
Total Power Factor	PF	0.94
Total Volt-Amps	kVA	150.4
Total Volt-Amps Reactive	kVAR	49.6
Total Power	kW	142.0

========== Warning Messages ==========
None

========== Tool Input Data ==========

1. Transformer Primary

Description	Unit	Value
Enter Data (optional)		False
Voltage	kVrms	N/A
Short Circuit Current	kArms	N/A

2. Transformer Secondary

Description	Unit	Value
Voltage	Vrms	480
Frequency	Hz	60
Transformer kVA	kVA	1500
Transformer % Impedance	%Z	5.75

3. Secondary Correction Target

Harmonic Correction	True
Desired iTDD	5
IEEE-519 Target	False
Power Factor Correction	False

4. Non-Linear Loads (20 max)

					Internal Drive Reactor		External KDR Line Reactor	
Item #	Qty	Rectifier Type	HarmonicGuard Passive Filter	VFD HP	% DC Choke	% AC Reactor	% AC Reactor	% VFD Load
1	2	6 Pulse Diode	None	30	4	0	3	100
2	2	6 Pulse Diode	None	25	4	0	5	100
3	1	6 Pulse Diode	None	20	4	0	3	100
4	1	6 Pulse Diode	None	10	4	0	3	100
5	3	6 Pulse Diode	None	1	0	0	0	100
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

5. Linear Loads (10 max)

			Rating			
Item #	Qty	Load Type	HP	kVA	PF	% Load
1	1	Motors	10		0.8	100
2	3	Motors	5		0.8	100
3	2	Motors	2		0.8	100
4	1	Motors	1		0.8	100
5						
6						
7						
8						
9						
10						

HARMONICGUARD® SOLUTION CENTER

Harmonic Solution Sizing Report

Project Name:	NEEDCO - Town of Orleans, MA - MCC 10-1 - Bus B
Project Location:	
Date:	Monday, January 4, 2021
Report By:	
Name	TERRY BRUNDAGE
Company	transcoil
Contact info	eMail: tbrundage@transcoil.com Phone: 414-357-2710
Version:	v2.1.4

========== IEEE-519 Compliance Summary ==========

System Harmonic Performance					
		Baseline System		Final Filtered System	
	I_{sc}/I_L	iTDD(%)	vTDD(%)	iTDD(%)	vTDD(%)
Harmonic Target	Manual	5		5	
Harmonic Actual	121.1	35.9	1.8	4.0	0.2
Harmonic Compliance		-- iTDD Non-Compliant --		----- iTDD Compliant -----	

Maximum Harmonic Current Distortion in Percent (TDD) per IEEE Std 519-2014 Table 2	
TDD(%)	I_{sc}/I_L
5.0	<20
8.0	20<50
12.0	50<100
15.0	100<1000
20.0	>1000

========== Final Filtered System Summary ==========
With 100 A HGA Active Filter

Description	Unit	Value
Active Filter Current Rating	Arms	100
Total Current THD	iTHD	4.0%
Total Secondary Voltage THD	vTHD	0.2%
System Voltage	Vrms	480
System Frequency	Hz	60
Source Transformer Rating	kVA	1500
Secondary Short Circuit Current (I_{sc})	Arms	31377.73
Secondary Short Circuit Current to Load Current Ratio (I_{sc}/I_L)		121.1
Maximum Demand Current (I_L)	Arms	259.1
Total Current	Arms	259.3
Fundamental Current	Arms	259.1
Harmonic Current	Arms	10.4
Displacement Power Factor	DPF	0.95
Distortion Power Factor	Dist PF	1.00
Total Power Factor	PF	0.95
Total Volt-Amps	kVA	215.6
Total Volt-Amps Reactive	kVAR	68.8
Total Power	kW	204.3

========== Warning Messages ==========
None

========== Tool Input Data ==========

1. Transformer Primary

Description	Unit	Value
Enter Data (optional)		False
Voltage	kVrms	N/A
Short Circuit Current	kArms	N/A

2. Transformer Secondary

Description	Unit	Value
Voltage	Vrms	480
Frequency	Hz	60
Transformer kVA	kVA	1500
Transformer % Impedance	%Z	5.75

3. Secondary Correction Target

Harmonic Correction	True
Desired iTDD	5
IEEE-519 Target	False
Power Factor Correction	False

4. Non-Linear Loads (20 max)

					Internal Drive Reactor		External KDR Line Reactor	
Item #	Qty	Rectifier Type	HarmonicGuard Passive Filter	VFD HP	% DC Choke	% AC Reactor	% AC Reactor	% VFD Load
1	1	6 Pulse Diode	None	30	4	0	3	100
2	3	6 Pulse Diode	None	30	4	0	0	100
3	2	6 Pulse Diode	None	25	4	0	3	100
4	1	6 Pulse Diode	None	20	4	0	3	100
5	1	6 Pulse Diode	None	10	4	0	3	100
6	1	6 Pulse Diode	None	5	4	0	3	100
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

5. Linear Loads (10 max)

			Rating			
Item #	Qty	Load Type	HP	kVA	PF	% Load
1	1	Motors	30		0.8	100
2	2	Motors	1		0.8	100
3	1	Motors	10		0.8	100
4	1	Motors	2		0.8	100
5						
6						
7						
8						
9						
10						

HARMONICGUARD® SOLUTION CENTER

Harmonic Solution Sizing Report

Project Name:	NEEDCO - Town of Orleans, MA - MCC 10-2 - Bus A
Project Location:	
Date:	Monday, January 4, 2021
Report By:	
Name	TERRY BRUNDAGE
Company	transcoil
Contact info	eMail: tbrundage@transcoil.com Phone: 414-357-2710
Version:	v2.1.4

========== IEEE-519 Compliance Summary ==========

System Harmonic Performance					
		Baseline System		Final Filtered System	
	I_{sc}/I_L	iTDD(%)	vTDD(%)	iTDD(%)	vTDD(%)
Harmonic Target	Manual	5		5	
Harmonic Actual	1432.4	27.2	0.1	27.2	0.1
Harmonic Compliance		-- iTDD Non-Compliant --		--- iTDD Non-Compliant ---	

Maximum Harmonic Current Distortion in Percent (TDD) per IEEE Std 519-2014 Table 2	
TDD(%)	I_{sc}/I_L
5.0	<20
8.0	20<50
12.0	50<100
15.0	100<1000
20.0	>1000

========== Final Filtered System Summary ==========
With 0 A HGA Active Filter

Description	Unit	Value
Active Filter Current Rating	Arms	0
Total Current THD	iTHD	27.2%
Total Secondary Voltage THD	vTHD	0.1%
System Voltage	Vrms	480
System Frequency	Hz	60
Source Transformer Rating	kVA	1500
Secondary Short Circuit Current (I_{sc})	Arms	31377.73
Secondary Short Circuit Current to Load Current Ratio (I_{sc}/I_L)		1432.4
Maximum Demand Current (I_L)	Arms	21.9
Total Current	Arms	22.7
Fundamental Current	Arms	21.9
Harmonic Current	Arms	6.0
Displacement Power Factor	DPF	0.95
Distortion Power Factor	Dist PF	0.96
Total Power Factor	PF	0.91
Total Volt-Amps	kVA	18.9
Total Volt-Amps Reactive	kVAR	7.7
Total Power	kW	17.2

========== Warning Messages ==========
None

========== Tool Input Data ==========

1. Transformer Primary

Description	Unit	Value
Enter Data (optional)		False
Voltage	kVrms	N/A
Short Circuit Current	kArms	N/A

2. Transformer Secondary

Description	Unit	Value
Voltage	Vrms	480
Frequency	Hz	60
Transformer kVA	kVA	1500
Transformer % Impedance	%Z	5.75

3. Secondary Correction Target

Harmonic Correction	True
Desired iTDD	5
IEEE-519 Target	False
Power Factor Correction	False

4. Non-Linear Loads (20 max)

					Internal Drive Reactor		External KDR Line Reactor	
Item #	Qty	Rectifier Type	HarmonicGuard Passive Filter	VFD HP	% DC Choke	% AC Reactor	% AC Reactor	% VFD Load
1	1	6 Pulse Diode	None	8	4	0	5	100
2	2	6 Pulse Diode	None	3	4	0	5	100
3	4	6 Pulse Diode	None	1	0	0	5	100
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

5. Linear Loads (10 max)

			Rating			
Item #	Qty	Load Type	HP	kVA	PF	% Load
1	1	Motors	2		0.8	100
2	1	Motors	1		0.8	100
3						
4						
5						
6						
7						
8						
9						
10						

Harmonic Solution Sizing Report

Project Name:	NEEDCO - Town of Orleans, MA - MCC 10-2 - Bus B
Project Location:	
Date:	Monday, January 4, 2021
Report By:	
Name	TERRY BRUNDAGE
Company	transcoil
Contact info	eMail: tbrundage@transcoil.com Phone: 414-357-2710
Version:	v2.1.4

========== IEEE-519 Compliance Summary ==========

System Harmonic Performance					
		Baseline System		Final Filtered System	
	I_{sc}/I_L	iTDD(%)	vTDD(%)	iTDD(%)	vTDD(%)
Harmonic Target	Manual	5		5	
Harmonic Actual	1042.3	28.2	0.2	28.2	0.2
Harmonic Compliance		-- iTDD Non-Compliant --		--- iTDD Non-Compliant ---	

Maximum Harmonic Current Distortion in Percent (TDD) per IEEE Std 519-2014 Table 2	
TDD(%)	I_{sc}/I_L
5.0	<20
8.0	20<50
12.0	50<100
15.0	100<1000
20.0	>1000

========== Final Filtered System Summary ==========
With 0 A HGA Active Filter

Description	Unit	Value
Active Filter Current Rating	Arms	0
Total Current THD	iTHD	28.2%
Total Secondary Voltage THD	vTHD	0.2%
System Voltage	Vrms	480
System Frequency	Hz	60
Source Transformer Rating	kVA	1500
Secondary Short Circuit Current (I_{sc})	Arms	31377.73
Secondary Short Circuit Current to Load Current Ratio (I_{sc}/I_L)		1042.3
Maximum Demand Current (I_L)	Arms	30.1
Total Current	Arms	31.3
Fundamental Current	Arms	30.1
Harmonic Current	Arms	8.5
Displacement Power Factor	DPF	0.95
Distortion Power Factor	Dist PF	0.96
Total Power Factor	PF	0.92
Total Volt-Amps	kVA	26.0
Total Volt-Amps Reactive	kVAR	10.5
Total Power	kW	23.8

========== Warning Messages ==========
None

========== Tool Input Data ==========

1. Transformer Primary

Description	Unit	Value
Enter Data (optional)		False
Voltage	kVrms	N/A
Short Circuit Current	kArms	N/A

2. Transformer Secondary

Description	Unit	Value
Voltage	Vrms	480
Frequency	Hz	60
Transformer kVA	kVA	1500
Transformer % Impedance	%Z	5.75

3. Secondary Correction Target

Harmonic Correction	True
Desired iTDD	5
IEEE-519 Target	False
Power Factor Correction	False

4. Non-Linear Loads (20 max)

					Internal Drive Reactor		External KDR Line Reactor	
Item #	Qty	Rectifier Type	HarmonicGuard Passive Filter	VFD HP	% DC Choke	% AC Reactor	% AC Reactor	% VFD Load
1	1	6 Pulse Diode	None	8	4	0	5	100
2	3	6 Pulse Diode	None	5	4	0	5	100
3	3	6 Pulse Diode	None	1	0	0	5	100
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

5. Linear Loads (10 max)

			Rating			
Item #	Qty	Load Type	HP	kVA	PF	% Load
1	1	Motors	2		0.8	100
2	1	Motors	1		0.8	100
3						
4						
5						
6						
7						
8						
9						
10						

Bill: **R1USE01851-0001-0001** Rockwell Automation

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EW Part No	IFS 7.5Part No	Description	QTY	UM
102419	102419	TERMINAL BLOCK, 4 PT, 20A	3	PCS
140G-H-RVM21B	PN-232970	CB,ROTARY HANDLE MECHANISM, FOR H AND J FRAME 140G, 21",	1	PCS
140G-J6F3-D10	PN-233960	CIRCUIT BREAKER, FRAME J, 100A, 3 POLE, 65kA/480V	1	PCS
140G-J-EXT3-3P_BOT-PB-3D	PN-D12949	TERMINAL, EXTENDED, FRONT, FRAME-J, 3P-BOT W/ PHASE BARRIERS, QTY-3	1	EA
140G-J-TC3H	PN-D13059	TERMINAL COVER, HIGH, FRAME-J, 3P, QTY-2	1	PCS
140G-J-TLC13-3P_TOP-3D	PN-D12981	TERM/LUG, FCCu, J-FRAME, 3P, TOP, 1X6-185, QTY-3	1	EA
1492-100X	1492-100X B	POWER BLOCK, 3 POLE, 600 VAC, 175 AMP, 2/0-#14 LINE, 2/0-#14 LOAD	1	PCS
1492-100Y	1492-100Y B	POWER BLOCK, 1 POLE, 600 VAC, 175 AMP, 2/0-#14 LINE, 2/0-#14 LOAD	1	PCS
1492-CJLJ6-10	1492-CJLJ6-10 A	CENTER JUMPER, PLUG-IN TYPE, FOR 1492-J4, 10 POLE.	2	PCS
1492-CJLJ6-2	1492-CJLJ6-2 A	CENTER JUMPER, PLUG-IN TYPE, FOR 1492-J4, 2 POLE (PKG 60).	1	PCS
1492-CJLJ6-4	1492-CJLJ6-4 A	CENTER JUMPER, PLUG-IN TYPE, FOR 1492-J4, 4 POLE.	1	PCS
1492-EAJ35	1492-EAJ35 A	END ANCHOR, NORMAL DUTY, GRAY, 1492-J3/J4/J6/J10.	11	PCS
1492-EBJ3	1492-EBJ3 A	END BARRIER, GRAY, FOR 1492-J3/J4/J6/J10.	5	PCS
1492-FB1M30	1492-FB1M30 B	DIN RAIL FUSE HOLDER 1 POLE, 30 AMP, MIDGET, TOUCH SAFE.	4	PCS
1492-FB2C30	1492-FB2C30 B	DIN RAIL FUSE HOLDER 2 POLE, 30 AMP, CLASS CC, TOUCH SAFE.	1	PCS
1492-J4	1492-J4 A	TERMINAL BLOCK, BUL 1492-J4, GRAY, 600 VAC/DC, 35 AMP 22-10AWG UL/25 AMP 26-10AWG CSA.	26	PCS
1492-JKD4	1492-JKD4 A	1492-J IEC TERMINAL BLOCK, KNIFE DISCONNTEC FEED-THRU, 4MM(#26 AWG-#10 AWG), STD FEEDTHRU, GRAY	10	PCS
1492-PBC1	1492-PBC1 A	TERMINAL BLOCK GUARD FOR 3P, 150-175A	1	PCS
1492-PBC-4	1492-PBC-4		1	
1497-K-BASX-0-N	1497-K-BASX-0-N A	TRANSFORMER, CONTROL, 1000VA, 240/480V PRI, 110/120V SEC	1	PCS
20-750-2262D-2R	PN-102578	POWERFLEX 750 ACCESSORY, 115V I/O MOD W/2 RELAY OUTPUTS (SCHEMATIC OF INPUTS)	1	PCS
20F14FD077JA0NNNNN	20F14FD077JA0NNNNN	POWERFLEX 753, FRAME 5, 77A, 60HP, FLANGE MOUNT, 648VDC IN, EMBEDDED I/O, CM JUMPER INSTALLED,WITH BRAKE IGBT	1	PCS
20-HIM-C6S	316561-A10	POWERFLEX 750 SERIES ACCESSORY, HIM KIT, LCD FULL NUMERIC, DOOR MOUNTED, IP66 (NEMA 4X/12),W/3M CABLE	1	PCS
30126-006-02	30126-006-02	FAN TRAY SUPPORT BRACKET	2	PCS
30126-825-02	30126-825-02	GUSSET, XFMR, TS8, SUPPORT	4	PCS
30126-830-01	30126-830-01	BRACKET, 23-24 INCH WIDE XFMR RITTAL TS8	4	PCS
310426	310426	MYLAR OVERLAY, DOOR, AB/POWERFLEX, FOR 1000MM	1	PCS
314771	314771	LABEL, DANGER ARC FLASH AND SHOCK HAZARD, 4.00 X 2.00.	1	PCS
318882	318882	GROMMET,,BUSHING, SNAP,FOR 0.75IN DIA HO	1	PCS
375654	375654	18 PULSE BRIDGE ASSEMBLY, 130AMP, PARALLEL DIODE	1	PCS
388392	388392	HOFFMAN GROUNDING BAR SYSTEM (PGS2K) PART NUMBER PGS2K	1	PCS
389530	389530	LABEL, CAUTION . . . FILTER (REPLACES 154899)	1	PCS
389531	389531	LABEL, DANGER, STORAGE CAPS, 3.00 X 1.12. (REPLACES 156940)	1	PCS
389532	389532	LABEL, DANGER, REMOTE SOURCES OF POWER, 3.00 X 1.12. (REPLACES 156942)	1	PCS

Bill: **R1USE01851-0001-0001** Rockwell Automation

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EW Part No	IFS 7.5Part No	Description	QTY	UM
393707	393707	DV/DT FILTER TC#I: V1K80A00	1	
691-XG	691-XG	FUSE REPLACEMENT L/P, REPLACE WITH SAME.....	2	PCS
700-HB33A1	700-HB33A1 E	RELAY, 3PDT, (3) FORM C CONTACTS, 120VAC COIL	4	PCS
700-HK32A1-4	700-HK32A1-4 B	RELAY,GENERAL PURPOSE, SLIMLINE,(2) FORM C CONTACTS,8A MAX,120VAC COIL,W/PL	4	PCS
700-HN122	700-HN122 A	SOCKET W/CLIP, (HK RELAY), 8 BLADE.	4	PCS
700-HN153	700-HN153 B	SOCKET, GUARDED TERMINALS, (HB, HJ, HS RELAYS), 11 BLADE.	4	PCS
800T-A2A4	800T-A2A4	RESET	1	PCS
800TC-PH16A	PN-127103	800T PILOT LIGHTS,115VAC TRANSFORMER LED,AMBER, FINGER GUARDS	3	PCS
800TC-PH16G	PN-126731	800T PILOT LIGHTS,115VAC TRANSFORMER LED,GREEN, FINGER GUARDS	1	PCS
800TC-PH16R	PN-127736	800T PILOT LIGHTS,115VAC TRANSFORMER LED,RED, FINGER GUARDS	1	PCS
800T-J2KC1	800T-J2KC1 T	800T SELECTOR SWITCHES 3 POS,MAINTAINED,SPCL CAM[OOX,OXO],STD OPERATOR	1	PCS
800T-N1	800T-N1 T	HOLE PLUG, CLOSING BUTTON, 800T, 30.5mm (GRAY)	4	PCS
800T-XA	800T-XA D	(1) NO-(1) NC CONTACT	1	PCS
ADDA_AK1781HB-AW-LF	PN-39067	TUBEAXIAL, 176X89MM., 380CFM 115VAC,50/60HZ, 0.57A	4	PCS
ADDA_FG176	PN-39100	GUARD, 176MM FAN, ADDA AK1781HB-AW-LF	8	PCS
BUSSMANN_FNM-10	PN-317678	FUSE, 10 AMPS, 250VAC, TIME DELAY MIDGET - RoHS COMPLIANT	1	PCS
BUSSMANN_FNM-2	128706	FUSE, 2 AMPS, 250VAC, TIME DELAY MIDGET - RoHS COMPLIANT	1	PCS
BUSSMANN_FNM-6	394692	FUSE, 6 AMPS, 250VAC, TIME DELAY MIDGET - RoHS COMPLIANT	2	PCS
BUSSMANN_FNQ-R-5	25184-254-24	FUSE, 5 AMP, 600VAC, 200kA TIME DELAY, CUR-LIMITING, CLASS CC - RoHS COMPLIANT	2	PCS
CR1220	CR1220	PN-71582	1	
GB-13B	GB-13B	WIRE D-RING	1	PCS
HAMMOND-POWER-SOLUTIONS_214940	PN-E006828	18PULSE AL TRANSFORMER, 40/57.5 KVA, DUAL RATED AIR AMP/ FAN AMP, 267 LBS	1	PCS
HOFFMAN_ATEMNO	372114	TEMP. CONTROL SWITCH N.O., 30-140 F	1	PCS
INTERNATIONAL-HYDRAULICS_2S2/0-31-42	PN-390804	ALUMINUM POWER LUG - (2) 2/0-14AWG, MECHANICAL	1	PCS
PN-332101	PN-332101	BAFFLE KIT	1	PCS
PN-356204	PN-356204	UNISTRUT, 1-5/8X1-5/8,SLOTTED, GALV	2	PCS
PN-71582	PN-71582	BATTERY, LITHIUM COIN CELL, CR1220, 3VOLT, 36 mAh	1	PCS
PN-76214	PN-76214	ELAPSED TIMER	1	PCS
PN-E020270	PN-E020270	18 PULSE ENCL, 2200 X 1000 X 600 (87 X 39 X 24), FOR FRAME 5 PF750	1	PCS
PN-E021259	PN-E021259	FAN TRAY, 4 FAN	1	PCS
PN-E024238	PN-E024238	BRACKET, FAN TRAY SUPPORT, LEFT SIDE	1	PCS
PN-E024239	PN-E024239	BRACKET, FAN TRAY SUPPORT, RIGHT SIDE	1	PCS
ST320-4M	ST320-4M	SURGE SUP,480V,50KA SCCR	1	PCS
UNISTRUT_P1008	103198	NUTS FOR STRUT CANNEL, 3/8-16 - "USE UNISTRUT_P1008T"	4	PCS

Bill: **R1USE01851-0002-0002** Rockwell Automation

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EW Part No	IFS 7.5Part No	Description	QTY	UM
1321-3R45-C	1321-3R45-C A	Line Reactor, Top View, Max. Continuous Amps=67.5, 1.2mh Inductance	1	PCS
140G-H6C3-C60	PN-234921	MCCB 140G-H 65kA/480V FF 60A 3p	1	PCS
140G-H-EXT3-3P_BOT-3D	PN-D12947	TERMINAL, EXTENDED, FRONT, FRAME-H, 3P-BOT W/ PHASE BARRIERS AND COVER, QTY-3	1	PCS
140G-H-RVM21B	PN-232970	CB,ROTARY HANDLE MECHANISM, FOR H AND J FRAME 140G, 21",	1	PCS
140G-H-TC3H	PN-D13057	TERMINAL COVER, HIGH, FRAME-H, 3P, QTY-2	1	PCS
140G-H-TLC13	PN-D12979	CIRCUIT BREAKER, LUG, 3 LUGS , 14GA-1/0GA	1	PCS
1492-100X	1492-100X B	POWER BLOCK, 3 POLE, 600 VAC, 175 AMP, 2/0-#14 LINE, 2/0-#14 LOAD	1	PCS
1492-100Y	1492-100Y B	POWER BLOCK, 1 POLE, 600 VAC, 175 AMP, 2/0-#14 LINE, 2/0-#14 LOAD	1	PCS
1492-CJLJ6-10	1492-CJLJ6-10 A	CENTER JUMPER, PLUG-IN TYPE, FOR 1492-J4, 10 POLE.	2	PCS
1492-EBJ3	1492-EBJ3 A	END BARRIER, GRAY, FOR 1492-J3/J4/J6/J10.	5	PCS
1492-J4	1492-J4 A	TERMINAL BLOCK, BUL 1492-J4, GRAY, 600 VAC/DC, 35 AMP 22-10AWG UL/25 AMP 26-10AWG CSA.	23	PCS
1492-JKD4	1492-JKD4 A	1492-J IEC TERMINAL BLOCK, KNIFE DISCONNTEC FEED-THRU, 4MM(#26 AWG-#10 AWG), STD FEEDTHRU, GRAY	10	PCS
1492-PBC1	1492-PBC1 A	TERMINAL BLOCK GUARD FOR 3P, 150-175A	1	PCS
1492-PBC-4	1492-PBC-4		1	
1497-G-BASX-3-N	1497-G-BASX-3-N A	TRANSFORMER, CONTROL, 500VA, 240/480V PRI, 120V SEC W/PRI (CC) AND SEC (MIDGET) FUSE BLOCK	1	PCS
20-750-2262D-2R	PN-102578	POWERFLEX 750 ACCESSORY, 115V I/O MOD W/2 RELAY OUTPUTS (SCHEMATIC OF INPUTS)	1	PCS
20F14FD096JA0NNNNN	20F14FD096JA0NNNNN	POWERFLEX 753, FRAME 5, 96A, 60HP, FLANGE MOUNT, 648VDC IN, EMBEDDED I/O, CM JUMPER INSTALLED,WITH BRAKE IGBT	1	PCS
20-HIM-C6S	316561-A10	POWERFLEX 750 SERIES ACCESSORY, HIM KIT, LCD FULL NUMERIC, DOOR MOUNTED, IP66 (NEMA 4X/12),W/3M CABLE	1	PCS
25184-252-14	25184-252-14	TIME DELAY FUSE, 5A, 600V, CLASS CC	2	PCS
388392	388392	HOFFMAN GROUNDING BAR SYSTEM (PGS2K) PART NUMBER PGS2K	1	PCS
700-HB33A1	700-HB33A1 E	RELAY, 3PDT, (3) FORM C CONTACTS, 120VAC COIL	1	PCS
700-HN122	700-HN122 A	SOCKET W/CLIP, (HK RELAY), 8 BLADE.	3	PCS
700-HN153	700-HN153 B	SOCKET, GUARDED TERMINALS, (HB, HJ, HS RELAYS), 11 BLADE.	4	PCS
800T-A2A4	800T-A2A4	RESET RESET	1	PCS
800TC-PH16A	PN-127103	800T PILOT LIGHTS,115VAC TRANSFORMER LED,AMBER, FINGER GUARDS	3	PCS
800TC-PH16G	PN-126731	800T PILOT LIGHTS,115VAC TRANSFORMER LED,GREEN, FINGER GUARDS	1	PCS
800TC-PH16R	PN-127736	800T PILOT LIGHTS,115VAC TRANSFORMER LED,RED, FINGER GUARDS	1	PCS
800T-J2KC1	800T-J2KC1 T	800T SELECTOR SWITCHES 3 POS,MAINTAINED,SPCL CAM[OOX,OXO],STD OPERATOR	1	PCS
800T-N1	800T-N1 T	HOLE PLUG, CLOSING BUTTON, 800T, 30.5mm (GRAY)	1	PCS
HOFFMAN_ATEMNO	372114	TEMP. CONTROL SWITCH N.O., 30-140 F	1	PCS
2S2/0-31-42	PN-390804	ALUMINUM POWER LUG - (2) 2/0-14AWG, MECHANICAL	1	PCS
PN-144134	PN-144134	RITTAL ENCLOSURE WITH FAN AND EXHAUST	1	PCS
PN-71582	PN-71582	BATTERY, LITHIUM COIN CELL, CR1220, 3VOLT, 36 mAh	1	PCS
PN-76214	PN-76214	ELAPSED TIME METER	1	PCS
PN-D172948	PN-D172948	FUSE COVERS	3	PCS
RITTAL_2508010	RITTAL_2508010	RITTAL 2508.010	4	PCS
TCI_V1K45A00	395064	DV/DT OUTPUT FILTER , 45A, 600V, OPEN	1	PCS

Bill: **R1USE01851-0003-0003** Rockwell Automation

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EW Part No	IFS 7.5Part No	Description	QTY	UM
1321-3R55-C	1321-3R55-C A	Line Reactor, Top View, Max. Continuous Amps=82.5, 0.85mh Inductance	1	PCS
140G-H6C3-C70	PN-234919	MCCB 140G-H 65kA/480V FF 70A 3p	1	PCS
140G-H-EXT3-3P_BOT-3D	PN-D12947	TERMINAL, EXTENDED, FRONT, FRAME-H, 3P-BOT W/ PHASE BARRIERS AND COVER, QTY-3	1	PCS
140G-H-RVM21B	PN-232970	CB,ROTARY HANDLE MECHANISM, FOR H AND J FRAME 140G, 21",	1	PCS
140G-H-TC3H	PN-D13057	TERMINAL COVER, HIGH, FRAME-H, 3P, QTY-2	1	PCS
140G-H-TLC13	PN-D12979	CIRCUIT BREAKER, LUG, 3 LUGS , 14GA-1/0GA	1	PCS
1492-100X	1492-100X B	POWER BLOCK, 3 POLE, 600 VAC, 175 AMP, 2/0-#14 LINE, 2/0-#14 LOAD	1	PCS
1492-100Y	1492-100Y B	POWER BLOCK, 1 POLE, 600 VAC, 175 AMP, 2/0-#14 LINE, 2/0-#14 LOAD	1	PCS
1492-CJLJ6-10	1492-CJLJ6-10 A	CENTER JUMPER, PLUG-IN TYPE, FOR 1492-J4, 10 POLE.	2	PCS
1492-EBJ3	1492-EBJ3 A	END BARRIER, GRAY, FOR 1492-J3/J4/J6/J10.	5	PCS
1492-J4	1492-J4 A	TERMINAL BLOCK, BUL 1492-J4, GRAY, 600 VAC/DC, 35 AMP 22-10AWG UL/25 AMP 26-10AWG CSA.	23	PCS
1492-JKD4	1492-JKD4 A	1492-J IEC TERMINAL BLOCK, KNIFE DISCONNTEC FEED-THRU, 4MM(#26 AWG-#10 AWG), STD FEEDTHRU, GRAY	10	PCS
1492-PBC1	1492-PBC1 A	TERMINAL BLOCK GUARD FOR 3P, 150-175A	1	PCS
1492-PBC-4	1492-PBC-4		1	
1497-G-BASX-3-N	1497-G-BASX-3-N A	TRANSFORMER, CONTROL, 500VA, 240/480V PRI, 120V SEC W/PRI (CC) AND SEC (MIDGET) FUSE BLOCK	1	PCS
20-750-2262D-2R	PN-102578	POWERFLEX 750 ACCESSORY, 115V I/O MOD W/2 RELAY OUTPUTS (SCHEMATIC OF INPUTS)	1	PCS
20F11ND065JA0NNNNN	20F11ND065JA0NNNNN	POWERFLEX 753, FRAME 4, 65A, 40HP, IP20, 480VAC/648VDC IN, EMBEDDED I/O, CM JUMPER INSTALLED,WITH BRAKE IGBT	1	PCS
20-HIM-C6S	316561-A10	POWERFLEX 750 SERIES ACCESSORY, HIM KIT, LCD FULL NUMERIC, DOOR MOUNTED, IP66 (NEMA 4X/12),W/3M CABLE	1	PCS
25184-252-14	25184-252-14	TIME DELAY FUSE, 5A, 600V, CLASS CC	2	PCS
388392	388392	HOFFMAN GROUNDING BAR SYSTEM (PGS2K) PART NUMBER PGS2K	1	PCS
700-HB33A1	700-HB33A1 E	RELAY, 3PDT, (3) FORM C CONTACTS, 120VAC COIL	1	PCS
700-HN122	700-HN122 A	SOCKET W/CLIP, (HK RELAY), 8 BLADE.	3	PCS
700-HN153	700-HN153 B	SOCKET, GUARDED TERMINALS, (HB, HJ, HS RELAYS), 11 BLADE.	4	PCS
800T-A2A4	800T-A2A4	RESET RESET	1	PCS
800TC-PH16A	PN-127103	800T PILOT LIGHTS,115VAC TRANSFORMER LED,AMBER, FINGER GUARDS	3	PCS
800TC-PH16G	PN-126731	800T PILOT LIGHTS,115VAC TRANSFORMER LED,GREEN, FINGER GUARDS	1	PCS
800TC-PH16R	PN-127736	800T PILOT LIGHTS,115VAC TRANSFORMER LED,RED, FINGER GUARDS	1	PCS
800T-J2KC1	800T-J2KC1 T	800T SELECTOR SWITCHES 3 POS,MAINTAINED,SPCL CAM[OOX,OXO],STD OPERATOR	1	PCS
800T-N1	800T-N1 T	HOLE PLUG, CLOSING BUTTON, 800T, 30.5mm (GRAY)	1	PCS
HOFFMAN_ATEMNO	372114	TEMP. CONTROL SWITCH N.O., 30-140 F	1	PCS
2S2/0-31-42	PN-390804	ALUMINUM POWER LUG - (2) 2/0-14AWG, MECHANICAL	1	PCS
PN-144134	PN-144134	RITTAL ENCLOSURE WITH FAN AND EXHAUST	1	PCS
PN-71582	PN-71582	BATTERY, LITHIUM COIN CELL, CR1220, 3VOLT, 36 mAh	1	PCS
PN-76214	PN-76214	ELAPSED TIME METER	1	PCS
PN-D172948	PN-D172948	FUSE COVERS	3	PCS
RITTAL_2508010	RITTAL_2508010	RITTAL 2508.010	4	PCS
TCI_V1K55A00	395071	DV/DT OUTPUT FILTER , 55A, 600V, OPEN	1	PCS

Selection Guide

Allen-Bradley

Molded Case Circuit Breakers

Bulletin Numbers 140G, 140MG

LISTEN. THINK. SOLVE.®

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Allen-Bradley Molded Case Circuit Breakers

The Bulletin 140G family of Molded Case Circuit Breakers (MCCBs) offers a wide range of features include thermal/magnetic and electronic protection devices, high interrupting/breaking capacities and complete line of factory and field installed accessories. The Bulletin 140G MCCBs are ideal for use in line protection of control panels.

Molded case circuit breakers have the following features:

- 10…3000 A current range
- 3- and 4-pole devices
- Space-saving dimensions
- End cap/bolt-on terminals are standard
- Thermal/Magnetic protection: 15…800 A
- Electronic protection: 10…3000 A
- Approved for global application: UL, CSA, CCC, and IEC performance interrupting/breaking capacity
- Wide range of mounting options
- Extensive range of factory- or field-installed accessories

Standards Compliance and Certifications

Standards Compliance	Certifications
IEC 60947-2	CE Marked
UL489	CCC
CSA22.2, No. 5	CSA Certified
	UL Listed
	HACR Type

	MIX.BLW-3, MIX.BLW-4		MIX.BLW-1,-2 SBR.BLW-1,-2,-3
G-Frame	H-Frame	I-Frame	J-Frame
K-Frame	M-Frame	N-, NS-Frame	R-Frame

Product Overview

MIX.BLW-3, MIX.BLW-4

MIX.BLW-1,-2
SBR.BLW-1,-2,-3

Frame Size	G-Frame	H-Frame	I-Frame	J-Frame	K-Frame	M-Frame	N-Frame	NS-Frame	R-Frame
Rated Current I_n	125 A (160 A - IEC)	125 A (160 A - IEC)	225 A	250 A	400 A	800 A	1200 A	1200…1250 A	2000…3000 A
No. of Poles	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4	3, 4
Dimensions [mm (in.)]									
Height	130 (5.19)	130 (5.19)	150 (5.90)	160 (6.23)	205 (8.07)	268 (10.55)	268 (10.55)	268 (10.55)	382 (15.04)
Width, 3-Pole	76.2 (3)	90 (3.54)	105 (4.13)	105 (4.13)	139.5 (5.49)	210 (8.27)	210 (8.27)	210 (8.27)	428 (16.85)
Width, 4-Pole	101.2 (3.98)	120 (4.72)	140 (5.51)	140 (5.51)	186 (7.32)	280 (11.02)	280 (11.02)	280 (11.02)	554 (21.81)
Depth	70 (2.75)	82.5 (3.25)	70 (2.75)	82.5 (3.25)	103.5 (4.07)	103.5 (4.07)	125 (4.92)	125 (4.92)	231 (9.09)
Interrupting Rating [kA]									
240V	50 65 100	65 100 150 200 200	50 65	65 100 150 200	100 150 200 200	100 200 200	65 100 150	65 100 150	125
480V	25 35 65	25 35 65 100 150	25 35	25 35 65 100	35 65 100 150	50 65 100	50 65 100	50 65 100	125
600V	—	14 18 25 35 42	—	14 18 25 35	25 35 65 100	25 35 42	25 50 65	25 50 65	100
600Y/347V	10 14 25	—	10 10	—	—	—	—	—	—
Breaking Capacity I_{cu} [kA]									
220…240V	65 85 100	65 85 100 150 200	65 85	65 85 100 150	85 100 150 200	70 100 200	85 100 200	85 100 200	130
415V	36 50 70	36 50 70 120 150	36 50	36 50 70 120	50 70 120 150	36 70 100	50 70 120	50 70 120	80
440V	30 36 50	36 50 65 100 150	36 40	36 50 65 100	40 65 100 180	35 50 65	50 65 100	50 65 100	80
690V	6 8 10	10 12 15 18 20	36 50	10 12 15 18	25 40 70 80	20 25 30	30 42 50	30 42 50	40
250V DC	36 50 10	36 50 70 85 100	36 50	36 50 70 85	—	—	—	—	—
500V DC	36 50 70	36 50 70 85 100	36 50	36 50 70 85	36 50 70 100	—	—	—	—
750V DC	—	—	—	—	25 36 70 70	16 36 50	—	—	—
Protection Type:									
Thermal Magnetic	✓	✓	✓	✓	✓	✓	—	—	—
Electronic (LSI,LSIG)	—	✓	—	✓	✓	✓	✓	✓	✓
Molded Case Switch	✓	✓	✓	✓	✓	✓	✓	—	✓
MCP	✓	✓	✓	✓	✓	✓	✓	—	—
MPCB	—	✓	—	✓	—	—	—	—	—
Internal Accessories									
Auxiliary Contact	✓	✓	✓	✓	✓	✓	✓	✓	✓
Alarm Contact	✓	✓	✓	✓	✓	✓	✓	✓	—
AX/AL Combo	✓	✓	✓	✓	✓	✓	✓	✓	—
Trip Unit Contact	—	✓		✓	—	—	✓	✓	✓
Shunt Trip	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shunt Close	—	—	—	—	—	—	—	✓	✓
UV Relay	✓	✓	✓	✓	✓	✓	✓	✓	✓
Field Installable	✓	✓	✓	✓	✓	✓	✓	✓	✓

		MIX.BLW-3, MIX.BLW-4		MIX.BLW-1,-2 SBR.BLW-1,-2,-3					
Frame Size	**G-Frame**	**H-Frame**	**I-Frame**	**J-Frame**	**K-Frame**	**M-Frame**	**N-Frame**	**NS-Frame**	**R-Frame**
External Accessories									
End Cap (Bolt-on) Terminals	standard	standard	standard	standard	standard	standard	standard	standard	
Terminal Lugs	✓	✓	✓	✓	✓	✓	✓	✓	✓
Multi-cable Terminal Lugs	✓	✓	✓	✓	✓	—	—	—	—
Extended Terminal	✓	✓	✓	✓	✓	✓	✓	✓	—
Spreader Terminal	✓	✓	✓	✓	✓	✓	✓	✓	✓
Rear Terminal	—	—	—	—	—	—	✓	✓	✓
25 mm Phase barriers	standard	standard	standard	standard	standard	—	—	—	—
Extended Phase barriers	✓	✓	✓	✓	✓	✓	✓	✓	✓
Back Plates	standard	standard	standard	standard	standard	standard	—	—	—
DIN Mounting	✓	✓	✓	✓	—	—	—	—	—
Padlock	✓	✓	✓	✓	✓	✓	✓	✓	✓
Terminal Cover	✓	✓	✓	✓	✓	✓	✓	✓	—
Direct Rotary	✓	✓	✓	✓	✓	✓	✓	—	—
Variable Depth (Door)	✓	✓	✓	✓	✓	✓	✓	—	—
Internal NFPA 79	✓	✓	✓	✓	✓	✓	✓	—	—
Flange Operator	✓	✓	✓	✓	✓	✓	✓	—	—
Flange Cable	✓	✓	✓	✓	✓	✓	✓	—	—
Motor Operator	✓	✓	✓	✓	✓	✓	—	✓	✓
Residual Current	✓	✓	✓	✓	✓	—	—	—	—
Neutral Current	—	—	—	—	✓	✓	✓	✓	✓
Field Installable	✓	✓	✓	✓	✓	✓	✓	✓	✓

125 A, H-Frame Molded Case Circuit Breakers

Catalog Number Explanation

Complete Circuit Breaker Assemblies — 125 A, H-Frame

Examples given in this section are not intended to be used for product selection. Use ProposalWorks to configure the molded case circuit breaker. These configurations are for selection of all factory-installed options for shunt trips, undervoltage release units, auxiliary contacts, trip units, and alarm contacts. Use the codes from Table g to add on to the molded case circuit breaker cat. no. selected on the following pages to form a complete cat. no. with factory-installed options. ProposalWorks is available from http://www.rockwellautomation.com/global/e-tools/overview.page. Note: Terminal lugs are not supplied and can be ordered separately. See page 85 for available lugs.

140G	–	H	3	C	3	–	C60	–	SD	–	AA
a		b	c	d	e		f		g		g

a	
Bulletin Number	
Code	Description
140G	Global Molded Case Circuit Breaker

b	
Frame/Rating	
Code	Description
H	125 A

c	
Interrupting Rating/Breaking Capacity (based on I_c at 480V)	
Code	Description
2	25 kA
3	35 kA
6	65 kA
0	100 kA
15	150 kA
T	Trip unit

d	
Protection Type	
Code	Description
C	Fixed thermal/fixed magnetic
F	Adjust thermal/ adjust magnetic
H	Electronic LSI- long, short, instant
I	Electronic LSIG -Long, short instant, and ground fault
X	Breaker frame
S	Molded case switch (isolator)

e	
No. of Poles	
Code	Description
3	3 poles
4	4 poles

f	
Current Range	
Code	Description
C	e.g., C30 = 30 A
D	e.g., D16 = 160 A
Blank	Frame only

g			
Factory-Installed Internal Options[1]			
Shunt Trip and Undervoltage Release Units		Auxiliary and Alarm Contacts, Trip Units	
Code	Description	Code	Description
SJ	Shunt Trip, 24…30V AC/DC	KA	1 Aux. Contact, 250V
SK	Shunt Trip, 48…60V AC/DC	AA	1 Aux., 1 Alarm Contact, 250V
SD	Shunt Trip, 110…127V AC; 110…125V DC	BA	2 Aux., 1 Alarm Contact, 250V
SA	Shunt Trip, 220…240V AC; 220…250V DC	DA	1 Trip Unit Alarm Contact, 250V
SB	Shunt Trip, 380…440V AC	FB	2 Aux. Contacts, 400V
SC	Shunt Trip, 480…525V AC	AB	1 Aux., 1 Alarm Contact, 400V
UJ	Undervoltage Release, 24…30V AC/DC	KJ	1 Aux. Contact, 24V
UR	Undervoltage Release, 48V AC/DC	AJ	1 Aux., 1 Alarm Contact, 24V
UD	Undervoltage Release, 110…127V AC; 110… 125V DC	DJ	1 Trip Unit Alarm Contact, 24V
UA	Undervoltage Release, 220…240V AC; 220… 250V DC		
UB	Undervoltage Release, 380…440V AC		
UC	Undervoltage Release, 480…525V AC		
No Digit	No Selection		

(1) Select up to two internal options: 1 for left side mounting (shunt trip or undervoltage release), 1 for right (auxiliary or alarm contact).

Breaker Frames and Trip Units

Frame Trip Unit MCCB

Table 9 - Breaker Frames, 125 A Rated Current

Interrupting Rating (50/60 Hz), UL 489/ CSA 22.2, No. 5 [kA](1)			Breaking Capacity (50/60 Hz), IEC 60947-2								Breaking Capacity (DC), IEC 60947-2 (1)				Cat. No.	
240V	480V	600V	220V(2)		415V		440V(2)		690V		250V DC (2- pole in series)		500V DC (3 Poles in series)			
			I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	3 Poles	4 Poles
65	25	14	65	100	36	100	36	100	10	100	36	100	36	100	140G-H2X3	140G-H2X4
100	35	18	85	100	50	100	50	100	12	100	50	100	50	100	140G-H3X3	140G-H3X4
150	65	25	100	100	70	100	65	100	15	100	70	100	70	100	140G-H6X3	140G-H6X4
200	100	35	150	100	120	100	100	100	18	75	85	100	85	100	140G-H0X3	140G-H0X4
200	150	42	200	100	150	100	150	100	20	75	100	100	100	100	140G-H15X3	140G-H15X4

(1) DC rating is applicable for thermal-magnetic trip unit only.
(2) These ratings have not been tested for the CCC listing.

Table 10 - Trip Units, Thermal-Magnetic

Rated Current I_n [A]	Thermal Trip [A] I_r	Magnetic Trip [A] I_m	Protection Type	Cat. No.	
				3 Poles	4 Poles
50	50	500	C (Fixed)	140G-HTC3-C50	140G-HTC4-C50
60	60	600	C (Fixed)	140G-HTC3-C60	140G-HTC4-C60
63	63	630	C (Fixed)	140G-HTC3-C63	140G-HTC4-C63
70	70	700	C (Fixed)	140G-HTC3-C70	140G-HTC4-C70
80	56...80	400…800	F (Adjustable)	140G-HTF3-C80	140G-HTF4-C80
90	63…90	450…900	F (Adjustable)	140G-HTF3-C90	140G-HTF4-C90
100	70…100	500…1000	F (Adjustable)	140G-HTF3-D10	140G-HTF4-D10
110	77…110	550…1100	F (Adjustable)	140G-HTF3-D11	140G-HTF4-D11
125	87…125	625…1250	F (Adjustable)	140G-HTF3-D12	140G-HTF4-D12

Table 11 - Trip Units, Electronic LSI (Long, Short, Instantaneous)

Rated Current I_n [A]	Protection Type					Cat. No.	
	L		S		I	3 Poles	4 Poles
	I_1=0.4…1 x I_n	t_1=sec.	I_2=1…10 x I_n	t_2=sec.	I_3=1…10 x I_n		
60	24…60	3, 12, 36, 60	60…600	0.05, 0.1, 0.2, 0.4	60…600	140G-HTH3-C60	140G-HTH4-C60
100	40…100	3, 12, 36, 60	100…1000	0.05, 0.1, 0.2, 0.4	100…1000	140G-HTH3-D10	140G-HTH4-D10
125	50…125	3, 12, 36, 60	125…1250	0.05, 0.1, 0.2, 0.4	125…1250	140G-HTH3-D12	140G-HTH4-D12

Table 12 - Trip Units, Electronic LSIG (Long, Short, Instantaneous, Ground Fault)

Rated Current I_n [A]	Protection Type							Cat. No.	
	L		S		I	G		3 Poles	4 Poles
	I_1=0.4…1 x I_n	t_1=sec.	I_2=1…10 x I_n	t_2=sec.	I_3=1…10 x I_n	I_4=0.2…1 x I_n	t_4=sec.		
60	24…60	3, 12, 36, 60	60…600	0.05, 0.1, 0.2, 0.4	60…600	12…60	0.1, 0.2, 0.4, 0.8	140G-HTI3-C60	140G-HTI4-C60
100	40…100	3, 12, 36, 60	100…1000	0.05, 0.1, 0.2, 0.4	100…1000	20…100	0.1, 0.2, 0.4, 0.8	140G-HTI3-D10	140G-HTI4-D10
125	50…125	3, 12, 36, 60	125…1250	0.05, 0.1, 0.2, 0.4	125…1250	25…125	0.1, 0.2, 0.4, 0.8	140G-HTI3-D12	140G-HTI4-D12

Assembled Molded Case Circuit Breakers — 125 A, H-Frame

Table 13 - Interrupting Rating/Breaking Capacity — Thermal-Magnetic Circuit Breakers

Interrupting Rating (50/60 Hz), UL 489/ CSA 22.2, No. 5 [kA]			Breaking Capacity (50/60 Hz), IEC 60947-2								Breaking Capacity (DC), IEC 60947-2				Interrupting Code[1]
240V	480V	600V	220V[2]		415V		440V[2]		690V		250V DC (2 Poles in series)		500V DC (3 Poles in series)		
			I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	
65	25	14	65	100	36	100	36	100	10	100	36	100	36	100	H2
100	35	18	85	100	50	100	50	100	12	100	50	100	50	100	H3
150	65	25	100	100	70	100	65	100	15	100	70	100	70	100	H6
200	100	35	150	100	120	100	100	100	18	75	85	100	85	100	H0
200	150	42	200	100	150	100	150	100	20	75	100	100	100	100	H15

(1) See Table 14 and Table 15 for Cat. No. selection.

(2) These ratings have not been tested for the CCC listing.

Table 14 - Thermal-Magnetic, Fixed and Adjustable

Rated Current I_n [A]	Thermal Trip [A] I_r	Magnetic Trip [A] I_m	Interrupting Code H2		Interrupting Code H3		Interrupting Code H6	
			Cat. No.		Cat. No.		Cat. No.	Cat. No.
			3 Poles	4 Poles	3 Poles	4 Poles	3 Poles	4 Poles
15	15	400	140G-H2C3-C15	140G-H2C4-C15	140G-H3C3-C15	140G-H3C4-C15	140G-H6C3-C15	140G-H6C4-C15
16	16	400	140G-H2C3-C16	140G-H2C4-C16	140G-H3C3-C16	140G-H3C4-C16	140G-H6C3-C16	140G-H6C4-C16
20	20	400	140G-H2C3-C20	140G-H2C4-C20	140G-H3C3-C20	140G-H3C4-C20	140G-H6C3-C20	140G-H6C4-C20
25	25	400	140G-H2C3-C25	140G-H2C4-C25	140G-H3C3-C25	140G-H3C4-C25	140G-H6C3-C25	140G-H6C4-C25
30	30	400	140G-H2C3-C30	140G-H2C4-C30	140G-H3C3-C30	140G-H3C4-C30	140G-H6C3-C30	140G-H6C4-C30
32	32	400	140G-H2C3-C32	140G-H2C4-C32	140G-H3C3-C32	140G-H3C4-C32	140G-H6C3-C32	140G-H6C4-C32
35	35	400	140G-H2C3-C35	140G-H2C4-C35	140G-H3C3-C35	140G-H3C4-C35	140G-H6C3-C35	140G-H6C4-C35
40	40	400	140G-H2C3-C40	140G-H2C4-C40	140G-H3C3-C40	140G-H3C4-C40	140G-H6C3-C40	140G-H6C4-C40
50	50	500	140G-H2C3-C50	140G-H2C4-C50	140G-H3C3-C50	140G-H3C4-C50	140G-H6C3-C50	140G-H6C4-C50
60	60	600	140G-H2C3-C60	140G-H2C4-C60	140G-H3C3- MIX.BLW-3 3C4-C60		140G-H6C3-C60	140G-H6C4-C60
63	63	630	140G-H2C3-C63	140G-H2C4-C63	140G-H3C3-C63	140G-H3C4-C63	140G-H6C3-C63	140G-H6C4-C63
70	70	700	140G-H2C3-C70	140G-H2C4-C70	140G-H3C3- MIX.BLW-4 3C4-C70		140G-H6C3-C70	140G-H6C4-C70
80	56...80	400…800	140G-H2F3-C80	140G-H2F4-C80	140G-H3F3-C80	140G-H3F4-C80	140G-H6F3-C80	140G-H6F4-C80
90	63…90	450…900	140G-H2F3-C90	140G-H2F4-C90	140G-H3F3-C90	140G-H3F4-C90	140G-H6F3-C90	140G-H6F4-C90
100	70…100	500…1000	140G-H2F3-D10	140G-H2F4-D10	140G-H3F3-D10	140G-H3F4-D10	140G-H6F3-D10	140G-H6F4-D10
110	77…110	550…1100	140G-H2F3-D11	140G-H2F4-D11	140G-H3F3-D11	140G-H3F4-D11	140G-H6F3-D11	140G-H6F4-D11
125	87…125	625…1250	140G-H2F3-D12	140G-H2F4-D12	140G-H3F3-D12	140G-H3F4-D12	140G-H6F3-D12	140G-H6F4-D12
160[1]	112…160	800…1600	140G-H2F3-D16	140G-H2F4-D16	140G-H3F3-D16	140G-H3F4-D16	140G-H6F3-D16	140G-H6F4-D16

(1) IEC only.

250 A, J-Frame Molded Case Circuit Breakers

Catalog Number Explanation

Complete Circuit Breaker Assemblies — 250 A, J-Frame

Examples given in this section are not intended to be used for product selection. Use ProposalWorks to configure the molded case circuit breaker. These configurations are for selection of all factory-installed options for shunt trips, undervoltage release units, auxiliary contacts, trip units, and alarm contacts. Use the codes from Table g to add on to the molded case circuit breaker cat. no. selected on the following pages to form a complete cat. no. with factory-installed options. ProposalWorks is available from http://www.rockwellautomation.com/global/e-tools/overview.page. Note: Terminal lugs are not supplied and can be ordered separately. See page 85 for available lugs.

140G	–	J	3	C	3	–	C60	–	SD	–	AA
a		b	c	d	e		f		g		g

a	
Bulletin Number	
Code	Description
140G	Global Molded Case Circuit Breaker

b	
Frame/Rating	
Code	Description
J	250 A

c	
Interrupting Rating/Breaking Capacity (based on I_c at 480V)	
Code	Description
2	25 kA
3	35 kA
6	65 kA
0	100 kA
T	Trip unit

d	
Protection Type	
Code	Description
C	Fixed thermal/ fixed magnetic
E	Adjust thermal/ fixed magnetic
F	Adjust thermal/ adjust magnetic
H	Electronic LSI-long, short, instant
I	Electronic LSIG -long, short, instant, and ground fault
X	Breaker frame
S	Molded case switch (isolator)

e	
No. of Poles	
Code	Description
3	3 poles
4	4 poles

f	
Current Range	
Code	Description
C	e.g., C30 = 30 A
D	e.g., D16 = 160 A
Blank	Frame only

g			
Factory-Installed Internal Options(1)			
Shunt Trip and Undervoltage Release Units		Auxiliary and Alarm Contacts, Trip Units	
Code	Description	Code	Description
SJ	Shunt Trip, 24…30V AC/DC	KA	1 Aux. Contact, 250V
SK	Shunt Trip, 48…60V AC/DC	AA	1 Aux., 1 Alarm Contact, 250V
SD	Shunt Trip, 110…127V AC; 110…125V DC	BA	2 Aux., 1 Alarm Contact, 250V
SA	Shunt Trip, 220…240V AC; 220…250V DC	DA	1 Trip Unit Alarm Contact, 250V
SB	Shunt Trip, 380…440V AC	FB	2 Aux. Contacts, 400V
SC	Shunt Trip, 480…525V AC	AB	1 Aux., 1 Alarm Contact, 400V
UJ	Undervoltage Release, 24…30V AC/DC	KJ	1 Aux. Contact, 24V
UR	Undervoltage Release, 48V AC/DC	AJ	1 Aux., 1 Alarm Contact, 24V
UD	Undervoltage Release, 110…127V AC; 110…125V DC	DJ	1 Trip Unit Alarm Contact, 24V
UA	Undervoltage Release, 220…240V AC; 220…250V DC		
UB	Undervoltage Release, 380…440V AC		
UC	Undervoltage Release, 480…525V AC		
No Digit	No Selection		

(1) Select up to two internal options: 1 for left side mounting (shunt trip or undervoltage release), 1 for right (auxiliary or alarm contact).

Breaker Frames and Trip Units

Frame + Trip Unit = MCCB

Table 23 - Breaker Frames, 250 A Rated Current

Interrupting Rating (50/60 Hz), UL 489/CSA 22.2, No. 5 [kA]			Breaking Capacity (50/60 Hz), IEC 60947-2								Breaking Capacity (DC), IEC 60947-2(1)				Cat. No.	
240V	480V	600V	220V(2)		415V		440V(2)		690V		250V DC (2 Poles in series)		500V DC (3 Poles in series)			
			I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	3 Poles	4 Poles
65	25	14	65	100	36	100	36	100	10	100	36	100	36	100	140G-J2X3	140G-J2X4
100	35	18	85	100	50	100	50	100	12	100	50	100	50	100	140G-J3X3	140G-J3X4
150	65	25	100	100	70	100	65	100	15	100	70	100	70	100	140G-J6X3	140G-J6X4
200	100	35	150	100	120	100	100	100	20	100	85	100	85	100	140G-J0X3	140G-J0X4

(1) DC rating is applicable for thermal-magnetic trip unit only.
(2) These ratings have not been tested for the CCC listing.

Table 24 - Trip Units, Thermal-Magnetic

Rated Current I_n [A]	Thermal Trip [A] I_r	Magnetic Trip [A] I_m	Protection Type	Cat. No.	
				3 Poles	4 Poles
25	25	400	C (Fixed)	140G-JTC3-C25	140G-JTC4-C25
30	30	400	C (Fixed)	140G-JTC3-C30	140G-JTC4-C30
32	32	400	C (Fixed)	140G-JTC3-C32	140G-JTC4-C32
35	35	400	C (Fixed)	140G-JTC3-C35	140G-JTC4-C35
40	40	400	C (Fixed)	140G-JTC3-C40	140G-JTC4-C40
50	50	500	C (Fixed)	140G-JTC3-C50	140G-JTC4-C50
60	60	600	C (Fixed)	140G-JTC3-C60	140G-JTC4-C60
63	63	630	C (Fixed)	140G-JTC3-C63	140G-JTC4-C63
70	70	700	C (Fixed)	140G-JTC3-C70	140G-JTC4-C70
80	56…80	400…800	F (Adjustable)	140G-JTF3-C80	140G-JTF4-C80
90	63…90	450…900	F (Adjustable)	140G-JTF3-C90	140G-JTF4-C90
100	70…100	500…1000	F (Adjustable)	140G-JTF3-D10	140G-JTF4-D10
110	77…110	550…1100	F (Adjustable)	140G-JTF3-D11	140G-JTF4-D11
125	87.5…125	625…1250	F (Adjustable)	140G-JTF3-D12	140G-JTF4-D12
150	105…150	750…1500	F (Adjustable)	140G-JTF3-D15	140G-JTF4-D15
160	112…160	800…1600	F (Adjustable)	140G-JTF3-D16	140G-JTF4-D16
175	122.5…175	875…1750	F (Adjustable)	140G-JTF3-D17	140G-JTF4-D17
200	140…200	1000…2000	F (Adjustable)	140G-JTF3-D20	140G-JTF4-D20
225	157.5…225	1125…2250	F (Adjustable)	140G-JTF3-D22	140G-JTF4-D22
250	175…250	1250…2500	F (Adjustable)	140G-JTF3-D25	140G-JTF4-D25

Table 25 - Trip Units, Electronic LSI (Long, Short, Instantaneous)

Rated Current I_n [A]	Protection Type					Cat. No.	Cat. No.
	L		S		I	3 Poles	4 Poles
	I_1=0.4…1 x I_n	t_1=sec.	I_2=1…10 x I_n	t_2=sec.	I_3=1…10 x I_n		
40	16…40	3, 12, 36, 60	40…400	0.05, 0.1, 0.2, 0.4	40…400	140G-JTH3-C40	140G-JTH4-C40
60	24…60	3, 12, 36, 60	60…600	0.05, 0.1, 0.2, 0.4	60…600	140G-JTH3-C60	140G-JTH4-C60
100	40…100	3, 12, 36, 60	100…1000	0.05, 0.1, 0.2, 0.4	100…1000	140G-JTH3-D10	140G-JTH4-D10
150	60…150	3, 12, 36, 60	150…1500	0.05, 0.1, 0.2, 0.4	150…1500	140G-JTH3-D15	140G-JTH4-D15
250	100…250	3, 12, 36, 60	250…2500	0.05, 0.1, 0.2, 0.4	250…2500	140G-JTH3-D25	140G-JTH4-D25

Table 26 - Trip Units, Electronic LSIG (Long, Short, Instantaneous, Ground Fault)

Rated Current I_n [A]	Protection Type							Cat. No.	Cat. No.
	L		S		I	G		3 Poles	4 Poles
	I_1=0.4…1 x I_n	t_1=sec.	I_2=1…10 x I_n	t_2=sec.	I_3=1…10 x I_n	I_4=0.2…1 x I_n	t_4=sec.		
40	16…40	3, 12, 36, 60	40…400	0.05, 0.1, 0.2, 0.4	40…400	8…40	0.1, 0.2, 0.4, 0.8	140G-JTI3-C40	140G-JTI4-C40
60	24…60	3, 12, 36, 60	60…600	0.05, 0.1, 0.2, 0.4	60…600	12…60	0.1, 0.2, 0.4, 0.8	140G-JTI3-C60	140G-JTI4-C60
100	40…100	3, 12, 36, 60	100…1000	0.05, 0.1, 0.2, 0.4	100…1000	20…100	0.1, 0.2, 0.4, 0.8	140G-JTI3-D10	140G-JTI4-D10
150	60…150	3, 12, 36, 60	150…1500	0.05, 0.1, 0.2, 0.4	150…1500	30…150	0.1, 0.2, 0.4, 0.8	140G-JTI3-D15	140G-JTI4-D15
250	100…250	3, 12, 36, 60	250…2500	0.05, 0.1, 0.2, 0.4	250…2500	50…250	0.1, 0.2, 0.4, 0.8	140G-JTI3-D25	140G-JTI4-D25

Assembled Molded Case Circuit Breakers — 250 A J-Frame

Table 27 - Interrupting Rating/Breaking Capacity — Thermal-Magnetic Circuit Breakers

Interrupting Rating (50/60 Hz), UL 489/CSA 22.2, No. 5 [kA]			Breaking Capacity (50/60 Hz), IEC 60947-2								Breaking Capacity (DC), IEC 60947-2 (1)				Interrupting Code(2)
240V	480V	600V	220V(3)		415V		440V(3)		690V		250V DC (2- pole in series)		500V DC (3 Poles in series)		
			I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	
65	25	14	65	100	36	100	36	100	10	100	36	100	36	100	J2
100	35	18	85	100	50	100	50	100	12	100	50	100	50	100	J3
150	65	25	100	100	70	100	65	100	15	100	70	100	70	100	J6
200	100	35	150	100	120	100	100	100	20	100	85	100	85	100	J0

(1) DC rating is applicable for thermal-magnetic trip unit only.

(2) See Table 28 for Cat. No. selection.

(3) These ratings have not been tested for the CCC listing.

Table 28 - Thermal-Magnetic, Fixed and Adjustable

Rated Current I_n [A]	Thermal Trip [A] I_r	Magnetic Trip [A] I_m	Interrupting Code J2		Interrupting Code J3	
			Cat. No.		Cat. No.	
			3 Poles	4 Poles	3 Poles	4 Poles
25	25	400	140G-J2C3-C25	140G-J2C4-C25	140G-J3C3-C25	140G-J3C4-C25
30	30	400	140G-J2C3-C30	140G-J2C4-C30	140G-J3C3-C30	140G-J3C4-C30
32	32	400	140G-J2C3-C32	140G-J2C4-C32	140G-J3C3-C32	140G-J3C4-C32
35	35	400	140G-J2C3-C35	140G-J2C4-C35	140G-J3C3-C35	140G-J3C4-C35
40	40	400	140G-J2C3-C40	140G-J2C4-C40	140G-J3C3-C40	140G-J3C4-C40
50	50	500	140G-J2C3-C50	140G-J2C4-C50	140G-J3C3-C50	140G-J3C4-C50
60	60	600	140G-J2C3-C60	140G-J2C4-C60	140G-J3C3-C60	140G-J3C4-C60
63	63	630	140G-J2C3-C63	140G-J2C4-C63	140G-J3C3-C63	140G-J3C4-C63
70	70	700	140G-J2C3-C70	140G-J2C4-C70	140G-J3C3-C70	140G-J3C4-C70
80	56…80	400…800	140G-J2F3-C80	140G-J2F4-C80	140G-J3F3-C80	140G-J3F4-C80
90	63…90	450…900	140G-J2F3-C90	140G-J2F4-C90	140G-J3F3-C90	140G-J3F4-C90
100	70…100	500…1000	140G-J2F3-D10	140G-J2F4-D10	140G-J3F3-D10	140G-J3F4-D10
110	77…110	550…1100	140G-J2F3-D11	140G-J2F4-D11	140G-J3F3-D11	140G-J3F4-D11
125	87.5…125	625…1250	140G-J2F3-D12	140G-J2F4-D12	140G-J3F3-D12	140G-J3F4-D12
150	105…150	750…1500	140G-J2F3-D15	140G-J2F4-D15	140G-J3F3-D15	140G-J3F4-D15
160	112…160	800…1600	140G-J2F3-D16	140G-J2F4-D16	140G-J3F3-D16	140G-J3F4-D16
175	122.5…175	875…1750	140G-J2F3-D17	140G-J2F4-D17	140G-J3F3-D17	140G-J3F4-D17
200	140…200	1000…2000	140G-J2F3-D20	140G-J2F4-D20	140G-J3F3-D20	140G-J3F4-D20
225	157.5…225	1125…2250	140G-J2F3-D22	140G-J2F4-D22	140G-J3F3-D22	140G-J3F4-D22
250	175…250	1250…2500	140G-J2F3-D25	140G-J2F4-D25	140G-J3F3-D25	140G-J3F4-D25

Rated Current I_n [A]	Thermal Trip [A] I_r	Magnetic Trip [A] I_m	Interrupting Code J6		Interrupting Code J0	
			Cat. No.		Cat. No.	
			3 Poles	4 Poles	3 Poles	4 Poles
25	25	400	140G-J6C3-C25	140G-J6C4-C25	140G-J0C3-C25	140G-J0C4-C25
30	30	400	140G-J6C3-C30	140G-J6C4-C30	140G-J0C3-C30	140G-J0C4-C30
32	32	400	140G-J6C3-C32	140G-J6C4-C32	140G-J0C3-C32	140G-J0C4-C32
35	35	400	140G-J6C3-C35	140G-J6C4-C35	140G-J0C3-C35	140G-J0C4-C35
40	40	400	140G-J6C3-C40	140G-J6C4-C40	140G-J0C3-C40	140G-J0C4-C40
50	50	500	140G-J6C3-C50	140G-J6C4-C50	140G-J0C3-C50	140G-J0C4-C50
60	60	600	140G-J6C3-C60	140G-J6C4-C60	140G-J0C3-C60	140G-J0C4-C60
63	63	630	140G-J6C3-C63	140G-J6C4-C63	140G-J0C3-C63	140G-J0C4-C63
70	70	700	140G-J6C3-C70	140G-J6C4-C70	140G-J0C3-C70	140G-J0C4-C70
80	56…80	400…800	140G-J6F3-C80	140G-J6F4-C80	140G-J0F3-C80	140G-J0F4-C80
90	63…90	450…900	140G-J6F3-C90	140G-J6F4-C90	140G-J0F3-C90	140G-J0F4-C90
100	70…100	500…	140G-J6F3-D10	140G-J6F4-D10	140G-J0F3-D10	140G-J0F4-D10
110	77…110	550…1100	140G-J6F3-D11	140G-J6F4-D11	140G-J0F3-D11	140G-J0F4-D11
125	87.5…125	625…1250	140G-J6F3-D12	140G-J6F4-D12	140G-J0F3-D12	140G-J0F4-D12
150	105…150	750…1500	140G-J6F3-D15	140G-J6F4-D15	140G-J0F3-D15	140G-J0F4-D15
160	112…160	800…1600	140G-J6F3-D16	140G-J6F4-D16	140G-J0F3-D16	140G-J0F4-D16
175	122.5…175	875…1750	140G-J6F3-D17	140G-J6F4-D17	140G-J0F3-D17	140G-J0F4-D17
200	140…200	1000…2000	140G-J6F3-D20	140G-J6F4-D20	140G-J0F3-D20	140G-J0F4-D20
225	157.5…225	1125…2250	140G-J6F3-D22	140G-J6F4-D22	140G-J0F3-D22	140G-J0F4-D22
250	175…250	1250…2500	140G-J6F3-D25	140G-J6F4-D25	140G-J0F3-D25	140G-J0F4-D25

MIX.BLW-1,-2
SBR.BLW-1,-2,-3

Table 29 - Interrupting Rating/Breaking Capacity — Electronic Circuit Breakers

Interrupting Rating (50/60 Hz), UL 489/ CSA C22.2, No. 5 [kA]			Breaking Capacity (50/60 Hz), IEC 60947-2								Interrupting Code(1)
240V	480V	600V	220V(2)		415V		440V(2)		690V		
			I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	I_{cu} [kA]	I_{cs} [%I_{cu}]	
65	25	14	65	100	36	100	36	100	10	100	J2
100	35	18	85	100	50	100	50	100	12	100	J3
150	65	25	100	100	70	100	65	100	15	100	J6
200	100	35	150	100	120	100	100	100	20	100	J0

(1) See Table 30 through Table 32 for Cat. No. selection.

(2) These ratings have not been tested for the CCC listing.

Table 30 - Electronic LSI (Long, Short, Instantaneous)

Rated Current I_n [A]	Protection Type					Interrupting Code J2		Interrupting Code J3	
	L		S		I	Cat. No.		Cat. No.	
	I_1=0.4…1 x I_n	t_1=sec.	I_2=1…10 x I_n	t_2=sec.	I_3=1…10 x I_n	3 Poles	4 Poles	3 Poles	4 Poles
40	16…40	3, 12, 36, 60	40…400	0.05, 0.1, 0.2, 0.4	40…400	140G-J2H3-C40	140G-J2H4-C40	140G-J3H3-C40	140G-J3H4-C40
60	24…60	3, 12, 36, 60	60…600	0.05, 0.1, 0.2, 0.4	60…600	140G-J2H3-C60	140G-J2H4-C60	140G-J3H3-C60	140G-J3H4-C60
100	40…100	3, 12, 36, 60	100…1000	0.05, 0.1, 0.2, 0.4	100…1000	140G-J2H3-D10	140G-J2H4-D10	140G-J3H3-D10	140G-J3H4-D10
150	60…150	3, 12, 36, 60	150…1500	0.05, 0.1, 0.2, 0.4	150…1500	140G-J2H3-D15	140G-J2H4-D15	140G-J3H3-D15	140G-J3H4-D15
250	100…250	3, 12, 36, 60	250…2500	0.05, 0.1, 0.2, 0.4	250…2500	140G-J2H3-D25	140G-J2H4-D25	140G-J3H3-D25	140G-J3H4-D25

Rated Current I_n [A]	Protection Type					Interrupting Code J6		Interrupting Code J0	
	L		S		I	Cat. No.		Cat. No.	
	I_1=0.4…1 x I_n	t_1=sec.	I_2=1…10 x I_n	t_2=sec.	I_3=1…10 x I_n	3 Poles	4 Poles	3 Poles	4 Poles
40	16…40	3, 12, 36, 60	40…400	0.05, 0.1, 0.2, 0.4	40…400	140G-J6H3-C40	140G-J6H4-C40	140G-J0H3-C40	140G-J0H4-C40
60	24…60	3, 12, 36, 60	60…600	0.05, 0.1, 0.2, 0.4	60…600	140G-J6H3-C60	140G-J6H4-C60	140G-J0H3-C60	140G-J0H4-C60
100	40…100	3, 12, 36, 60	100…1000	0.05, 0.1, 0.2, 0.4	100…1000	140G-J6H3-D10	140G-J6H4-D10	140G-J0H3-D10	140G-J0H4-D10
150	60…150	3, 12, 36, 60	150…1500	0.05, 0.1, 0.2, 0.4	150…1500	140G-J6H3-D15	140G-J6H4-D15	140G-J0H3-D15	140G-J0H4-D15
250	100…250	3, 12, 36, 60	250…2500	0.05, 0.1, 0.2, 0.4	250…2500	140G-J6H3-D25	140G-J6H4-D25	140G-J0H3-D25	140G-J0H4-D25

Table 31 - Electronic LSIG (Long, Short, Instantaneous, Ground Fault)

Rated Current I_n [A]	Protection Type							Interrupting Code J2		Interrupting Code J3	
	L		S		I	G		Cat. No.		Cat. No.	
	I_1=0.4… 1 x I_n	t_1=sec.	I_2=1… 10 x I_n	t_2=sec.	I_3=1… 10 x I_n	I_4=0.2… 1 x I_n	t_4=sec.	3 Poles	4 Poles	3 Poles	4 Poles
40	16…40	3, 12, 36, 60	40…400	0.05, 0.1, 0.2, 0.4	40…400	8…40	0.1, 0.2, 0.4, 0.8	140G-J2I3-C40	140G-J2I4-C40	140G-J3I3-C40	140G-J3I4-C40
60	24…60	3, 12, 36, 60	60…600	0.05, 0.1, 0.2, 0.4	60…600	12…60	0.1, 0.2, 0.4, 0.8	140G-J2I3-C60	140G-J2I4-C60	140G-J3I3-C60	140G-J3I4-C60
100	40…100	3, 12, 36, 60	100…1000	0.05, 0.1, 0.2, 0.4	100…1000	20…100	0.1, 0.2, 0.4, 0.8	140G-J2I3-D10	140G-J2I4-D10	140G-J3I3-D10	140G-J3I4-D10
150	60…150	3, 12, 36, 60	150…1500	0.05, 0.1, 0.2, 0.4	150…1500	30…150	0.1, 0.2, 0.4, 0.8	140G-J2I3-D15	140G-J2I4-D15	140G-J3I3-D15	140G-J3I4-D15
250	100…250	3, 12, 36, 60	250…2500	0.05, 0.1, 0.2, 0.4	250…2500	50…250	0.1, 0.2, 0.4, 0.8	140G-J2I3-D25	140G-J2I4-D25	140G-J3I3-D25	140G-J3I4-D25

Mechanical Accessories

Terminal Lugs

You can use mechanical terminal lugs to terminate line and load wiring to the MCCB. The 140G product line includes, as standard, the capability to terminate wiring using customer furnished "crimp-on" ring lug (ring tongue) or forked lug termination.

For customers who prefer terminating wiring to Mechanical Terminal Lugs, the 140G line offers a variety of mechanical terminals lugs to match the frame and application wiring.

Multiple tap terminal lugs are available for those customers terminating multiple wires to a MCCB pole, either to line or load connection. Use of a multi-tap connection can save on panel space, making wiring easier due to using (multiple) smaller diameter wire. For applications following the UL guidelines for panel short-circuit current rating (SCCR), the use of multiple wire termination on the load size permits the termination to be rated at the SCCR level of the circuit breaker, which may allow a higher SCCR than may be available using a separate power distribution block.

Description	Conductor Type	No. of Conductors	Wire Size		Frame Size	Cat. No. (Pkg. Qty. 3)	Cat. No. (Pkg. Qty. 4)
			[mm^2]	[AWG]			
	Cu wire	1	2.5…70	14…1/0	G	140G-G-TLC13(1)	140G-G-TLC14
	Cu wire	1	15…70	14…1/0		140G-G-TLC13A(2)	—
	Multiple cable - Cu wire	6	2.5…35	14…2		140G-G-MTL63(3)	140G-G-MTL64(3)
	Cu wire	1	2.5…95	14…1/0	H	140G-H-TLC13	140G-H-TLC14
	Multiple cable - Cu wire	6	2.5…35	14…2		140G-H-MTL63(3)	140G-H-MTL64(3)
	Al or Cu wire	1	2.5…50	14…1/0	I	140G-I-TLA13	140G-I-TLA14
	Al or Cu wire	1	25…150	4…300 MCM		140G-I-TLA1A3	140G-I-TLA1A4
	Cu wire	1	6…185	10…250 MCM		140G-I-TLC13	140G-I-TLC14
	Multiple cable - Cu wire	6	2.5…35	12…2		140G-I-MTL63(3)(4)	140G-I-MTL64(3)(4)
	Al or Cu wire	1	2.5…50	14…1/0	J	140G-J-TLA13	140G-J-TLA14
	Al or Cu wire	1	25…150	4…300 MCM		140G-J-TLA1A3	140G-J-TLA1A4
	Cu wire	1	6…185	10…250 MCM		140G-J-TLC13	140G-J-TLC14
	Cu wire	1	120…185	250…350 MCM		140G-J-TLC1A3	140G-J-TLC1A4
	Multiple cable - Cu wire	6	2.5…35	12…2		140G-J-MTL63(3)(4)	140G-J-MTL64(3)(4)
	Al or Cu wire	1	120…240	250…500 MCM	K	140G-K-TLA13	140G-K-TLA14
	Al or Cu wire	2	95…120	2/0…250 MCM		140G-K-TLA23(3)	140G-K-TLA24(3)
	Al or Cu wire	2	95…240	3/0…500 MCM		140G-K-TLA2A3	—
	Cu wire	1	120…240	250…500 MCM		140G-K-TLC13(4)	140G-K-TLC14(4)
	Cu wire	2	95…120	2/0…250 MCM		140G-K-TLC23(3)(4)	140G-K-TLC24(3)(4)
	Multiple cable - Cu wire	6	16…50	6…1/0		140G-K-MTL63(3)	140G-K-MTL64(3)
	Al or Cu wire	2	120…240	250…500 MCM	M	140G-M-TLA23	140G-M-TLA24
	Al or Cu wire	3	70…185	2/0…400 MCM		140G-M-TLA33(3)	140G-M-TLA34(3)
	Cu wire	2	85…185	3/0…350 MCM		140G-M-TLC23(4)	140G-M-TLC24(4)
	Cu wire	3	70…185	2/0…350 MCM		140G-M-TLC33(3)(4)	140G-M-TLC34(3)(4)
	Al or Cu wire	4	120…240	4/0…500 MCM	N, NS	140G-N-TLA43(3)	140G-N-TLA44(3)
	Cu wire	4	120…240	4/0…500 MCM		140G-N-TLC43(3)	140G-N-TLC44(3)
	Al or Cu wire	6	50…400	1/0…750 MCM	R	140G-R-TLA63	—
	Cu wire	6	50…400	1/0…750 MCM		140G-R-TLC63	—

(1) Molded case circuit breaker only

(2) Motor circuit protector only.

(3) Includes the High Terminal cover. Multiple cable logs for use with load side connectors only.

(4) Includes screw for customer supplied connection for voltage tap.

Phase Barriers

Phase barriers allow you to increase the insulation characteristics between the phases at the connections. Phase barriers provide additional electrical clearance between each phase when special connections extend past the circuit breaker housing. They are mounted from the front, even with the circuit breaker already installed.

Description	Frame Size	Length	3-Pole Cat. No. (Pkg. Qty. 4)	4-Pole Cat. No. (Pkg. Qty. 6)
• Provides additional clearance when special connections that extend beyond the frame of the MCCB are used. • Frames G, H, I, J, and K are supplied with 25 mm barriers as standard.	G, I	1 in. (25 mm)	140G-G-PB3M	140G-G-PB4M
		4 in. (100 mm)	140G-G-PB3L	140G-G-PB4L
		8 in. (200 mm)	140G-G-PB3H	140G-G-PB4H
	H, J	1 in. (25 mm)	140G-H-PB3M	140G-H-PB4M
		4 in. (100 mm)	140G-H-PB3L	140G-H-PB4L
		8 in. (200 mm)	140G-H-PB3H	140G-H-PB4H
	K, N, NS	4 in. (100 mm)	140G-K-PB3L	140G-K-PB4L
		8 in. (200 mm)	140G-K-PB3H	140G-K-PB4H
	M	4 in. (100 mm)	140G-M-PB3L	140G-M-PB4L
	R	4 in. (100 mm)	140G-R-PB3L(1)	140G-R-PB4L(2)
		8 in. (200 mm)	140G-R-PB3H(1)	140G-R-PB4H(2)

(1) Package Qty 2. Supplied for the line side only.
(2) Package Qty 3. Supplied for the line side only.

Terminal Covers

The terminal shield prevents accidental contact with live parts, they also provide phase-to-phase insulation.

Description	Frame Size	Height	3-Pole Cat. No. (Pkg. Qty. 2)	4-Pole Cat. No. (Pkg. Qty. 2)
• Provide IP40 finger protection against accidental contact with live parts. • Terminal covers are pre-punched to ease installation. • Supplied as standard with the selection of multiple cable terminal lugs.	G	2 in. (50 mm)	140G-G-TC3H	140G-G-TC4H
	H	2 in. (50 mm)	140G-H-TC3H	H-TC4H
	I	2.36 in. (60 mm)	140G-I-TC3H	140G-I-TC4H
	J	2.36 in. (60 mm)	140G-J-TC3H	140G-J-TC4H
	K	2.36 in. (60 mm)	140G-K-TC3H	140G-K-TC4H
	M	2.36 in. (60 mm)	140G-M-TC3H	140G-M-TC4H
	N, NS	2.76 in. (70 mm)	140G-N-TC3H	140G-N-TC4H

MIX.BLW-3, MIX.BLW-4

MIX.BLW-1,-2
SBR.BLW-1,-2,-3

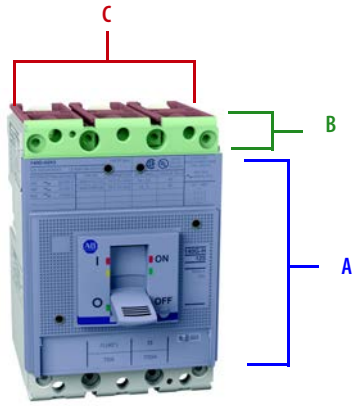
Description	Frame Size	Cat. No. (Pkg. Qty. 2)
• Terminal Cover seal kit provides protection against tampering with installed terminal cover. • Supplied with two (2) screws and two (2) seals. • Sealing wire and lead to be supplied by the customer. • Quantity one required for Line cover, one required for Load cover.	G, H, I, J	140G-G-TS
	K	140G-K-TS
	M, N, NS	140G-M-TS

Ingress Protection

The table indicates the degrees of protection against intrusion and accidental contact according to IEC 60529.

Location	Without Terminal Covers	With High Terminal Covers[1]
A	IP40[2]	—
B	IP20[3]	IP40[2]
C	—	IP40[4]

(1) High terminal covers have a height of 60 mm and are designated with a suffix "H" in the catalog number (140G-G-TC3H)
(2) Also with direct or variable depth rotary operator.
(3) G through M frames.
(4) After installation.



Variable Depth Rotary Operating Kits

When you install MCCBs as the main or feeder circuit breaker in an industrial control panel and you use a non-flanged enclosure, a common method of operating the circuit breaker using a rotary operator mechanism. The use of a rotary operator converts a rotary motion to a vertical motion that "toggles" the MCCB. In this situation, the rotary operator kit consists of:

- External operating handle
- Operating shaft
- Circuit breaker-mounted rotary operating mechanism

Using these kits allows external operation of the circuit breaker with the capability of turning the circuit breaker on/off, or resetting it without having to open the enclosure. Traditionally, these kits are sold with an operating shaft that allows you to use the kit with enclosures of various depths. The operating handles will also provide status indication when the circuit breakers trip.

NFPA 79 Operators

A NFPA 79-compliant Internal Rotary Operating Handle Kit for Bulletin 140G MCCBs, and Bulletin 140MG MCPs and MPCBs is available to address current requirements of the NFPA 79 standard. The NFPA 79 kits are available for G-, H-, I-, J-, K-, M-, and N-Frame Circuit Breaker product lines.

Compliance with the current NFPA 79 standard enables you to maintain control of the main disconnecting means when the door is open; an issue for rotary-operated through-the-door disconnect switches and circuit breakers.

This standard requires that the rotary main disconnecting means be operable without the use of accessory tools or devices (independent of door position) and restates the requirement for an interlocking provision to prevent the closing of the disconnecting means while the enclosure door is open, unless the interlock is operated by a deliberate action. Without this requirement, rotary-operated devices may have a shaft protruding from the panel when the door is open. If the panel is powered and it is necessary to turn power off, it is difficult to de-energize the panel with the operating shaft alone. This standard is to reduce the possibility of personnel not being able to turn an energized panel off with the door opened.

Why is This Relatively Simple Product Important to You?

The trend in the market is moving toward building smaller and less-expensive control panels. To achieve this, many panel builders and OEMs have started using rotary operators because they are easier to install and the non-flanged enclosure is

significantly less expensive. With the introduction of this internal handle, customers can now comply with the NFPA 79 requirement and use the less-expensive, non-flanged enclosure with circuit breakers.

Applications Where NFPA 79 Compliance is Required as an Upgrade

From an installation perspective, the internal handle replaces the existing operating shaft. Externally, the same 140G handle is used. In the case of an existing 140G installation, installing the kit can be as simple as removing the existing operating shaft, measuring it, and then cutting the new internal operating handle shaft to the same length. It is then installed in place of the existing operating shaft.

Easy to Use, No-Tools-Required Internal Handle Operation

When the door is open, the kit provides an internal handle with a positive grip, allowing users to operate the breaker. If the enclosure were opened using the defeater on the external handle with the circuit breaker on, the user could then turn the breaker off using the internal handle, rather than using a tool to rotate the operating shaft.

Compliance with "Deliberate Action Required"

Finally, the handle complies with the NFPA 79 requirement to: "Prevent closing of the disconnecting means while the enclosure door is open, unless an interlock is operated by deliberate action." The internal handle must be pulled out before it can be turned, otherwise the handle itself will just ratchet on the shaft.

Rotary Variable Depth Operators

	Description	Frame Size	Handle Color	Shaft Length	Cat. No.
	• Supplied with external handle, operating shaft, and MCCB mounted operating mechanism. • See page 90 to select as components. • Frames G, H, I, and J use a Bul. 140U P-style handle. • Frames K, M, and N use a Bul. 140U medium style handle.	G, I	Black	12 in. (305 mm)	140G-G-RVM12B
			Red/Yellow		140G-G-RVM12R
			Black	21 in. (533 mm)	140G-G-RVM21B
			Red/yellow		140G-G-RVM21R
		H, J	Black	12 in. (305 mm)	140G-H-RVM12B
			Red/yellow		140G-H-RVM12R
			Black	21 in. (533 mm)	140G-H-RVM21B
			Red/yellow		140G-H-RVM21R
		K	Black	12 in. (305 mm)	140G-K-RVM12B
			Red/yellow		140G-K-RVM12R
			Black	22 in. (559 mm)	140G-K-RVM21B
			Red/yellow		140G-K-RVM21R
		M	Black	12 in. (305 mm)	140G-M-RVM12B
			Red/yellow		140G-M-RVM12R
			Black	22 in. (559 mm)	140G-M-RVM21B
			Red/yellow		140G-M-RVM21R
		N	Black	12 in. (305 mm)	140G-N-RVM12B
			Red/yellow		140G-N-RVM12R
			Black	22 in. (559 mm)	140G-N-RVM21B
			Red/yellow		140G-N-RVM21R

Rotary Variable Depth Operators with Internal NFPA 79 Operating Handle

	Description	Frame Size	Handle Color	Shaft Length	Cat. No.
	• Supplied with external handle, NFPA handle with operating shaft, support bracket, and MCCB mounted operating mechanism. • See page 90 to select as individual components. • Frames G, H, I, and J use a Bul. 140U P-style handle. • Frames K, M, and N use a Bul. 140U medium style handle.	G, I	Black	12 in. (305 mm)	140G-G-NVM12B
			Red/yellow		140G-G-NVM12R
			Black	21 in. (533 mm)	140G-G-NVM21B
			Red/yellow		140G-G-NVM21R
		H, J	Black	12 in. (305 mm)	140G-H-NVM12B
			Red/yellow		140G-H-NVM12R
			Black	21 in. (533 mm)	140G-H-NVM21B
			Red/yellow		140G-H-NVM21R
		K	Black	12 in. (305 mm)	140G-K-NVM12B
			Red/yellow		140G-K-NVM12R
			Black	22 in. (559 mm)	140G-K-NVM21B
			Red/yellow		140G-K-NVM21R
		M	Black	12 in. (305 mm)	140G-M-NVM12B
			Red/yellow		140G-M-NVM12R
			Black	22 in. (559 mm)	140G-M-NVM21B
			Red/yellow		140G-M-NVM21R
		N	Black	12 in. (305 mm)	140G-N-NVM12B
			Red/yellow		140G-N-NVM12R
			Black	22 in. (559 mm)	140G-N-NVM21B
			Red/yellow		140G-N-NVM21R

Variable Depth Rotary Components

	Description	Handle Color	Frame Size	Cat. No.
	• P-style handle for G, H, I, and J frames • Medium handles for K, M, and N frames • Rated 3/3R/4/4X/12 • Accepts 3 padlocks	Black/Grey	G, H, I, J	140U-PB
		Red/Yellow		140U-PY
		Black/Grey	K, M, N	140U-HM4
		Red/Yellow		140U-HM4E

	Description	Shaft Length	Frame Size	Cat. No.
	Extension Shaft	12 in. (305 mm)	G, H, I, J	194R-S1
		21 in. (533 mm)		194R-S2
		12 in. (305 mm)	K, M, N	194R-R7
		22 in. (305 mm)		194R-R8

	Description	Shaft Length	Frame Size	Cat. No.
	NFPA 79 internal operating handle with shaft Internal handle permits operation of the molded case circuit breaker when the door is open in compliance with NFPA 79.	12 in. (305 mm)	G, H, I, J	140G-N1
		21 in. (533 mm)		140G-N2
		12 in. (305 mm)	K, M, N	140G-N7
		22 in. (305 mm)		140G-N8

	Description	Frame Size	Cat. No.
	Rotary Variable Depth Operating Mechanism • Direct molded case circuit breaker mount • G, H, I, and J frame use 194R-S1 or 194R-S2 shafts (140G-N1 or 140G-N2 NFPA) • K, M, and N frames use 194R-R7 or 194R-R8 shafts (140G-R7 or 140G-R8 NFPA) • Shaft secured with set screw or cotter pin	G, I	140G-G-RMX
		H, J	140G-H-RMX
		K	140G-K-RMX
		M	140G-M-RMX
		N	140G-N-RMX

	Description	Frame Size	Cat. No.
	Support Bracket Supplied as standard with NFPA variable depth operator kits	G, H, I, J	140G-G-OSB
		K	140G-K-OSB
		M	140G-M-OSB
		N	140G-N-OSB

Figure 28 - 140G-H Time-Current Curve

- Maximum voltage: 600V AC
- Maximum current: 60…70 A
- Instantaneous (magnetic) trip tolerance: -20% / +30%

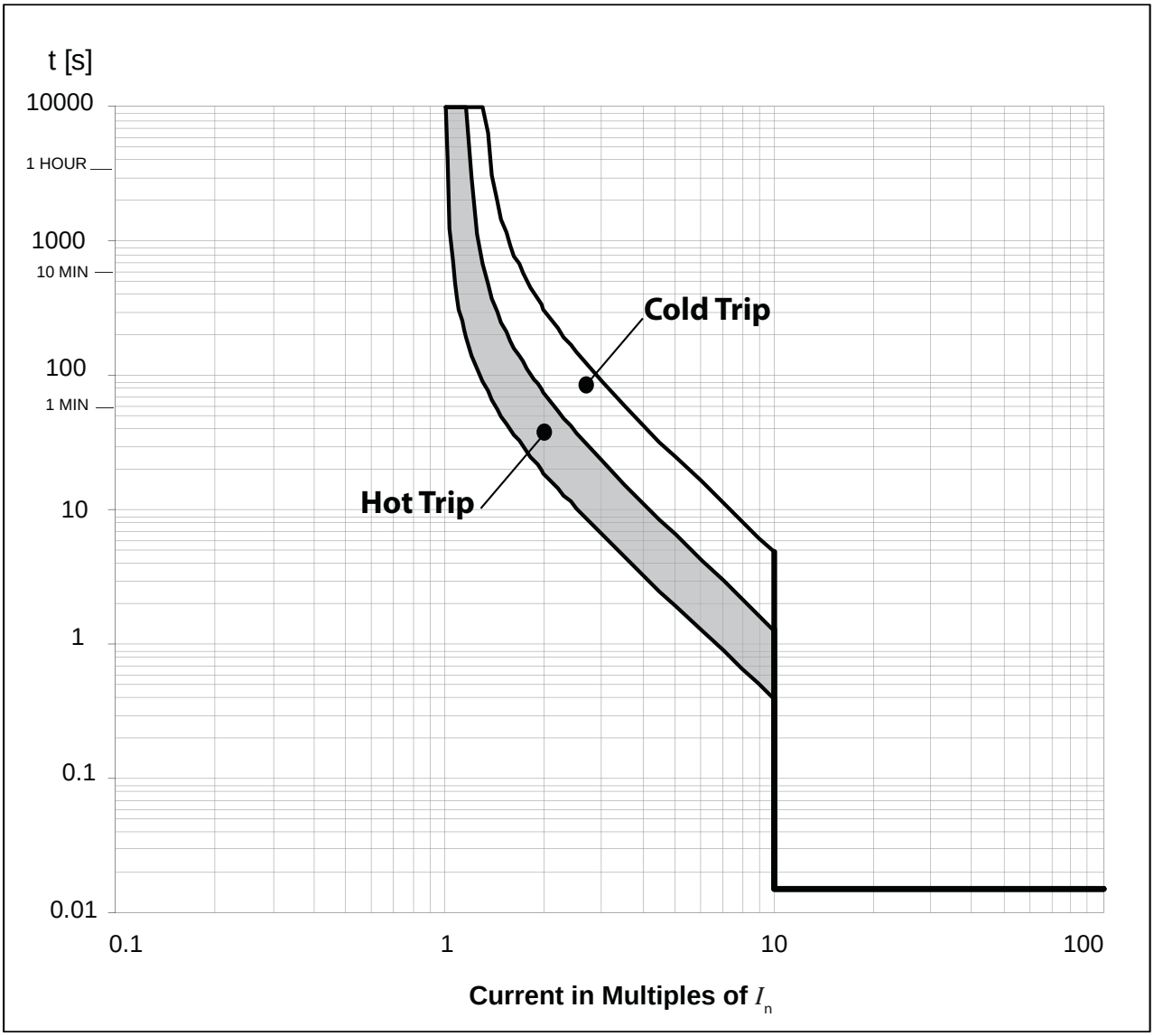


Table 129 - Current Ratings

Rated Current I_n [A]	Magnetic Trip I_m [A]	
60	600	MIX.BLW-3
63	630	
70	700	MIX.BLW-4

Figure 37 - 140G-J Time-Current Curve

MIX.BLW-1,-2
SBR.BLW-1,-2,-3

- Maximum voltage: 600V AC
- Maximum current: 80…100 A
- Instantaneous (magnetic) trip tolerance: -20% / +30%

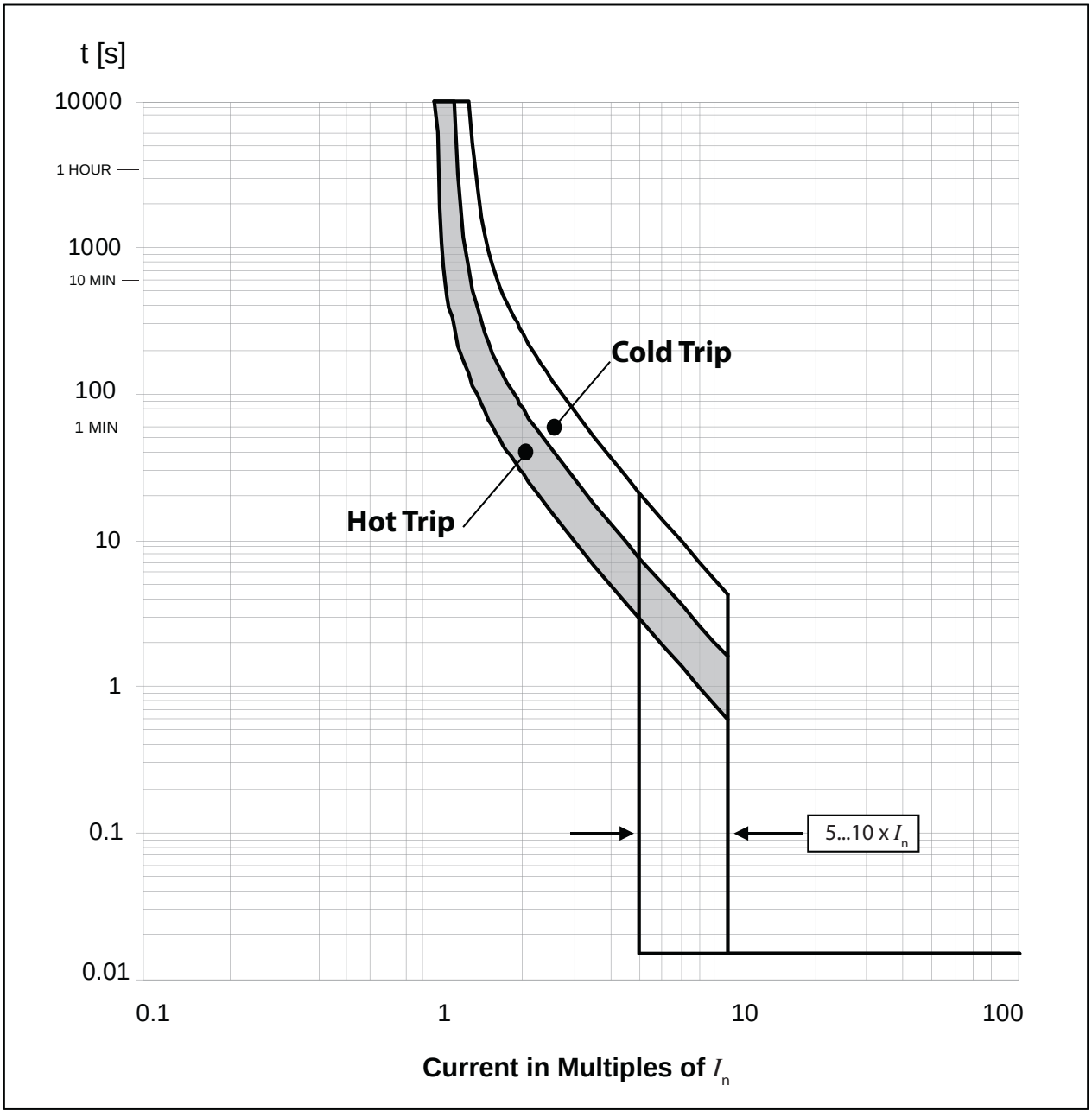


Figure 60 - Let-through Current Curve for MCCBs, 480V

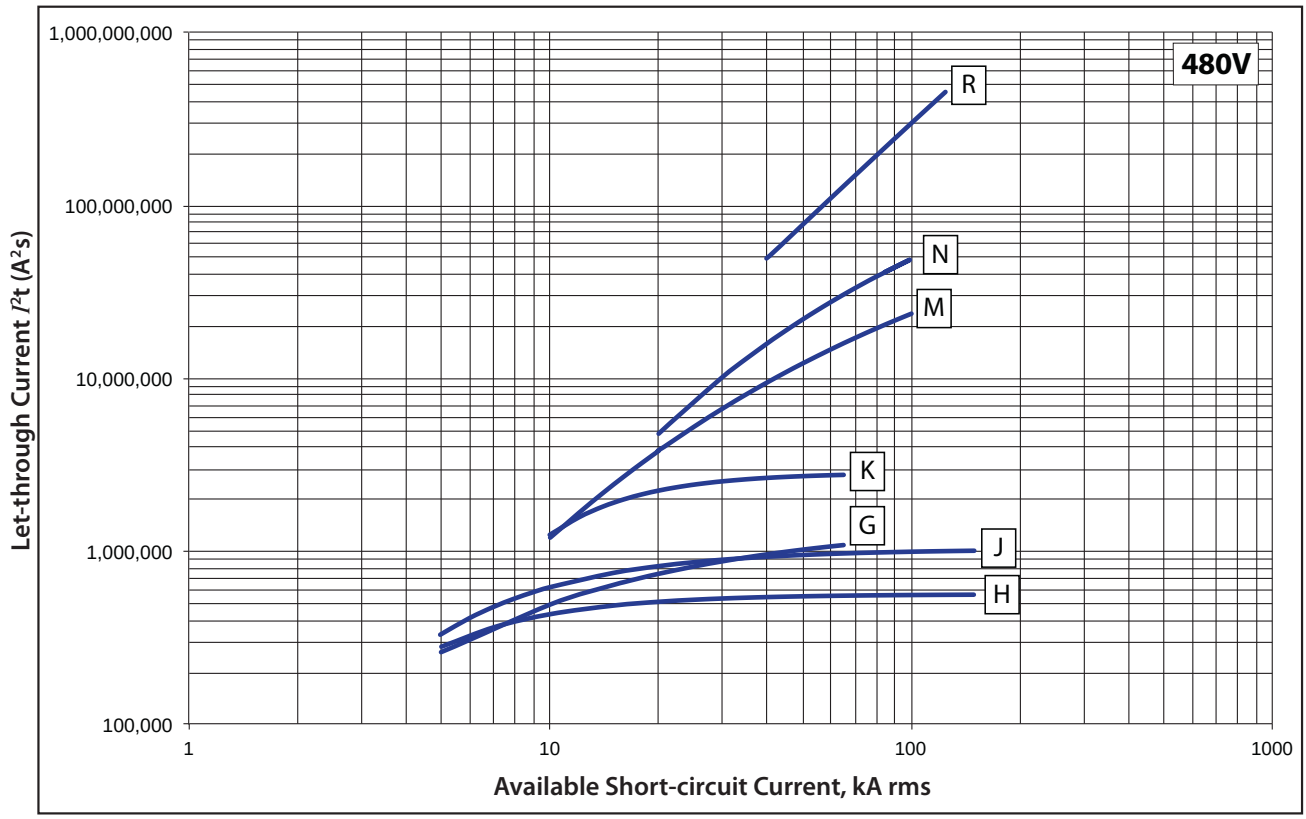
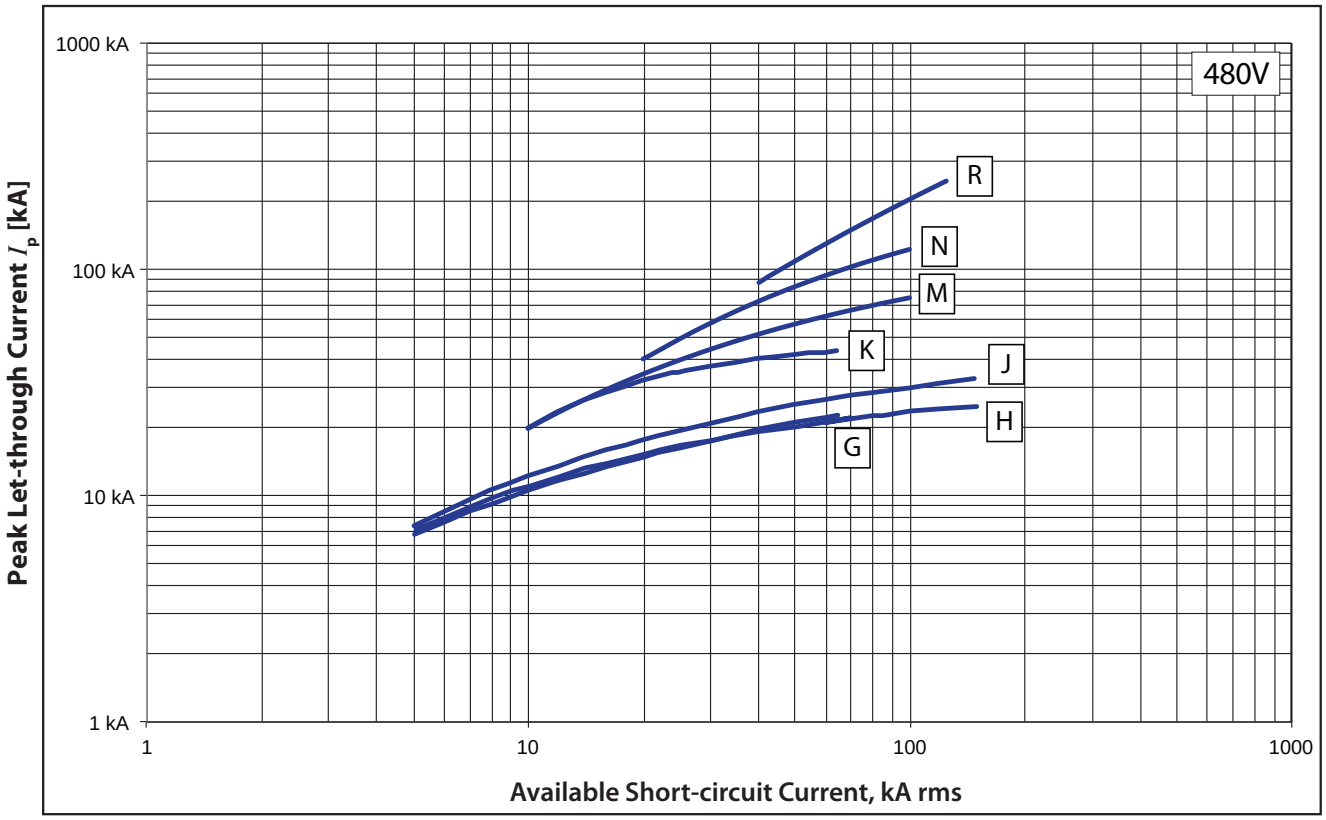


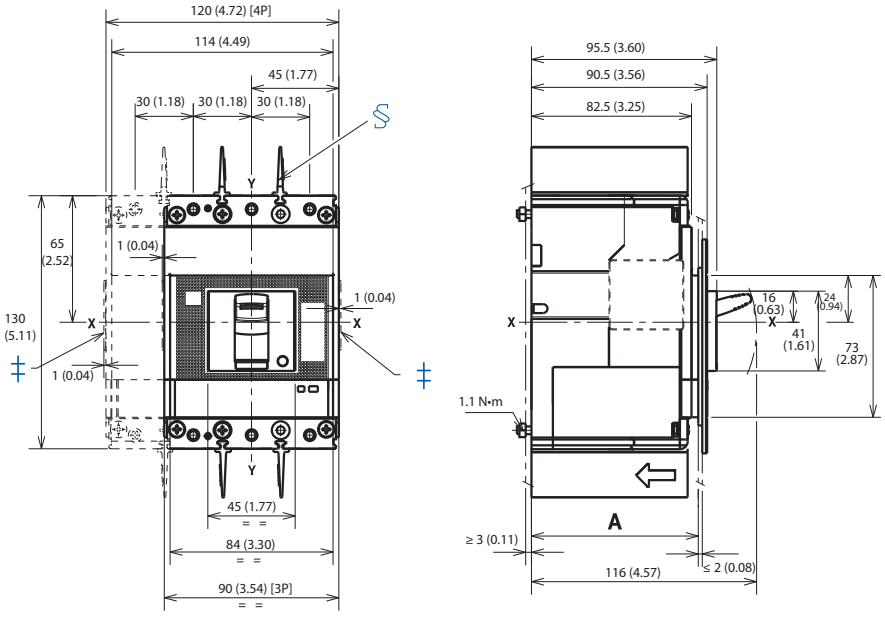
Figure 61 - Peak Let-through Current Curve for MCCBs, 480V



Bulletin 140G/MG H-Frame

Figure 97 - Panel Mounted Molded Case Circuit Breaker

MIX.BLW-3, MIX.BLW-4



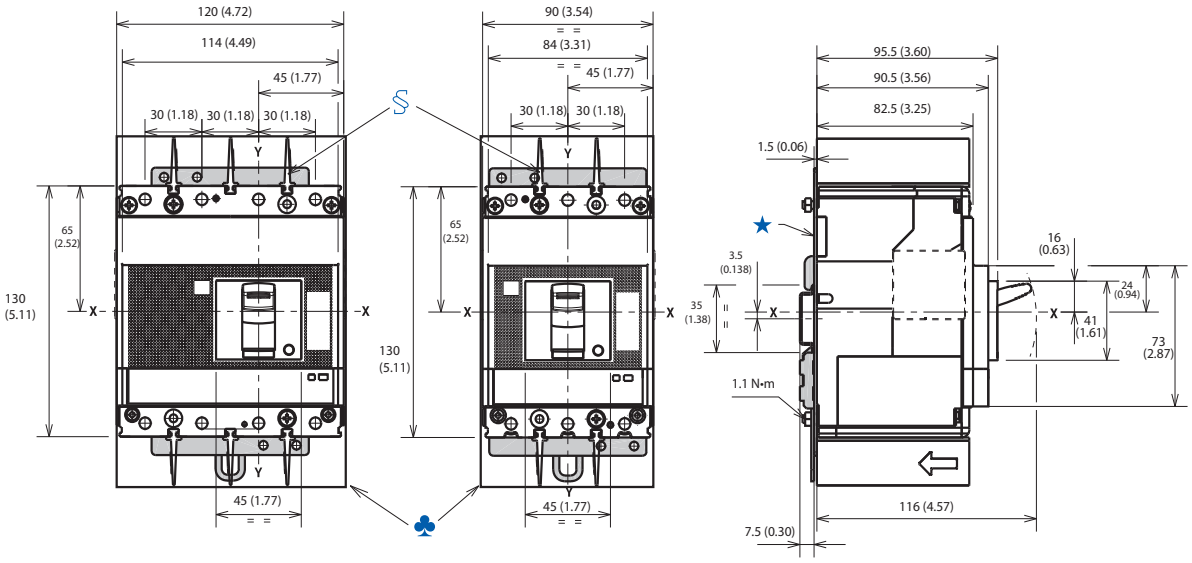
‡ Overall dimensions of optional side covers.

§ Required 25 mm insulating phase barriers provided.

Description	No. of Poles	A
With escutcheon	3…4	86 (3.39)
Without escutcheon	3…4	83.5 (3.29)
	3…4	91.5 (3.60)

‡ Overall dimensions of optional side covers.

Figure 98 - DIN Rail Mounted Molded Case Circuit Breaker



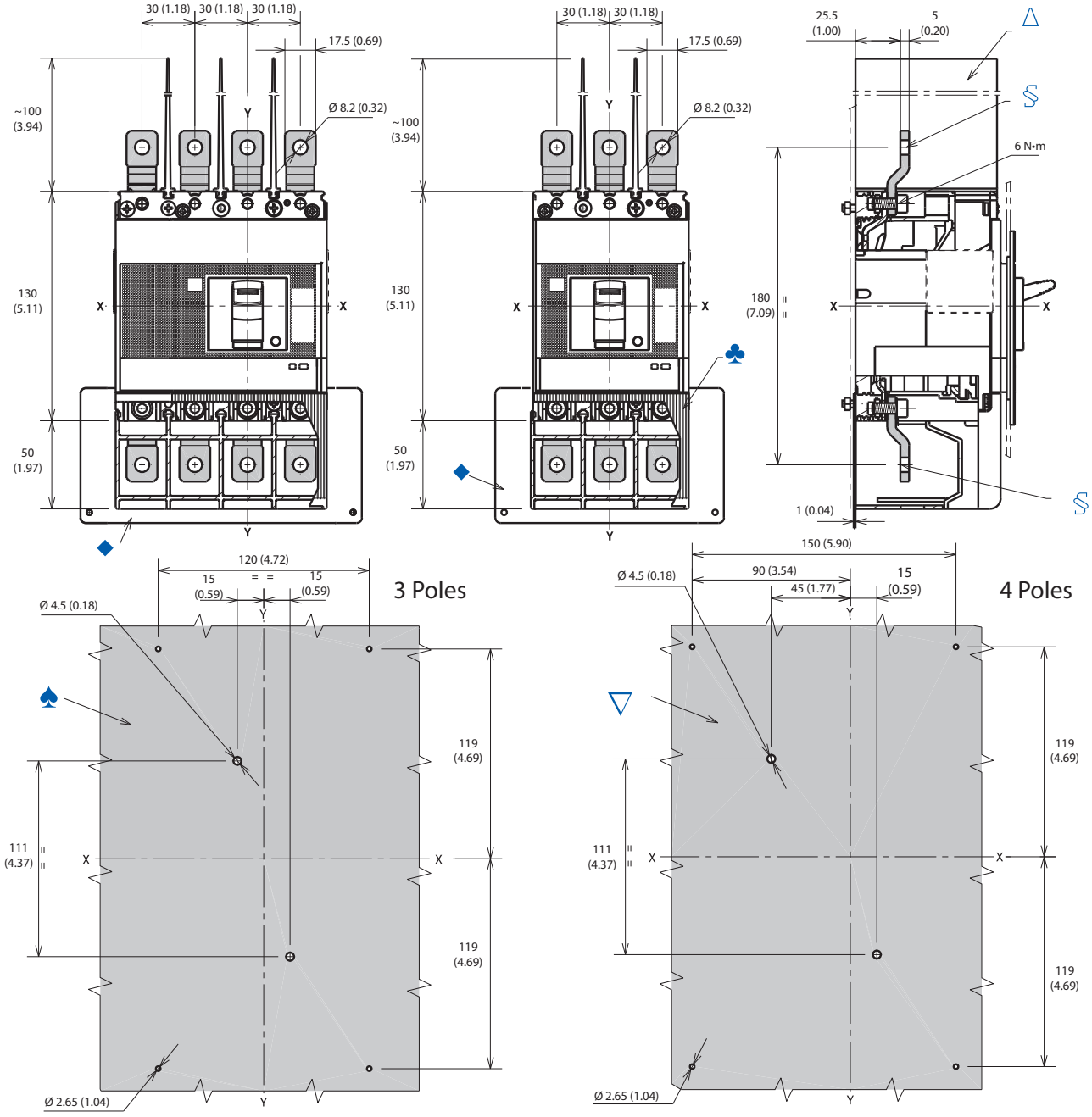
★ Mounting bracket.

§ Required 25 mm insulating phase barriers provided.

♣ Flexible insulator.

Figure 101 - Cat. Nos. 140G-H-EXT3, -EXT4 Extended Terminals

MIX.BLW-3, MIX.BLW-4



§ Extended terminals.

♣Optional terminal covers with IP40 protection provided.

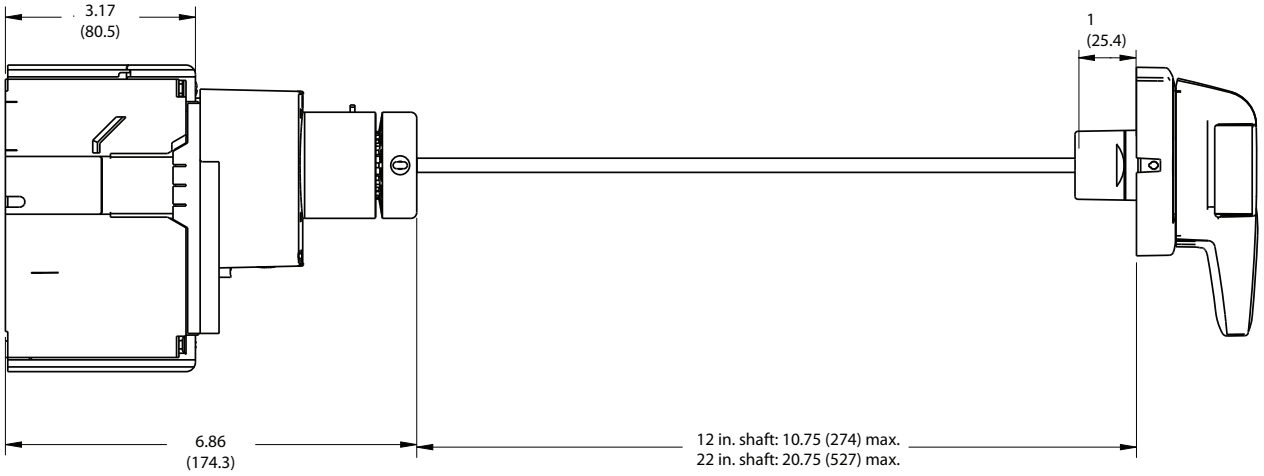
Δ Required 100 mm insulating phase barriers provided.

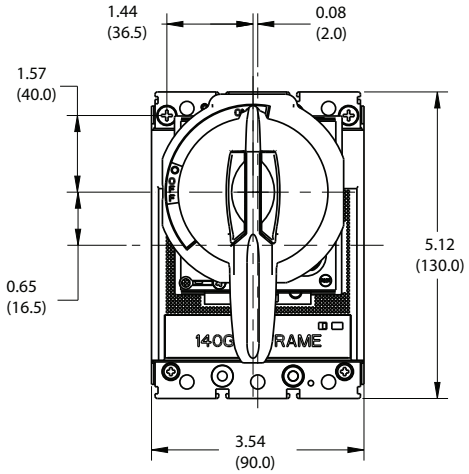
♦ Supplied insulator panel, required for U_e >440V applications.

♠ Drilling template for 3-pole molded case circuit breaker, U_e>440V (required).

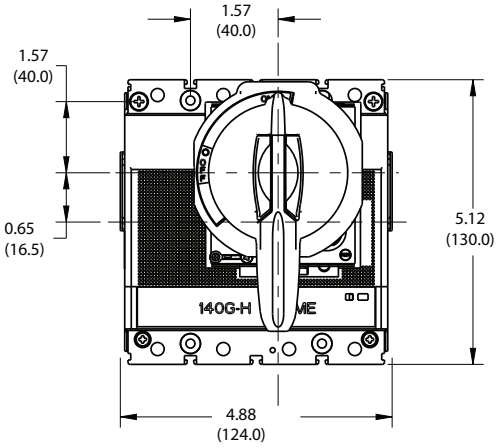
∇ Drilling template for 4-pole molded case circuit breaker, U_e>440V (required).

Figure 107 - Cat. No. 140G-H-RVM… Rotary Handle Operating Mechanism MIX.BLW-3, MIX.BLW-4

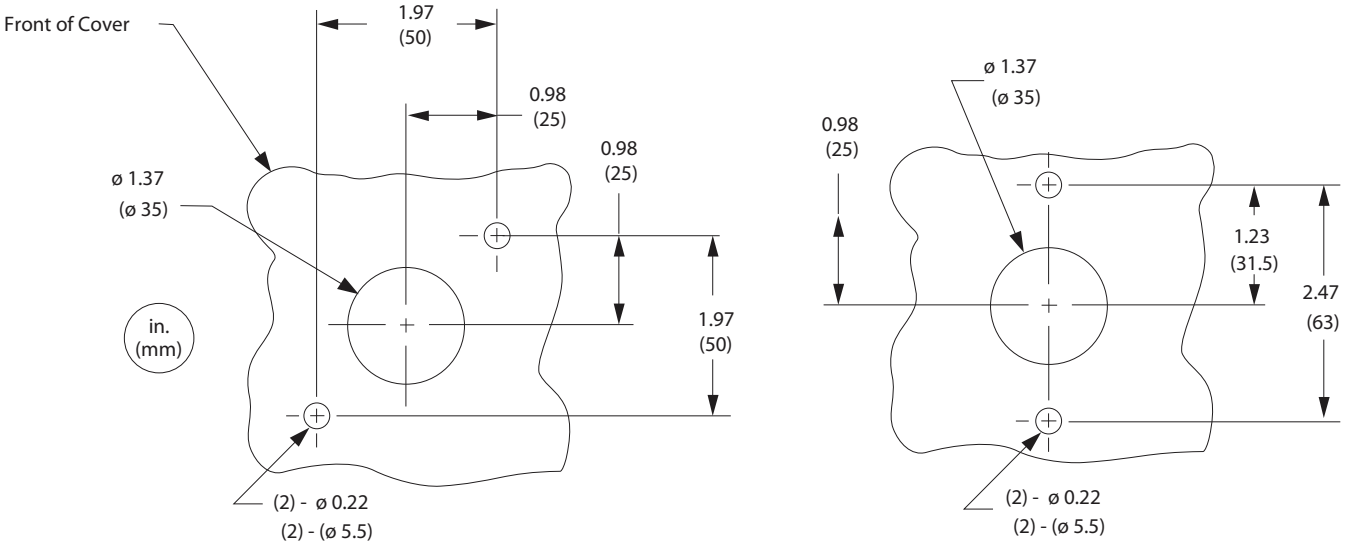




3-Pole



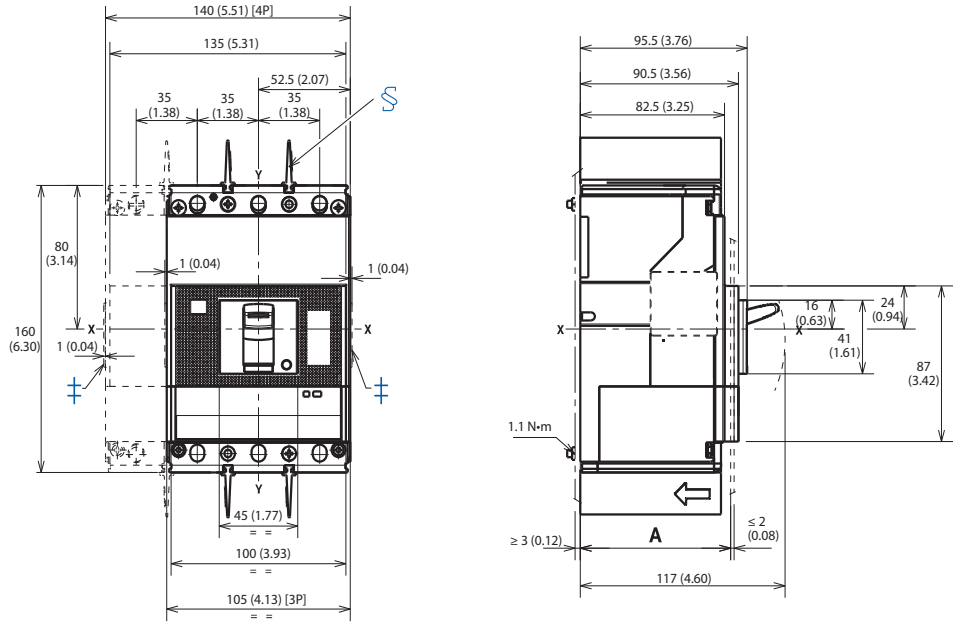
4-Pole



Bulletin 140G/MG J-Frame

MIX.BLW-1,-2
SBR.BLW-1,-2,-3

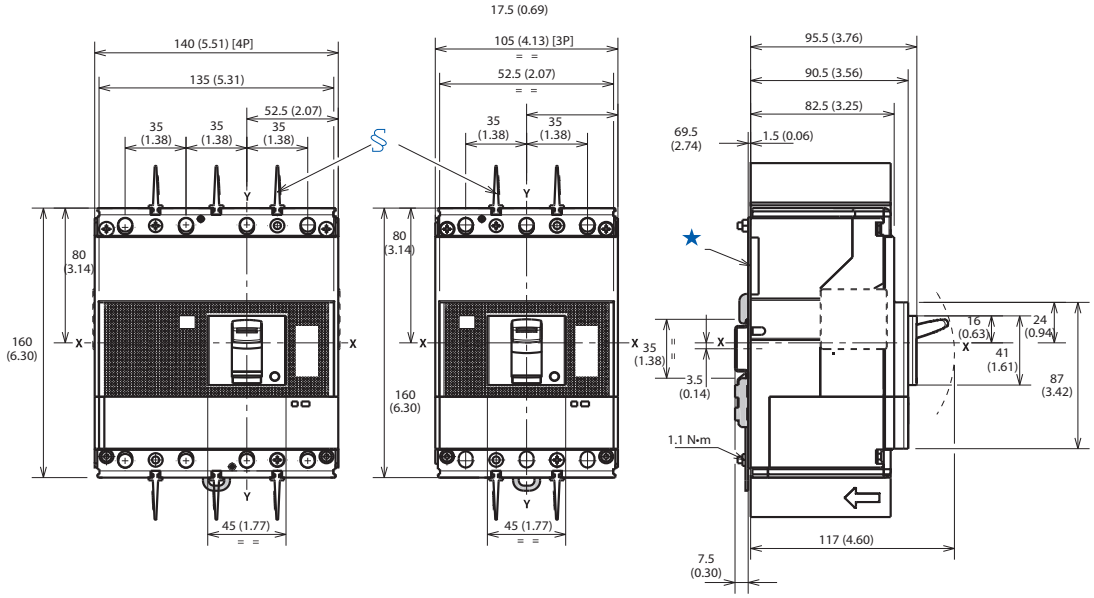
Figure 130 - Panel Mounted Molded Case Circuit Breaker



‡ Overall dimensions of optional wiring ducts.
§ Required 25 mm insulating phase barriers provided.

Description	No. of Poles	A
With escutcheon	3…4	86 (3.39)
Without escutcheon	3…4	83.5 (3.29)
	3…4	91.5 (3.60)

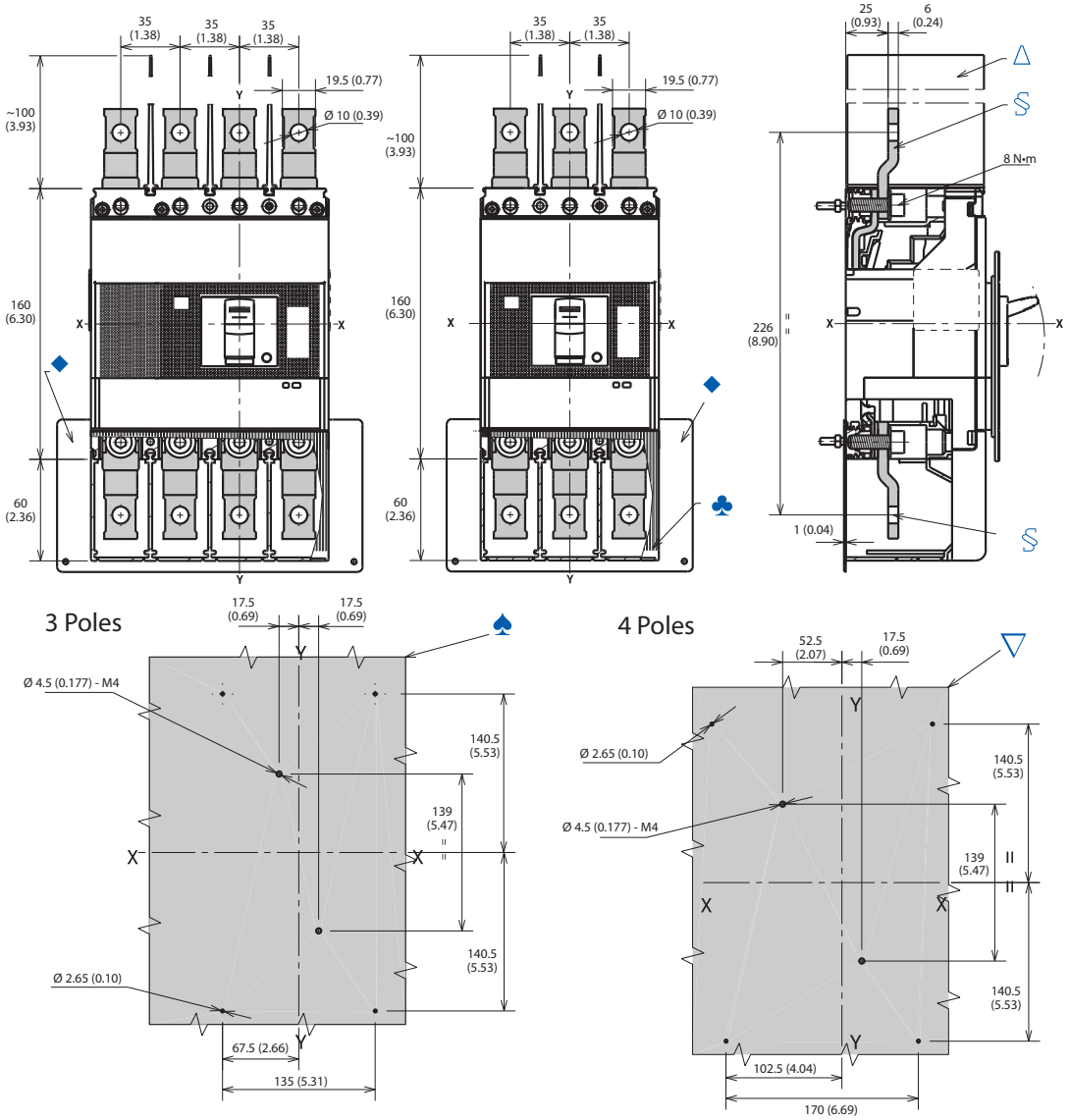
Figure 131 - DIN Rail Mounted Molded Case Circuit Breaker



★ Mounting bracket
§ Required 25 mm insulating phase barriers provided

Figure 134 - Cat. Nos. 140G-J-EXT3, -EXT4 Extended Terminals

MIX.BLW-1,-2
SBR.BLW-1,-2,-3



§ Extended terminals.

♣ Optional terminal covers with IP40 protection provided.

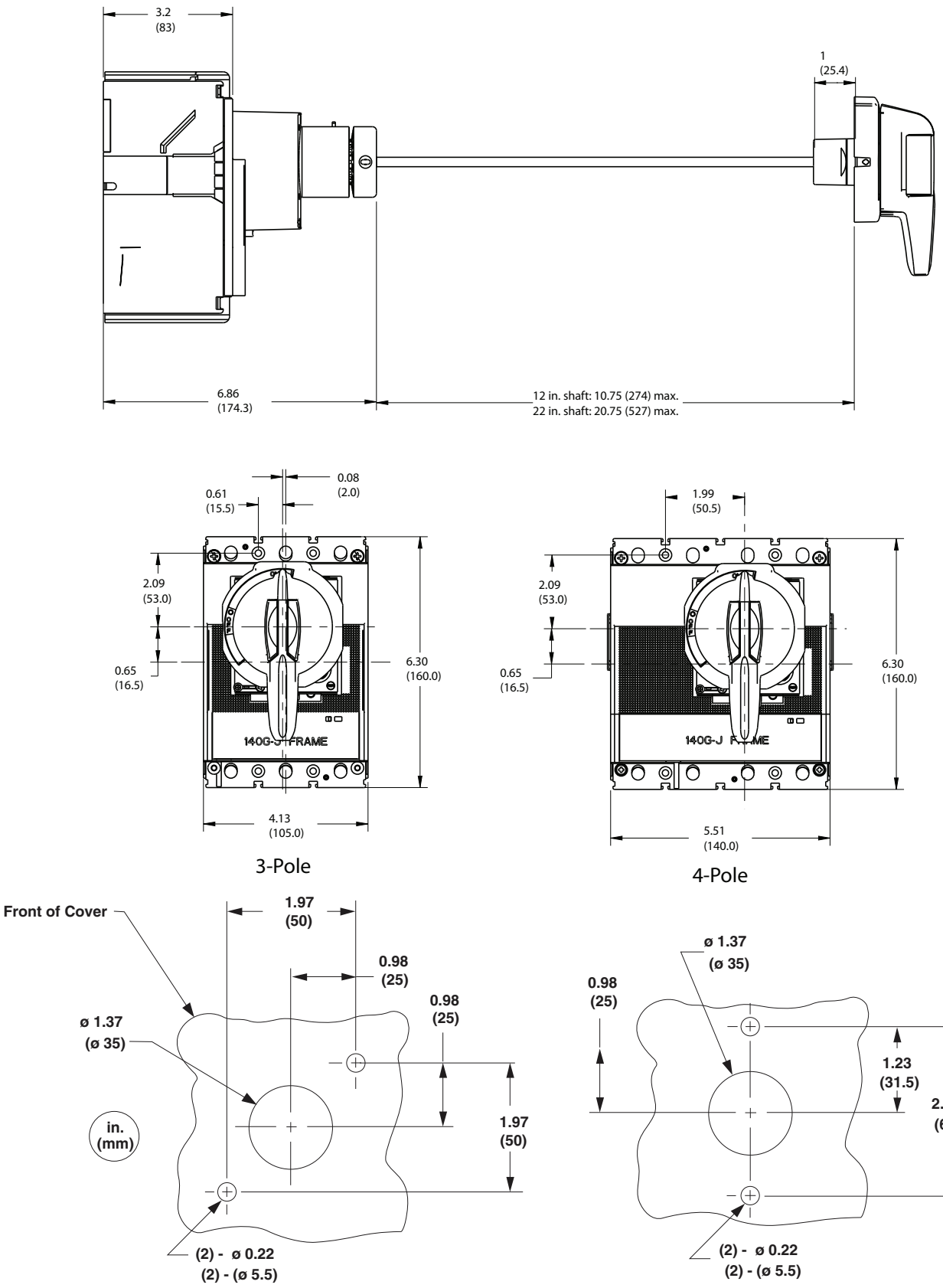
Δ Required 100 mm insulating phase barriers provided.

♦ Supplied insulator panel, required for U_e>440V applications.

♠ Drilling template for 3-pole molded case circuit breaker.

∇Drilling template for 4-pole molded case circuit breaker.

Figure 142 - Cat. No. 140G-H-RVM… Variable Depth Rotary Handle Operating Mechanism (For J-Frame Molded Case Circuit Breaker)



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1321 Power Conditioning Products

Don't Ignore the Cost of Power Line Disturbance

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Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-IN001	Provides basic information needed to properly wire and ground PWM AC drives.
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control, publication SGI-1.1	Provides general guidelines for the application, installation, and maintenance of solid-state control.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

For Allen-Bradley Drives Technical Support:

Title	Online at…
Allen-Bradley Drives Technical Support	www.ab.com/support/abdrives or call (1) 262.512.8176

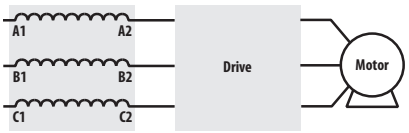
Product Overview

Allen-Bradley reactors help keep equipment running longer by absorbing many of the power line disturbances which can shut down your drive. Allen-Bradley isolation transformers can provide both voltage change and isolation for your variable speed drive. These designs are harmonic compensated and IGBT protected to assure optimum performance in the presence of harmonics.

1321-3R and 3RA Series Line Reactors

Applying Allen-Bradley Line Reactors

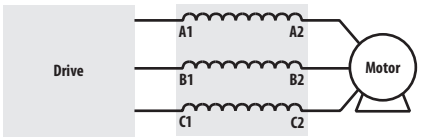
At the Input of the Drive



At the input of a drive, line reactors help protect against surges or spikes on the incoming power lines and help reduce harmonic distortion.

- Eliminate Nuisance Tripping
- Extend Semiconductor Life
- Reduce Harmonic Distortion
- Improve True Power Factor
- Reduce Voltage Notching
- Meet IEEE-519 or EN-61800

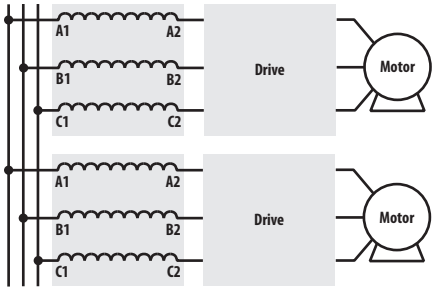
At the Output of the Drive



In long motor lead applications, Allen-Bradley load reactors located between the drive and motor help reduce dv/dt and motor terminal peak voltages. The use of a load reactor also helps protect the drive from surge currents caused by rapid changes in the load.

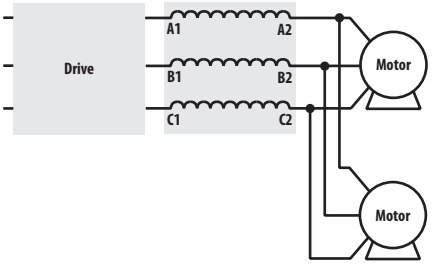
- Protect Motors from Long Lead Effects
- Reduce Output Voltage dv/dt
- Extend Semiconductor Life
- Reduce Surge Currents
- Reduce Motor Temperature
- Reduce Audible Motor Noise

With Multiple Drives



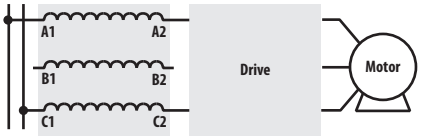
Multiple drives on a common power line should each have their own line reactor. Individual line reactors provide filtering between each drive to help reduce any crosstalk while providing optimum surge protection for each drive.

With Multiple Motors



When more than one motor is controlled by a single drive, a single line reactor can typically be used between the drive and all the motors. Size the line reactor based on the total motor/load horsepower.

With Single-Phase Input



A three-phase reactor can be used for single-phase applications by routing each of the two input power conductors to the outside two coils, and leaving the center coil disconnected. The sum of the inductance of the two coils is the total inductance applied to the circuit. Contact Rockwell Automation Technical Support for assistance in specifying the proper reactor.

Selecting the Correct Impedance Rating

Why is the Right Impedance Rating Important?

Selecting the correct impedance rating is critical for your job. An impedance value too low may not limit peak current. Too high of an impedance may reduce input voltage. Allen-Bradley line reactors offer two impedance ratings.

3% Impedance Rated Reactors to Reduce Nuisance Trips

Allen-Bradley line reactors rated at 3% are typically sufficient to absorb line spikes and motor current surges and will help prevent nuisance tripping of drive and circuit breakers in most applications.

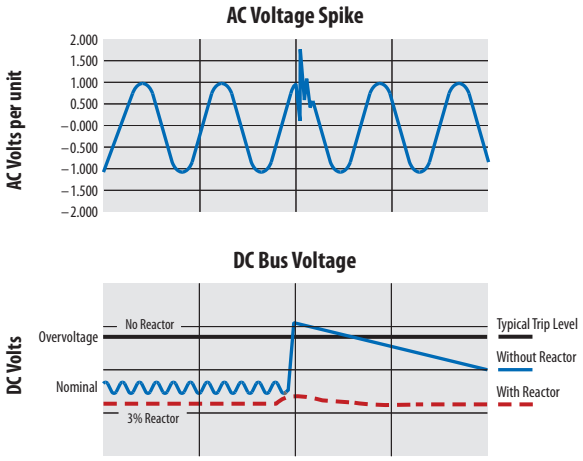
5% Impedance Rated Reactors to Reduce Harmonic Content

Allen-Bradley reactors rated at 5% are best for reducing harmonic current and frequencies. These line reactors help comply with IEEE-519 (not normally used as load reactors).

Voltage Spike Protection

Voltage spikes on AC power lines can cause elevation of the DC bus voltage which may cause the drive to trip on an overvoltage condition.

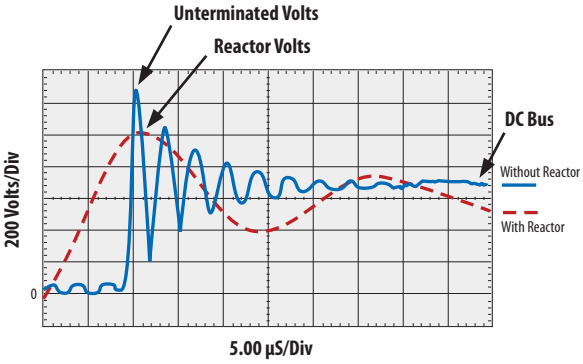
3% impedance reactors are very effective at protecting drives against voltage spikes and nuisance tripping. Allen-Bradley line reactors absorb these line spikes protecting the drive from nuisance tripping and damage.



Motor Protection

Allen-Bradley load reactors can help protect motors from high peak voltages.

For IGBT drive applications with long drive-to-motor lead lengths, Allen-Bradley load reactors can help protect against fast dv/dt rise times.



Catalog Number Explanation

Position Number

1-4		*6*	7	8		10
1321	–	3	R	4	–	B
a		*b*	*c*	*d*		*e*

a

Product	
Code	**Type**
1321	1321 Power Component

b

Phases	
Code	**Description**
3	Three-Phase

c

Device	
Code	**Description**
R	Reactor, Open
RA, RB	Reactor, NEMA 1
RAB	Reactor, NEMA 1, Cabinet Style 2 Only

d

Fundamental Amps		
Code	**Amps**	
1	1	
2	2	
4	4	
8	8	
12	12	
18	18	
25	25	
35	35	
45	45	MIX.BLW-3
55	55	MIX.BLW-4
80	80	MIX.BLW-1,-2 SBR.BLW-1,-2,-3
100	100	
130	130	
160	160	
200	200	
250	250	
320	320	
400	400	
500	500	
600	600	
750	750	
850	850	
1000	1000	

e

Inductance Rating	
Code	**Description**
A	Each reactor current rating has four inductance ratings also available. See the IP00 dimension table.
B	
C	
D	

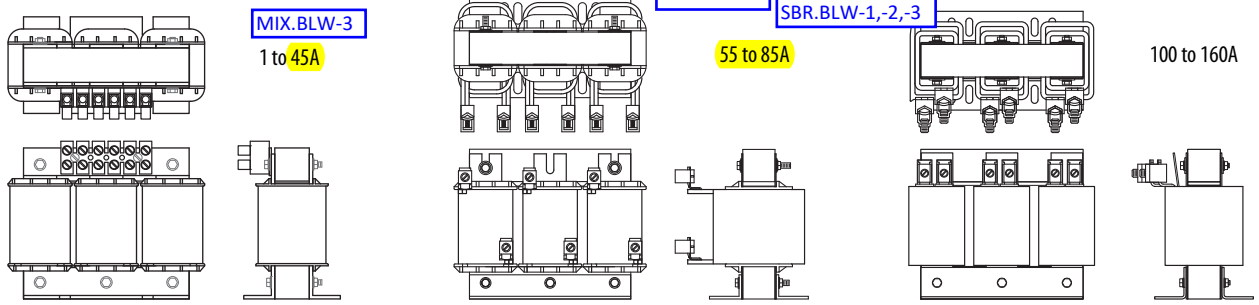
Common Specifications

Specification		Rating
Material	Enclosures	IP11 (NEMA/UL Type 1) — Sheet steel in accordance with UL, NEMA requirements
		IP00 (Open) or IP20 (Open - with finger safe terminals)
	Terminations	1-45 Amp (fundamental) Ratings – Finger guard IP20 terminal block
		80-160 Amp (fundamental) Ratings – Solid copper box lugs
		200-400 Amp (fundamental) Ratings – Copper tab terminals
		401 Amps and Above – Copper tab terminals
Harmonic Compensation	All line reactors are compensated for the additional currents and high frequencies caused by the presence of harmonics	
General Protection	Impedance	3% or 5% based on the fundamental current ratings
	Overload Rating	200% of fundamental current for 30 minutes 300% of fundamental current for 1 minute
	dv/dt Protection	Meets NEMA MG-1, part 31
Electrical	Max. Rated Voltage	600V AC (units with terminal blocks) 690V AC (units with box lugs or tab terminals)
	Max. Switching Freq.	20 kHz
	Fundamental Frequency	Line/Load - 50/60 Hz
	Temperature Rise	135 degrees C average
	Dielectric Strength	3,000 Volts rms (4,243 volts peak)
	Inductance Curve (Typical)	100% at 100% current 100% at 150% current 50% at 350% current (minimum)
	Inductance Tolerance	±10%
	Insulation System	Class N (200 degrees C)
	Impregnation	High bond strength solventless epoxy, 200 degrees C, UL94HB recognized
Environmental	Ambient Temperature	45 degrees C (maximum)
	Altitude	1000 meters (3280 feet)
Agency Approvals	UL-508	File E180243 Component Listed (1-2400 amps) File E180243 UL Listed NEMA Type 1 units (1-2400 amps) Note: Short Circuit rating not required under Exception No.1 of UL508A SB4.2.1 effective 4/25/06
	CSA C22.2, Class N, 200 °C	File LR29753-13 CSA Certified (1 amp - 2400 amps) File E66214, Type 200-18, UL Recognized Insulation System
	CE	TUV certified to EN61558-2-20:2000

Termination

Allen-Bradley reactors rated 45 Amps (fundamental) and below are supplied with an integral mounted terminal block. Reactors rated from 55 to 160 Amps (fundamental) are supplied with box lugs. Reactors rated 200 to 400 Amps (fundamental) will be supplied with front facing copper tabs. Above 400 Amps (fundamental), side facing copper tabs are used. The “3R” and “3RA” designations for the 1321 line reactors indicate the following: 3R = Open Enclosure Line Reactor and 3RA = NEMA 1 Enclosure Line Reactor.

Typical Termination Types and Specifications

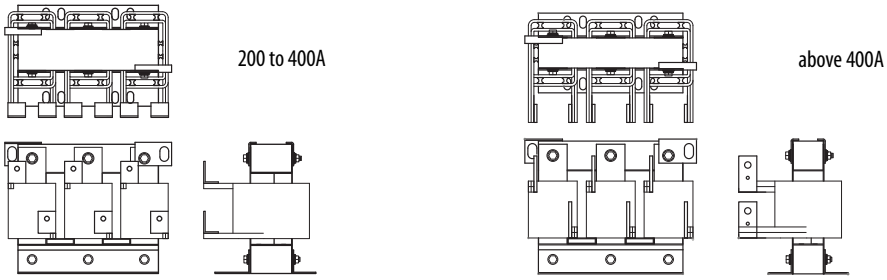


Terminal Blocks

SLU-125 Box Lugs

SLU-225 Box Lugs

Reactor Catalog Number		Termination	Max./Min. Wire Size	Max. Torque
IP00 (Open) or IP20	IP11 (NEMA/UL Type 1)	Type	mm^2 (AWG)	Nm (lb.-in.)
1321-3R1-A to 1321-3R8-D	1321-3RA1-A to 1321-3RA8-D	20A Terminal Block	2.1/0.3 (14/22)	0.51 (4.5)
1321-3R12-A to 1321-3R35-B	1321-3RA12-A to 1321-3RA35-B	65A Terminal Block	16.0/0.3 (5/22)	1.81 (16)
1321-3R35-C to 1321-3R45-C	1321-3RA35-C to 1321-3RA45-C	85A Terminal Block	21.2/0.8 (4/18)	2.26 (20)
1321-3R55-A to 1321-3R80-C	1321-3RA55-A to 1321-3RA80-C	SLU-125 Box Lug	50.0/10.0 (0/6)	5.09 (45)
-A to	1321-3RA100-A to 1321-3RA160-C	SLU-225 Box Lug	120.0-27.0 (0000/2)	16.95 (150)

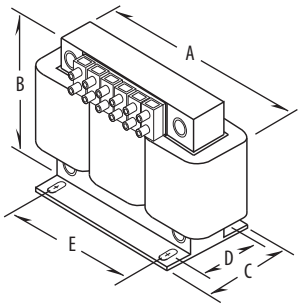


Front Facing Copper Tabs

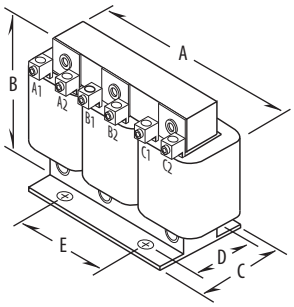
Side Facing Copper Tabs

Reactor Catalog Number		Termination	Contact Surface (H x W)	Hole Diameter	Thickness
IP00 (Open) or IP20	IP11 (NEMA/UL Type 1)	Type	mm (in.)	mm (in.)	mm (in.)
1321-3R200-A to 1321-3R200-C	1321-3RA200-A to 1321-3RA200-C	Front Facing Copper Tab	41.3 x 25.4 (1.63 x 1.0)	10.36 (0.408)	3.18 (0.125)
1321-3R250-B to 1321-3RB250-C	1321-3RAB250-A to 1321-3RAB250-C	Front Facing Copper Tab	57.2 x 19.1 (2.25 x 0.75)	10.31 (0.406)	4.75 (0.187)
1321-3RB320-A to 1321-3R400-A	1321-3RAB320-A to 1321-3RA400-A	Front Facing Copper Tab	44.5 x 38.1 (1.75 x 1.5)	10.31 (0.406)	3.18 (0.125)
1321-3R500-A	1321-3RA500-A	Side Facing Copper Tab	44.5 x 38.1 (1.75 x 1.5)	10.31 (0.406)	3.18 (0.125)
1321-3R500-B to 1321-3R500-C	–	Front Facing Copper Tab	76.2 x 38.1 (3.00 x 1.5)	13.49 & 6.35 (0.531 & 0.25)	6.35 (0.25)
–	1321-3RA500-B	Side Facing Copper Tab	44.5 x 38.1 (1.75 x 1.5)	10.31 (0.406)	3.18 (0.125)

IP00/Open



IP00 /Open, 45 Amps (fundamental) and Below



IP00/Open, 80 Amps (fundamental) and Above

Sizing Guidelines

Fundamental amps are used for sizing the reactor to be equal to or slightly higher than the total motor FLA. Sizing reactors to drive ampere ratings alone may result in mis-sizing the reactor.

Catalog Number	Fundamental Amps	Inductance - mH (Based on Fundamental Amps)	Watts Loss	Dimensions in mm (in.) and Weight in kg (lbs.)					
				A	B	C	D[1]	E	Weight
1321-3R1-A	1	100.0	14	112 (4.40)	104 (4.10)	79 (3.10)	60 (2.35)	37 (1.44)	1.8 (4)
1321-3R1-B		50.0	14.8	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R1-C		36.0	12	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.4 (3)
1321-3R1-D		18.0	5	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.4 (3)
1321-3R2-A	2	12.0	7.5	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-B		20.0	11.3	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-C		32.0	16	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-D		6.0	10.7	112 (4.40)	104 (4.10)	64 (2.50)	44 (1.73)	37 (1.44)	1.4 (3)
1321-3R4-A	4	3.0	14.5	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-B		6.5	20	112 (4.40)	104 (4.10)	71 (2.80)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-C		9.0	20	112 (4.40)	104 (4.10)	86 (3.40)	60 (2.35)	37 (1.44)	2.3 (5)
1321-3R4-D		12.0	21	112 (4.40)	104 (4.10)	86 (3.40)	66 (2.60)	37 (1.44)	2.7 (6)
1321-3R8-A	8	1.5	19.5	152 (6.00)	121 (4.75)	76 (3.00)	53 (2.10)	51 (2.00)	3.2 (7)
1321-3R8-B		3.0	29	152 (6.00)	121 (4.75)	76 (3.00)	53 (2.10)	51 (2.00)	3.6 (8)
1321-3R8-C		5.0	25.3	152 (6.00)	121 (4.75)	86 (3.40)	67 (2.62)	51 (2.00)	5.0 (11)
1321-3R8-D		7.5	28	152 (6.00)	121 (4.75)	86 (3.40)	63 (2.48)	51 (2.00)	5.9 (13)
1321-3R12-A	12	1.25	26	152 (6.00)	127 (5.00)	84 (3.30)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R12-B		2.5	31	152 (6.00)	127 (5.00)	84 (3.30)	53 (2.10)	51 (2.00)	4.5 (10)
1321-3R12-C		4.2	41	152 (6.00)	127 (5.00)	99 (3.90)	70 (2.75)	51 (2.00)	8.2 (18)
1321-3R18-A	18	0.8	36	152 (6.00)	135 (5.30)	81 (3.20)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R18-B		1.5	43	152 (6.00)	135 (5.30)	89 (3.50)	63 (2.48)	51 (2.00)	5.5 (12)
1321-3R18-C		2.5	43	206 (8.10)	155 (6.10)	102 (4.00)	66 (2.60)	76 (3.00)	7.3 (16)
1321-3R25-A	25	0.5	48	183 (7.20)	147 (5.80)	89 (3.50)	60 (2.35)	76 (3.00)	5.0 (11)
1321-3R25-B		1.2	52	183 (7.20)	147 (5.80)	89 (3.50)	60 (2.35)	76 (3.00)	6.4 (14)
1321-3R25-C		2.0	61	183 (7.20)	147 (5.80)	109 (4.30)	79 (3.10)	76 (3.00)	9.1 (20)
1321-3R35-A	35	0.4	49	183 (7.20)	147 (5.80)	102 (4.00)	66 (2.60)	76 (3.00)	6.4 (14)
1321-3R35-B		0.8	54	183 (7.20)	147 (5.80)	102 (4.00)	70 (2.75)	76 (3.00)	7.3 (16)
1321-3R35-C		1.2	54	229 (9.00)	188 (7.40)	119 (4.70)	80 (3.16)	76 (3.00)	14.0 (30)

continued

Catalog Number	Fundamental Amps	Inductance - mH (Based on Fundamental Amps)	Watts Loss	Dimensions in mm (in.) and Weight in kg (lbs.)					
				A	B	C	D[1]	E	Weight
1321-3R45-A	45	0.3	54	229 (9.00)	188 (7.40)	119 (4.70)	80 (3.16)	76 (3.00)	10.0 (22)
1321-3R45-B		0.7	62	229 (9.00)	188 (7.40)	119 (4.70)	80 (3.16)	76 (3.00)	13.0 (28)
MIX.BLW-3 1321-3R45-C		1.2	65	229 (9.00)	185 (7.30)	135 (5.30)	93 (3.66)	76 (3.00)	18.0 (39)
1321-3R55-A	55	0.25	64	229 (9.00)	185 (7.30)	135 (5.30)	80 (3.16)	76 (3.00)	11.0 (24)
1321-3R55-B		0.5	67	229 (9.00)	178 (7.00)	135 (5.30)	80 (3.16)	76 (3.00)	12.0 (26)
MIX.BLW-4 1321-3R55-C		0.85	71	229 (9.00)	178 (7.00)	152 (6.00)	99 (3.91)	76 (3.00)	16.0 (35)
1321-3R80-A	80	0.2	82	229 (9.00)	183 (7.20)	160 (6.30)	88 (3.47)	92 (3.63)	11.3 (25)
1321-3R80-B		0.4	86	229 (9.00)	183 (7.20)	165 (6.50)	88 (3.47)	92 (3.63)	14.9 (33)
1321-3R80-C		0.7	96	274 (10.80)	216 (8.50)	173 (6.80)	106 (4.16)	92 (3.63)	28.0 (61)
MIX.BLW-1,-2 SBR.BLW-1,-2,-3 1321-3R100-A	100	0.15	94	229 (9.00)	185 (7.30)	165 (6.50)	84 (3.30)	92 (3.63)	13.1 (29)
1321-3R100-B		0.3	84	229 (9.00)	185 (7.30)	173 (6.80)	93 (3.66)	92 (3.63)	16.8 (37)
1321-3R100-C		0.45	108	274 (10.80)	210 (8.30)	156 (6.20)	106 (4.16)	92 (3.63)	34.0 (74)
1321-3R130-A	130	0.1	108	229 (9.00)	178 (7.00)	118 (4.70)	80 (3.16)	76 (3.00)	13.1 (29)
1321-3R130-B		0.2	180	229 (9.00)	183 (7.20)	173 (6.80)	93 (3.66)	92 (3.63)	19.5 (43)
1321-3R130-C		0.3	128	279 (11.00)	216 (8.50)	156 (6.20)	106 (4.16)	92 (3.63)	29.0 (64)
1321-3R160-A	160	0.075	116	229 (9.00)	183 (7.20)	173 (6.80)	80 (3.16)	92 (3.63)	18.6 (41)
1321-3R160-B		0.15	149	274 (10.80)	211 (8.30)	152 (6.00)	88 (3.47)	92 (3.63)	23.0 (50)
1321-3R160-C		0.23	138	292 (11.50)	216 (8.50)	229 (9.00)	119 (4.69)	92 (3.63)	30.0 (67)
1321-3R200-A	200	0.055	124	229 (9.00)	191 (7.50)	185 (7.30)	106 (4.16)	76 (3.00)	17.2 (38)
1321-3R200-B[1]		0.110	168	229 (9.00)	191 (7.50)	211 (8.30)	112 (4.41)	76 (3.00)	24.5 (54)
1321-3R200-C[1]		0.185	146	274 (10.80)	211 (8.30)	254 (10.00)	150 (5.91)	92 (3.63)	45.4 (100)
1321-3RB250-A[1]	250	0.045	154	229 (9.00)	191 (7.50)	229 (9.00)	106 (4.19)	76 (3.00)	21.3 (47)
1321-3RB250-B[1]		0.090	231	274 (10.80)	216 (8.50)	229 (9.00)	131 (5.16)	117 (4.60)	36.3 (80)
1321-3RB250-C[1]		0.150	219	366 (14.40)	284 (11.20)	262 (10.30)	148 (5.82)	117 (4.60)	57.0 (125)
1321-3RB320-A[1]	320	0.040	224	274 (10.80)	229 (9.00)	211 (8.30)	131 (5.16)	117 (4.60)	36.3 (80)
1321-3RB320-B[1]		0.075	264	274 (10.80)	229 (9.00)	254 (10.00)	149 (5.88)	117 (4.60)	46.3 (102)
1321-3RB320-C[1]		0.125	351	366 (14.40)	286 (11.30)	267 (10.50)	181 (7.13)	117 (4.60)	72.6 (160)
1321-3RB400-A[1]	400	0.030	231	274 (10.80)	254 (10.00)	254 (10.00)	131 (5.16)	117 (4.60)	38.1 (84)
1321-3RB400-B[1]		0.060	333	381 (15.00)	286 (11.30)	292 (11.50)	172 (6.76)	117 (4.60)	53.5 (118)
1321-3RB400-C[1]		0.105	293	366 (14.40)	286 (11.30)	318 (12.50)	184 (7.26)	117 (4.60)	67.6 (149)
1321-3R500-A[1]	500	0.025	266	274 (10.80)	229 (9.00)	267 (10.50)	140 (5.50)	117 (4.60)	42.2 (93)
1321-3R500-B[1]		0.050	340	366 (14.40)	292 (11.50)	292 (11.50)	172 (6.76)	117 (4.60)	53.5 (118)
1321-3R500-C[1]		0.085	422	366 (14.40)	292 (11.50)	338 (13.30)	248 (9.76)	117 (4.60)	95.3 (210)
1321-3R600-A[1]	600	0.020	307	366 (14.40)	292 (11.50)	254 (10.00)	134 (5.26)	117 (4.60)	54.4 (120)
1321-3R600-B[1]		0.040	414	366 (14.40)	286 (11.30)	305 (12.00)	203 (8.00)	117 (4.60)	79.4 (175)
1321-3R600-C[1]		0.065	406	366 (14.40)	286 (11.30)	381 (15.00)	235 (9.26)	117 (4.60)	122.5 (270)
1321-3R750-A[1]	750	0.015	427	366 (14.40)	292 (11.50)	279 (11.00)	168 (6.63)	183 (7.20)	63.5 (140)
1321-3R750-B[1]		0.029	630	366 (14.40)	292 (11.50)	318 (12.50)	204 (8.01)	183 (7.20)	86.2 (190)
1321-3R750-C[1]		0.048	552	366 (14.40)	368 (14.50)	356 (14.00)	235 (9.26)	183 (7.20)	120.2 (265)
1321-3R750-E[1]		0.060	810	366 (14.40)	368 (14.50)	381 (15.00)	276 (10.88)	183 (7.20)	147.4 (325)
1321-3R850-A[1]	850	0.015	799	451 (17.80)	394 (15.50)	368 (14.50)	191 (7.50)	183 (7.20)	88.0 (195)
1321-3R850-B[1]		0.027	756	451 (17.80)	394 (15.50)	394 (15.50)	208 (8.20)	183 (7.20)	98.0 (215)
1321-3R850-C[1]		0.042	758	451 (17.80)	400 (15.80)	445 (17.50)	208 (8.20)	183 (7.20)	143.0 (315)
1321-3R1000-B[1]	1000	0.022	964	514 (20.25)	425 (16.80)	330 (13.00)	216 (8.50)	183 (7.20)	185.0 (408)
1321-3R1000-C[1]		0.038	960	514 (20.25)	425 (16.80)	381 (15.00)	273 (10.76)	183 (7.20)	267.2 (589)

(1) Removable lifting rings are supplied with the unit.

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this publication are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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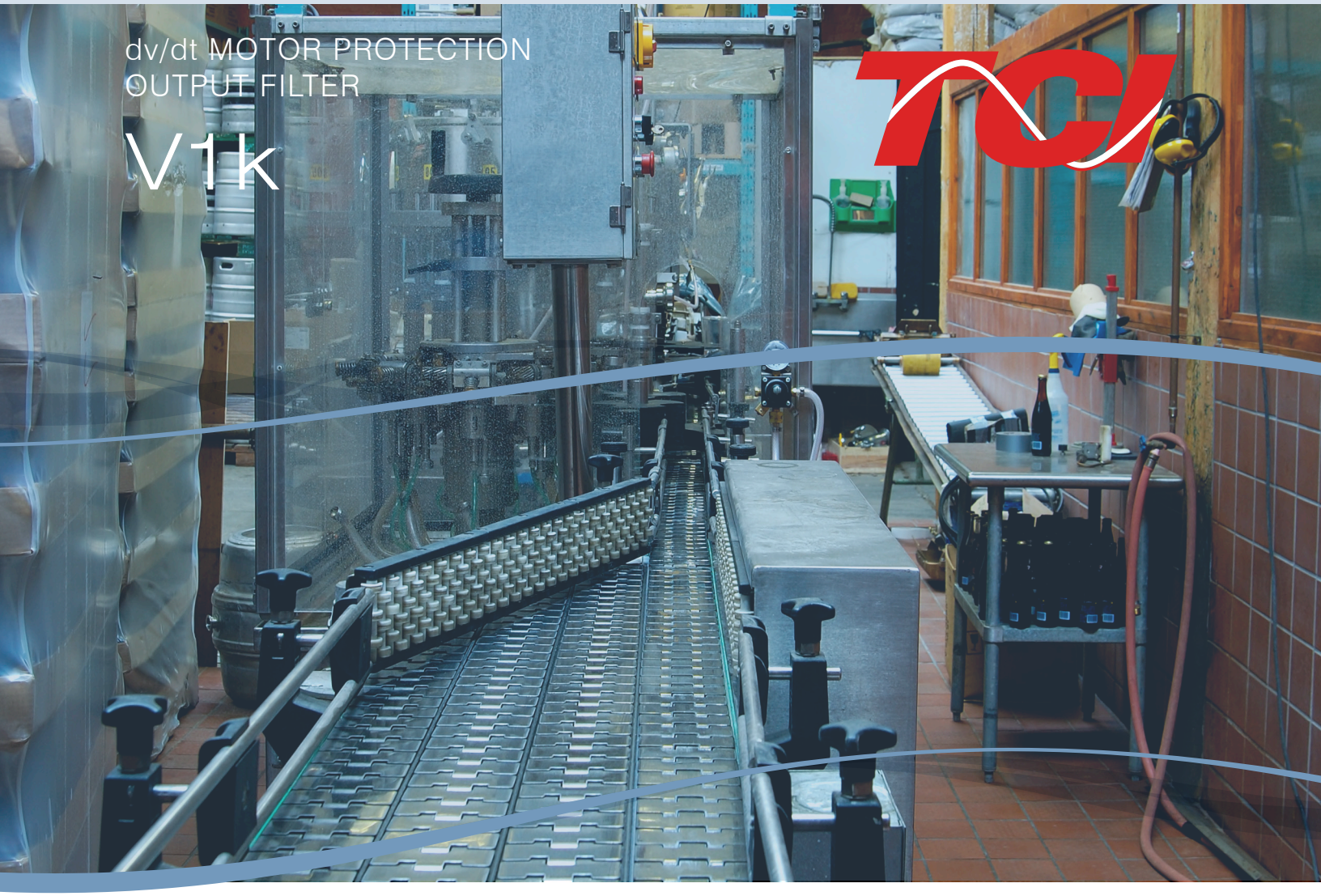
dv/dt MOTOR PROTECTION
OUTPUT FILTER

V1k



Limits voltage spikes below 1,000 Volts for long lead applications

- Greatly extends the life of the motor and cable
- Specific applications can reach 3,000 feet
- 30% reduction in Common Mode Current

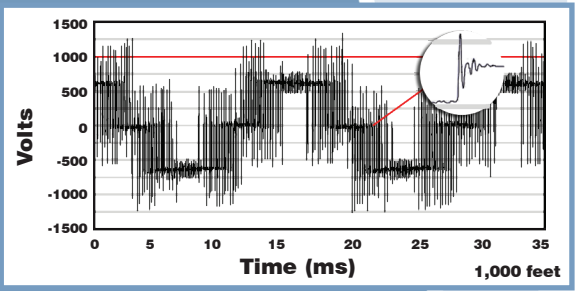
c UL US LISTED

Line Reactors • Harmonic Filters • EMC Filters • dv/dt Filters • Sinewave Filters

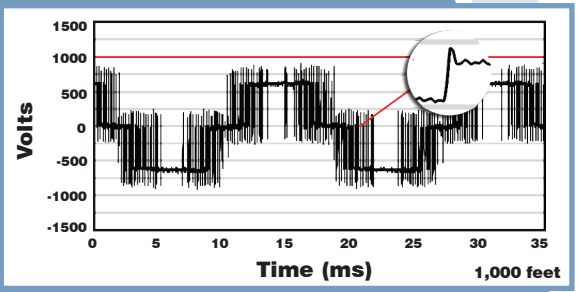
dv/dt MOTOR PROTECTION
OUTPUT FILTER

V1k

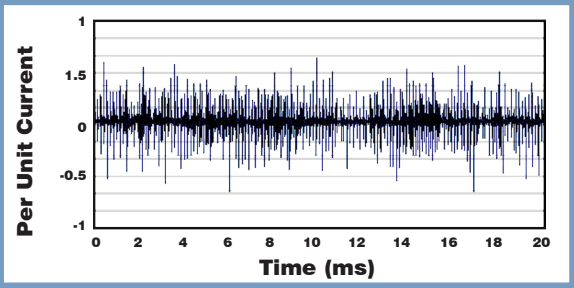
Voltage Without V1k



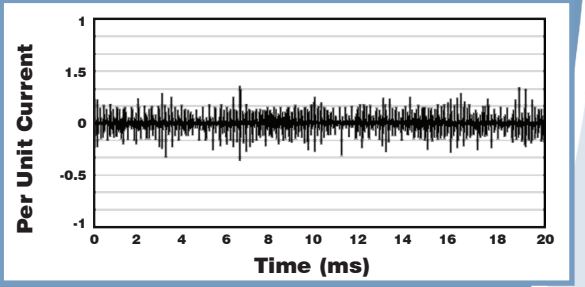
Voltage With V1k



Common Mode Without V1k



Common Mode With V1k



Typical Problems, Superior Solutions with V1k

As Pulse Width Modulated (PWM) Drives are incorporated into various applications and processes, the increased energy savings and decreased maintenance on Drives can be offset by increases in Motor failures.

The KLC-Series V1k product family has been designed as an engineered solution for motor failures due to the reflected wave phenomenon.

Reflective Wave Phenomenon

Voltage wave reflection is a function of the voltage rise time (dv/dt) and the length of the motor cables.

The impedance on either end of the cable run does not match, causing voltage pulses to be reflected back in the direction from which it arrived. As these reflected waves encounter other waves, their values add, causing higher peak voltage.

As wire length or carrier frequency increases, the overshoot peak voltage also increases.

Peak Voltages on a 460V system can reach 1200 to 1600V, causing rapid breakdown of motor insulation, leading to motor failure. On 575V systems, the peak voltages can easily reach 2100V. If this is left uncontrolled, insulation failure may occur.

Mitigate Reflective Wave

By combining a patented dampening circuit with a low pass filter, V1k filters:

- Increase the voltage rise time (dt out of dv/dt)
- Prevent voltage spikes from exceeding 1,000 V
- Slow pulse transitions, reduce dv/dt by a factor of 3 or more
- Protect motor and cable insulation

Reduces Common Mode Motor and Bearing Currents

Common Mode current, which lead to shaft voltages, bearing pitting, and bearing fluting is reduced by a minimum of 30%. V1k filters:

- Slow down the pulse dv/dt by a factor of 3, reducing the harmful common mode currents
- Increase bearing life and up-time
- Reduce common mode noise and currents

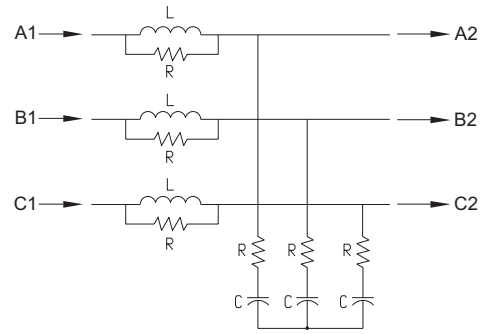
The V1K prevents voltage spikes from exceeding 1,000 V up to 2,000 feet and limits dv/dt to less than 1,000 V/ μs. The product has been used successfully in applications up to 3,000 feet depending on cable and VFD sizes.

Part Numbering System

V1K 80 A01 EX

Series
Current Rating (amps)
Enclosure
A00 = Open
A01 = UL Type 1
A03 = UL Type 3R
Option A
EX = Heavy Duty Model

One Line Diagram of Patented Design



THE dv/dt GUARANTEE

Properly sized and applied, TCI guarantees that the V1k will limit motor terminal peak input voltage to 150% of the bus voltage with a wire lead length of 1,000 feet and a carrier frequency of 4 kHz. Maximum lead length and carrier frequency can vary depending on wire lead type.

If a properly selected, installed and loaded V1k filter fails to meet the guaranteed performance levels, TCI will provide the necessary components or replacement filter at no additional charge.

TCI does not take responsibility for additional installation or removal costs to include but not limited to replacement of third party equipment. Please see TCI web site for minimum system requirements.

Product Specifications

- Ratings: 2 - 750 amps; 480 Volt; 7.5 - 600 HP
- Carrier Frequency: 1 - 12 kHz
- Fundamental Frequency: 0 - 60 Hz (consult factory for applications over 8 kHz and/or 60 - 120 Hz fundamental if the cable lengths exceed 400 feet)
- Efficiency: > 98%
- Insulation Rating: 600V Class
- Insulation Class:
  Class H (180°C) or Class R (220°C)
- Ambient Temperature: 40° C
- Maximum Altitude: 2,000 meters (6,000 feet)
  Derating necessary above 2,000 meters
- Agency Approvals: cUL, UL
- Enclosures: Open, UL Type 1, UL Type 3R
- Lead Length: Specific applications can reach 3,000 feet (consult factory for applications above 1,500 feet)
- SCCR Version Available

Reliable // Advanced Power Quality

V1k Typical Applications:

- Oil and Gas Pumps
- Irrigation Fields, Farms
- Water, Wastewater
- HVAC
- Pulp, Paper

Additional Power Quality Solutions:

KDR Line Reactor
- Prevents nuisance tripping
- Protects the source by lowering current distortion created by the drive

H5 Active Harmonic Filter
- Helps meet IEEE-519
- Reduces harmonic distortion to less than 5% TDD at full load
- Actively monitors the load current while returning the power factor to near unity

HG7 Passive Harmonic Filter
- Helps meet IEEE-519
- Reduces harmonic distortion to less than 7% TDD at full load
- Improves power factor

KRF EMC Filter
- Filter EMI/RFI noise caused by power switching devices
- Meet FCC regulation 15, subpart 3
- Prevents interference with automated lighting circuits, security cameras, and other critical electronics

KMG Motor Protection Output Filter
- Protects the motor by converting the PWM waveform into a near sinusoidal wave
- Prevents voltage overshoots that cause early degradation of insulation systems in motors, transformers, and cables
- Extends motor life by reducing operating temperature

TCI, LLC
www.transcoil.com

7878 North 86th Street
Milwaukee, WI 53224
USA

Toll Free: 800-824-8282
P: 414-357-4480
F: 414-357-4484

Please contact us about specific products and services.

Line Reactors • Harmonic Filters • EMC Filters • dv/dt Filters • Sinewave Filters

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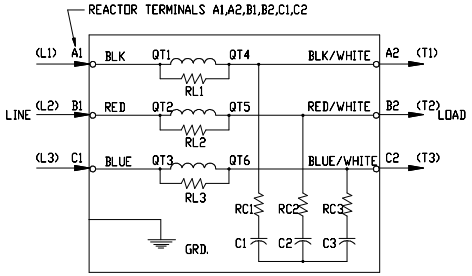
Part Number: 25383 Version 1.1

See V1K Installation Guide For
Terminal Wire Size And Torque Information.

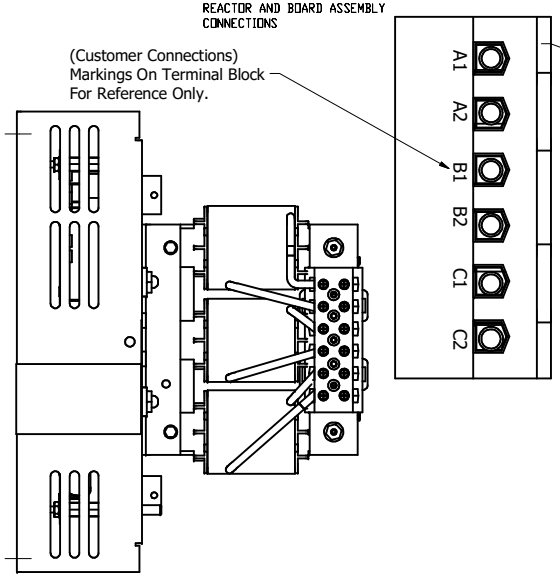
Note: Maintain Clearance of 3 Inches On All Sides To Other Equipment.

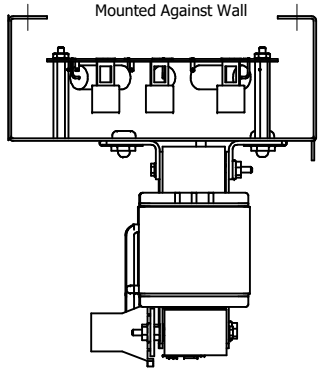
MIX.BLW-1,-2
SBR.BLW-1,-2,-3

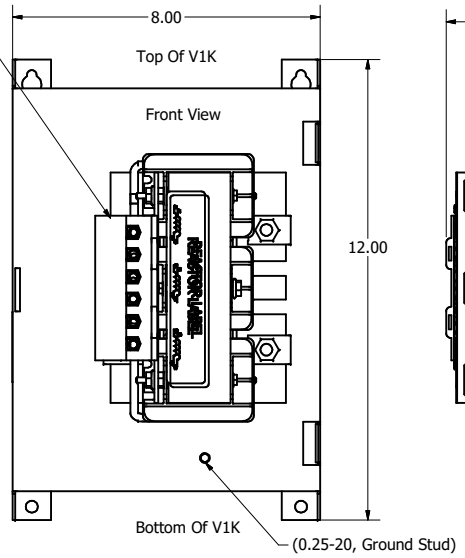
V1K Part Number	Max Voltage	Amps	Phase	Weight (LBS)
V1K80A00	600	80	3	23
V1K80A00EX	600	80	3	23

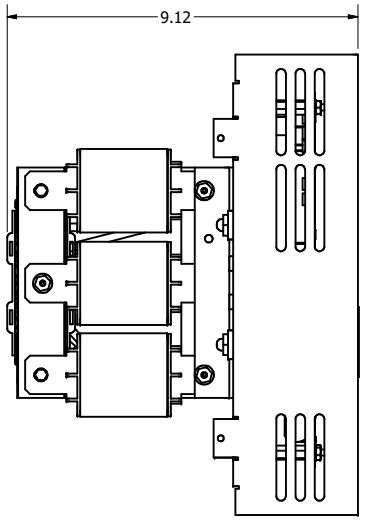


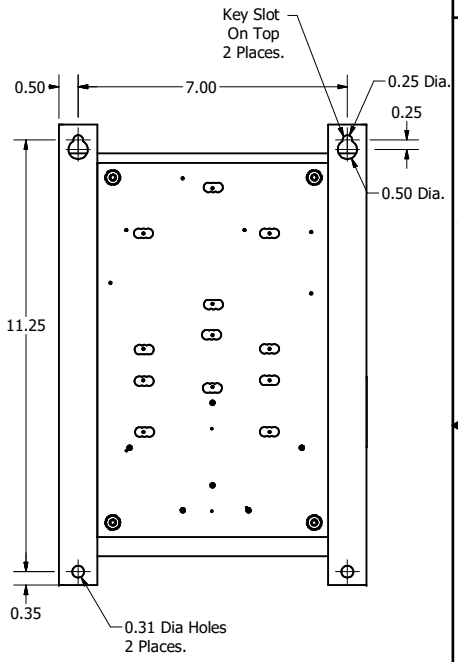
REACTOR AND BOARD ASSEMBLY CONNECTIONS

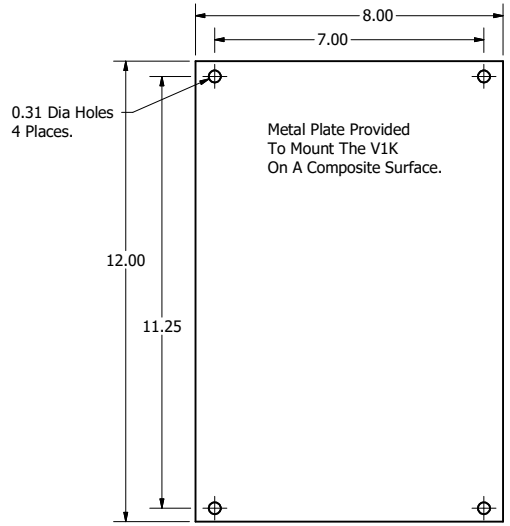












Customer Is Responsible For Installation to
Meet All National And Local Electrical Codes.

Material(s) Shall be RoHS Compliant

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NO	REVISION	DATE	BY
H	4658 Rated To Max Voltage	03/04/19	JRN
G	4030, Combine V1k Drawings	6/7/17	DSW

TOLERANCES (EXCEPT AS NOTED)
DECIMAL
.XX ± .25
.XXX ± .10
FRACTIONAL
± 1/16
ANGULAR
± 1°

TCI
W132 N10611 Grant Drive
Germantown, WI 53022

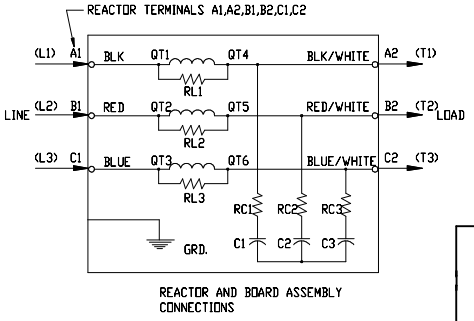
V1K, Open
80 Amps

DRN. BY: DSW
DATE: 4/26/17
SCALE: TO FIT
APRVD:
SIZE: C
102400DG
SHT 1 OF 1

See V1K Installation Guide For
Terminal Wire Size And Torque Information.

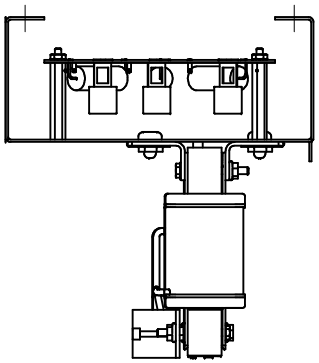
Note: Maintain Clearance of 3 Inches On All Sides To Other Equipment.

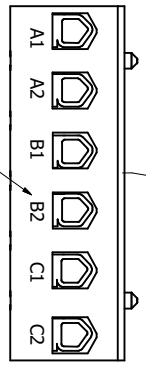
V1K Part Number	Max Voltage	Amps	Phase	Weight (LBS)
V1K35A00	600	35	3	17
V1K35A00EX	600	35	3	17
MIX.BLW-3 → V1K45A00	600	45	3	17
V1K45A00EX	600	45	3	17
MIX.BLW-4 → V1K55A00	600	55	3	17
V1K55A00EX	600	55	3	17



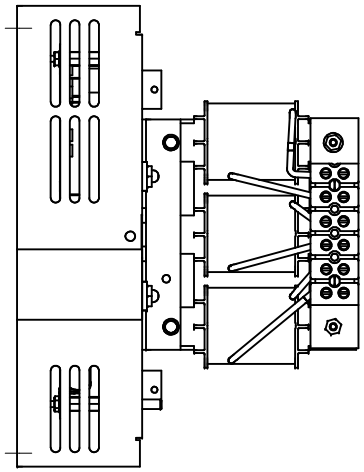
REACTOR AND BOARD ASSEMBLY
CONNECTIONS

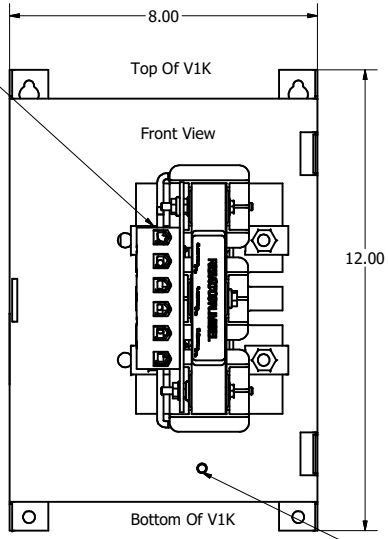
Back Of V1K
Mounted Against Wall

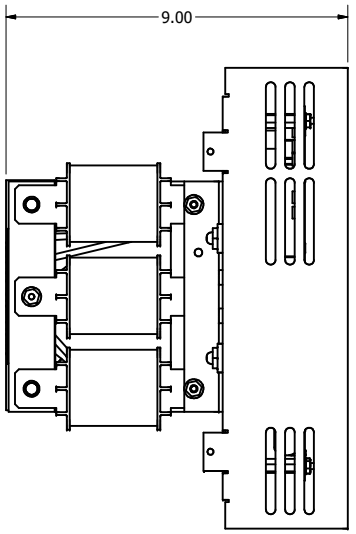


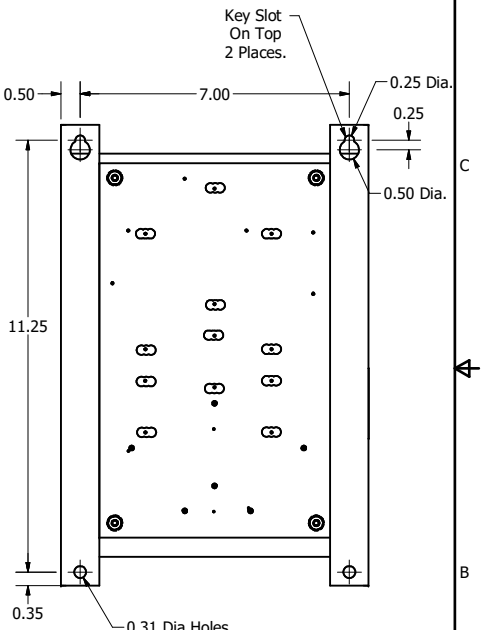


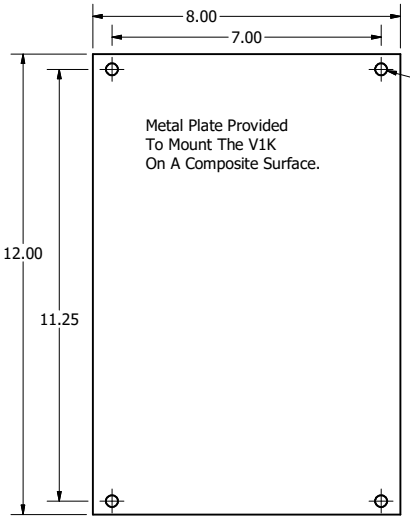
(Customer Connections)
Markings On Terminal Block
For Reference Only.











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NO	REVISION	DATE	BY
H	4658 Rated To Max Voltage	03/04/19	JRN
G	4030, Combine V1k Drawings	6/7/17	DSW

TOLERANCES (EXCEPT AS NOTED)
DECIMAL
.XX ± .25
.XXX ± .10
FRACTIONAL
± 1/16
ANGULAR
± 1°

TCI
W132 N10611 Grant Drive
Germantown, WI 53022

V1K, Open
35 Amps to 55 Amps

DRN. BY: DSW
DATE: 4/26/17
SCALE: TO FIT
APRVD:
SIZE: C
102397DG
SHT 1 OF 1

Allen-Bradley

Control Circuit Transformers

Bulletin Numbers 1497, 1497A, 1497B, 1497D

Topic	Page
1497 Control Circuit Transformer	4
1497A Machine Tool Transformer	9
1497B Control Power Transformer	14
1497D General Purpose Transformer	19

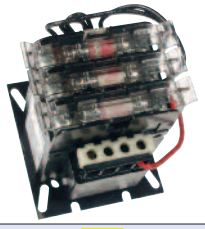
Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Transformers

				
Bulletin	1497	1497A	1497B	1497D
Type	**Control Circuit Transformer**	**Machine Tool Transformer**	**Control Power Transformer**	**General Purpose Transformer**
Features	• Single, dual, and multi-tap primary voltages • Single phase • EN 60-529 finger-safe protection • RoHS compliant • 50/60 Hz, 50 Hz, or 60 Hz • Optional Fusing	• Dual/Multi-tap • RoHS compliant • Single phase • 50/60 Hz • Optional Fusing	• Dual/Multi-tap • RoHS compliant • Single phase • 60 Hz only • Optional Fusing	• Indoor/outdoor non-ventilated enclosure • Single phase • Exceeds requirements of the Uniform Building Code (UBC) and California Code Title 24 • Copper windings provided for all transformers rated 2 kVA and below • Aluminum windings provided for all transformers rated 2 kVA and above • NEMA Type 3R rated enclosures • 50/60 HZ or 60 Hz
Output Power	63…2000VA	50…3000VA	50…3000VA	0.05…25 kVA
Input Voltage/ Primary Voltage	208…600V 220…550 (50 Hz)	208…575V (50/60 Hz)	120…600V	208…600V
Output Voltage/ Secondary Voltage	24…120V 24…230V (50 Hz)	24…120V (50/60 Hz)	24…240V	120…240V
Insulation	63…2000VA — Class 130 °C (55…80 °C temp. rise)	50…150VA — Class 105 °C (55 °C temp. rise) 200…1500VA — Class 130 °C (80 °C temp. rise) 2000…3000VA — Class 180 °C (100 °C temp. rise)		Class 180 °C (115 °C temp. rise)
Certifications	cULus, CE	cULus	cULus	UL, CSA
Standards	CSA C22.2 No. 66.1, EN 61558, UL 5085-1, 5085-2	CSA C22.2 No. 66.1, UL 5085-1, 5085-2	CSA C22.2 No. 66.1, UL 5085-1, 5085-2	CSA C22.2 No. 47 — M90, UL 1561
Page	**Page 4**	**Page 9**	**Page 14**	**Page 19**

Cat. No. 1497-B-HXJX-3-N
Control Circuit Transformer, 3-pole
Fuse Block with Optional
Cat. No. 1491-R150 Fuse Cover

Cat. No. 1497-C-BASX-0-N
Control Circuit Transformer, Non-Fused

Bulletin 1497 — Global Control Circuit Transformers

Bulletin 1497 Global Control Circuit Transformers are designed to reduce supply voltages to control circuits. The complete line of transformers is available with optional factory-installed or panel-mount primary and secondary fuse block. A dual primary and secondary fuse block is pre-wired and mounted on top of the transformer up to 500VA.

- 63…2000VA
- Single, dual, and multi-tap primary voltages
- Single phase
- EN 60-529 finger-safe protection
- RoHS compliant

Standards Compliance

UL 5085-1, UL 5085-2

EN61558

CSA C22.2 No. 66.1

Certifications

cULus Listed (File No. E52057; Guide No. XPTQ, XPTQ7)
CE

Catalog Number Explanation

Bulletin 1497 Multi-Tap Transformers

1497 – a – b – c – d

a

VA Rating	
Code	Description [VA]
A	63
B	80
C	130
D	200
E	250
F	350
G	500
H	750
J	800
K	1000
L	1600
M	2000

b

Primary and Secondary Voltage		
Code	Primary	Secondary
M1	240V, 208V	120V (60 Hz)
M2	240V, 208V	24V (60 Hz)
M3	240V, 208V	24V, 120V (60 Hz)
M4	415V, 400V, 380V	115X230V (50 Hz)
M5	415V, 400V, 380V	24V (50 Hz)

c

Fuse Block Options§	
Code	Block Options
0	0 Primary, 0 Secondary
1	0 Primary, 1 Secondary
2	2 Primary, 0 Secondary
3	2 Primary, 1 Secondary

d

Factory Installed Options	
Code	Description
N	No Fusing, No Cover

Bulletin 1497 Transformers

1497 – a – BADX – c – d

a

VA Rating	
Code	Description [VA]
A	63
B	80
C	130
D	200
E	250
F	350
G	500
H	750
J	800
K	1000
L	1600
M	2000

MIX.BLW-3
MIX.BLW-4
MIX.BLW-1,-2
SBR.BLW-1,-2,-3

b

Primary and Secondary Voltage		
Code	Primary	Secondary
HX	208V (60 Hz)	—
AX	240V (60 Hz), 220V (50 Hz)	—
BA∗	240X480V (60 Hz), 220X440V (50 Hz)	—
CX❄	600V (60 Hz), 550V (50 Hz)	—
DX‡	—	120V (60 Hz)
JX	—	24V (60 Hz)
SX	—	120V (60 Hz), 110V (50Hz)
JK	—	24V (50 Hz), 26V (60 Hz)

c

Fuse Block Options§	
Code	Block Options
0	0 Primary, 0 Secondary
1	0 Primary, 1 Secondary
2	2 Primary, 0 Secondary
3	2 Primary, 1 Secondary

d

Factory Installed Options	
Code	Description
N	No Fusing, No Cover

∗ When the primary voltage code **BA** is selected and a 120V AC secondary is desired, the secondary voltage code **SX** should be selected.
❄ VA rating codes **G**, **H**, or **J** with primary voltage over 500V have only cULus approval.
‡ Not available for use with primary voltage code **BA**.
§ VA rating codes **H**…**M** are only available with no fuse block option (**0**).

Selecting a Control Circuit Transformer

For proper transformer selection, three characteristics of the load circuit must be determined in addition to the minimum voltage required to operate the circuit. These are total steady-state (sealed) VA, total inrush VA, and inrush load power factor.

- Total steady-state (sealed) VA is the volt-amperes that the transformer must deliver to the load circuit for an extended period of time — the amount of current required to hold the contact in the circuit.
- Total inrush VA is the volt amperes that the transformer must deliver upon initial energization of the control circuit. Energization of electromagnetic devices takes 30…50 milliseconds. During this inrush period, the electromagnetic control devices draw many times normal current — 3…10 times normal is typical.
- Inrush load power factor is difficult to determine without detailed vector analysis of all the load components. Such an analysis is generally not feasible. Therefore, a safe assumption is 40% power factor.

Selection Process

1. Determine the total inrush VA of the control circuits from the table below. Do not neglect the current requirements of indicating lights and other devices that do not have an inrush VA but are re-energized at the same time as the other components in the circuit. Their total VA should be added to the total inrush VA.
2. Refer to the table below, *Regulation Data — Inrush VA*. If the supply circuit voltage (Step 1) is reasonably stable and fluctuates not more than ± 5%, refer to the 90% secondary voltage column. If it fluctuates as much as ± 10%, refer to the 95% secondary voltage column. Go down the column selected until at the inrush VA closest to, but not less than, the inrush VA of the control circuit.
3. Read to the far left side of the chart. The transformer's continuous nominal VA rating is now selected. The secondary voltage that will be delivered under inrush conditions will be either 85%, 90%, or 95% of the rated secondary voltage, depending on the column selected from the table below, *Regulation Data — Inrush VA*. The total sealed VA of the control circuit must not exceed the nominal VA rating of the transformer selected from the table below, *Typical Magnetic Motor Starter and Contactor Data 60 Hz, 120 Volt, 3-Pole*.
4. Refer to the specification tables on the following pages to select a transformer according to the required continuous nominal VA, and primary and secondary voltage combinations.

Regulation Data — Inrush VA

Inrush VA at 40% Power Factor				Power Factor Adjustments	
Nominal VA Rating	85%	90%	95%	Power Factor	Multiply By
63	347	289	216	100%	0.64
80	338	290	229	90%	0.67
130	907	745	541	80%	0.71
200	1267	1039	754	70%	0.78
250	1394	1116	781	60%	0.82
350	2870	2298	1584	50%	0.91
500	3786	3013	2065	40%	1.00
750	7360	5763	3786	30%	1.11
800	7360	5763	3786	20%	1.29
1000	8837	6785	4329	10%	1.50
1600	14921	11328	7070	—	—
2000	20500	14850	9100	—	—

Typical Magnetic Motor Starter and Contactor Data 60 Hz, 120 Volt, 3-Pole

	NEMA Size						
Contactor	0	1	2	3	4	5	
Bulletin 500	192	192	240	660	1225	1490	VA Inrush
	29	29	29	45	69	96	VA Sealed

Fuse Sizing Charts

Important: Select the fuse to protect the control circuit conductors in accordance with the National Electrical Code.

Primary Fuse Sizing Chart (When Only Primary Protection is Used)

Maximum Amp Rating for Current Limiting Fuses Based on Transformer Primary Voltage and the National Electrical Code

VA	208V	220V	240V	277V	347V	380V	400V	415V	440V	480V	500V	550V	600V	690V
63	0.75	0.75	0.75	0.5	0.5	0.4	0.4	0.4	0.4	0.25	0.25	0.25	0.25	0.25
80	1	1	1	0.75	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.25
130	1.5	1.5	1.5	1.25	1	1	0.75	0.75	0.75	0.75	0.75	0.5	0.5	0.5
200	2.5	2.5	2.5	2	1.5	1.5	1.5	1.25	1.25	1.25	1	1	1	0.75
250	3	3	3	2.5	2	1.5	1.5	1.5	1.5	1.5	1.5	1.25	1.25	1
350	5	4	4	3	3	2.5	2.5	2.5	2	2	2	1.5	1.5	1.5
500	4	3	3	5	4	3	3	3	3	3	3	2.5	2.5	2
750	6	5	5	4	3	5	5	5	5	4	4	4	3	3
800	6	6	5	4	3	3	3	5	5	5	4	4	4	3
1000	8	7	6	6	4	4	4	4	3	3	3	5	5	4
1600	12	12	11	9	7	7	6	6	6	5	5	4	4	3
2000	12	11	13	12	9	8	8	8	7	6	6	6	5	4

Primary Fuse Sizing Chart (When Primary and Secondary Protection is Used)

Maximum Amp Rating for Current Limiting Fuses Based on Transformer Primary Voltage and the National Electrical Code

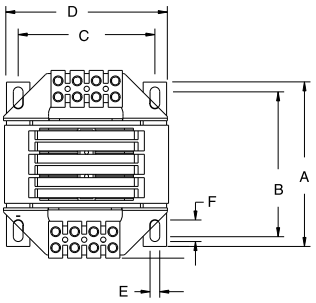
VA	208V	220V	240V	277V	347V	380V	400V	415V	440V	480V	500V	550V	600V	690V
63	0.75	0.75	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.25	0.25	0.25
80	1.5	1.5	1.5	1	1	1	1	0.75	0.75	0.75	0.75	0.5	0.5	0.5
130	3	2.5	2.5	2	1.5	1.5	1.5	1.5	1.25	1.25	1.25	1	1	0.75
200	4	4	4	3	2.5	2.5	2.5	2	2	2	2	1.5	1.5	1
250	6	5	5	4	3	3	3	3	2.5	2.5	2.5	2	2	1.5
350	8	7	7	6	5	4	4	4	3	3	3	3	2.5	2.5
500	6	5	5	9	7	6	6	6	5	5	5	4	4	3
750	9	8	7	6	5	9	9	9	8	7	7	6	6	5
800	9	9	8	7	5	5	5	8	8	8	8	7	6	5
1000	12	10	10	9	7	6	6	6	5	5	5	8	8	7
1600	15	15	15	12	11	10	10	9	9	8	8	7	6	5
2000	20	20	20	18	14	12	12	12	10	10	10	9	8	7

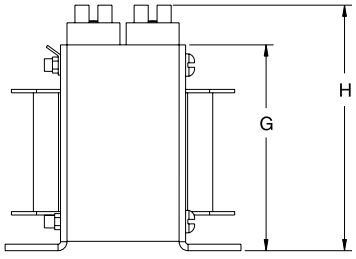
Secondary Fuse Sizing Chart

Maximum Amp Rating for Current Limiting Fuses Based on the National Electrical Code

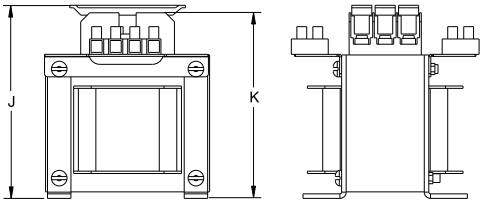
VA	24V	110V	115V	120V	230V
63	4	0.75	0.75	0.75	0.4
80	5	1	1	1	0.5
130	9	1.8	1.8	1.8	0.9
200	13	2.5	2.5	2.5	1.25
250	15	3.2	3.2	3.2	1.5
350	20	4.5	4.5	4.5	2.5
500	30	6.25	6.25	6.25	3
750	45	9	9	9	4.5
800	45	9	9	9	4.5
1000	60	12	12	12	6
1600	100	20	20	20	10
2000	—	25	25	25	12

Dimensions are shown in inches (millimeters). Dimensions are not intended to be used for manufacturing purposes.





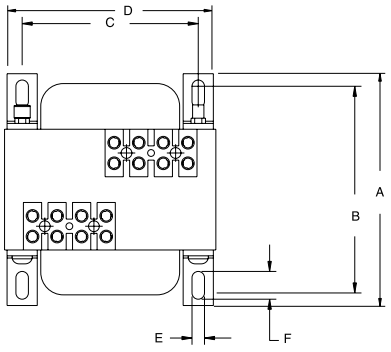
Transformer without Fusing

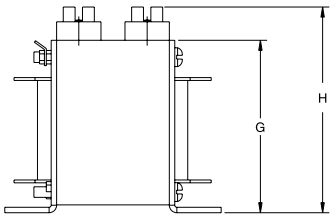


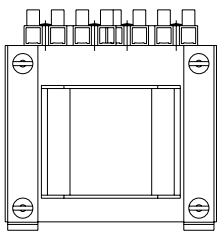
Transformer with Fuse Holder and Covers

MIX.BLW-3
MIX.BLW-4

VA	A	B	C	D	E	F	G	H	J	K	Approximate Shipping Wt. — lb (kg)	
											Without Top-Mounted Fuse Block	2-Pole Primary and 1-Pole Secondary Top-Mounted Fuse Block
500	5-1/4 (133.35)	4-33/64 (114.81)	4-3/8 (111.25)	5-1/4 (133.35)	5/16 (7.87)	45/64 (18.03)	4-17/32 (114.81)	5-1/2 (139.70)	6-3/16 (156.97)	5-15/16 (150.62)	17-3/5 (7.98)	17-19/20 (8.14)







Transformer without Fusing

MIX.BLW-1,-2
SBR.BLW-1,-2,-3

VA	A	B	C	D	E	F	G	H	Approximate Shipping Wt. — lb (kg)
									Without Top-Mounted Fuse Block
750	5-3/4 (146.05)	5 (127.51)	4-3/8 (111.25)	5-1/4 (133.35)	5/16 (7.87)	45/64 (18.03)	4-9/16 (114.81)	5-19/32 (137.41)	21-1/2 (9.75)
	5-3/4 (146.05)	5 (127.51)	4-3/8 (111.25)	5-1/4 (133.35)	5/16 (7.87)	45/64 (18.03)	4-9/16 (114.81)	5-19/32 (137.41)	21-1/2 (9.75)
1000	6-3/8 (161.92)	5-3/8 (136.53)	5-5/16 (134.94)	6-3/8 (161.92)	5/16 (7.87)	45/64 (18.03)	5-33/64 (140.21)	6-1/2 (162.56)	37-1/5 (16.87)
1600	8-1/2 (215.90)	7-1/4 (184.15)	5-3/4 (143.76)	6-3/4 (171.45)	7/16 (10.92)	45/64 (18.03)	5-3/4 (146.05)	7-1/16 (168.66)	50-4/5 (23.04)
2000	9-1/2 (241.30)	8-1/4 (209.55)	5-3/4 (143.76)	6-3/4 (171.45)	7/16 (10.92)	45/64 (18.03)	5-11/64 (149.86)	7-1/16 (172.47)	61 (27.67)

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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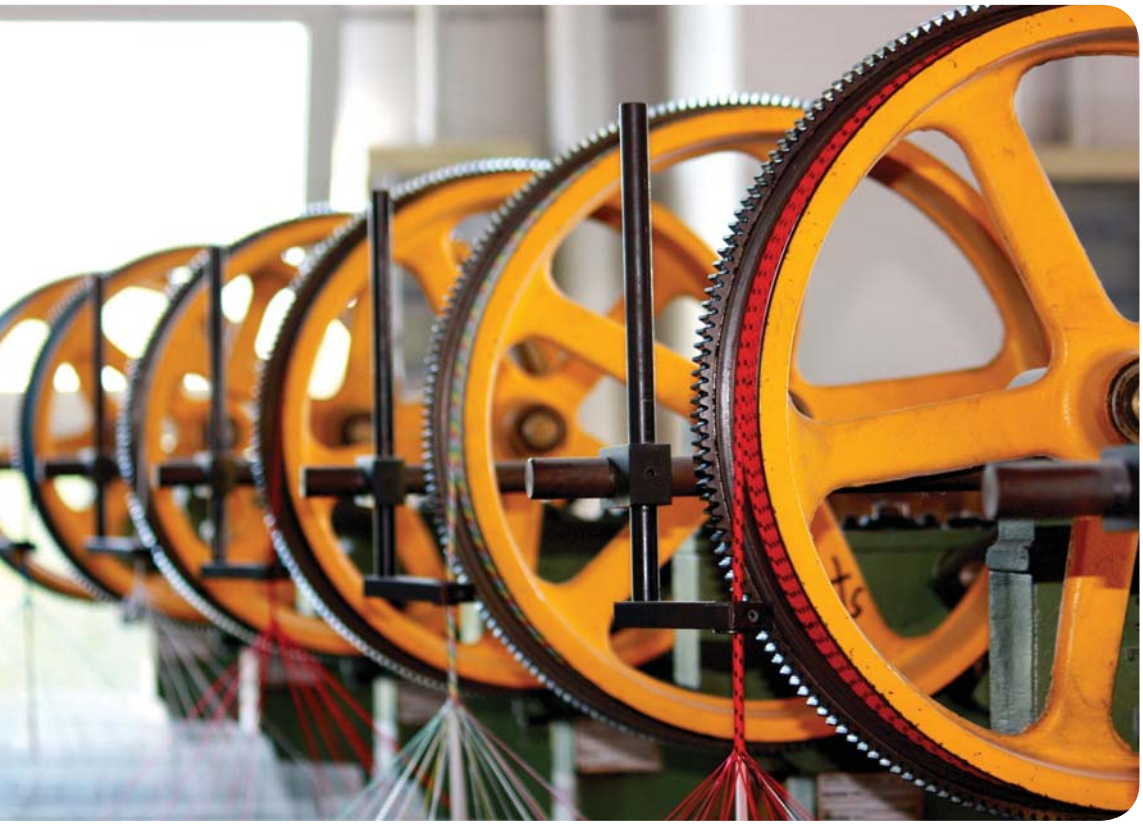
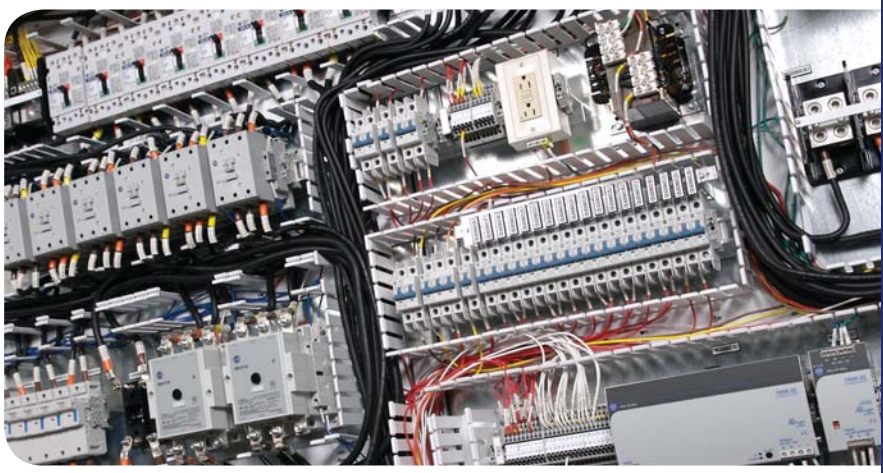
General Purpose, Interposing, Solid-State and Specialty Relays

Bulletin 700

Allen-Bradley





LISTEN. THINK. SOLVE.®

Allen-Bradley • Rockwell Software

Rockwell Automation

Breadth of Product. Ease of Selection.

World-class Allen-Bradley relays and timing relays by Rockwell Automation are designed, manufactured, and tested to meet your standard and most critical demands. We want you to focus your core activities, not parts. We offer a broad product selection that provides flexibility and industry-proven reliability.

Ideal Applications

- Reduced PLC outputs to meet energy consumption goals
- Provides longer life for PLC, saving money and increasing efficiency
- Switching currents or voltage too high for PLC outputs to handle
- Interfacing two or more system voltages – for example, 24V to 120V
- Controlling multiple loads from safety and interlock commands
- Logic for manual control
- Reduced PLC outputs by using relays to turn many devices on and off simultaneously
- Provides isolation from solid-state output leakage current

LONG LIFE + LOWER POWER CONSUMPTION + PLC COMPATIBILITY = SAVINGS FOR YOU

General Purpose Relays

Features

700-HA

- Pin-style terminals
- Bifurcated contacts with gold plating for low-energy

Control Relays

700-HB

- Blade-style quick connect terminals
- Color-coded voltage type for quick installation

700-HD

- Blade-style quick connect terminals
- Mounts directly to a panel – no DIN Rail required

700-HF

- Plug-in quick connect terminals
- Clear cover to allow visual inspection of contacts

700-HA

700-HB

Solid-State Relays

Features

700-SH

- High continuous load currents are achievable with heat sinks
- LED indicator for Input/Logic ON/OFF status monitoring

700-SH

700-SK

- High-response speed model
- Input and output modules allow flexibility

700-SK

Interposing Relays

Features

700-HL

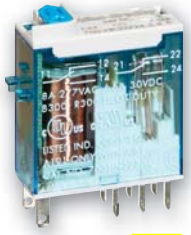
- Screw terminals or cage clamp terminals are available
- Leakage current suppression versions are available to address concerns of nuisance coil turn-on or non-dropout current when converting to PLCs with overage current

700-HL

700-HK

Interposing Relays

- Plug-in blade-style terminals
- Jumper system reduces wearing costs



700-HK

700-HC

- Blade-style terminals
- Same sockets can be used for DPDT or 4PDT versions which improves flexibility and reduces inventory

700-HP

- Plug-in pin style (PCB) terminals
- Economical PCB style design

Specialty Relays

Features

700-HG

- Auxiliary snap action switch versions
- Popular 3V HVAC applications

700-HG

700-HHF

- Blade-style quick connect terminals
- Pilot light available for visual identification of power to the coil

Latching 700-HJ

- Magnetic latching relay for energy savings
- Dual coil version available

Alternating 700-HTA

- Alternating feature allows users to select the primary or secondary load or alternate between the two

700-HJ

General Purpose Timing Relays

Features

700-HR

- Pin-style terminals
- Multiple voltage inputs to address a wide range of applications

700-HR

700-HNC

- Blade-style terminals
- Four different timing functions available

700-HT

- Pin-style terminals
- Higher contact rating for larger loads

700-HT

700-HX

- Pin-style terminals
- LCD display to make setting easier
- Environmentally friendly with flash memory, no battery

700-HX

700-HLF

- Compact size, only 6.2 mm wide when space is critical
- Gold contacts available for low voltage applications

700-FE

- Versions available with 1 N.O. contact
- Small (17.5 mm), effective economy timer

700-FS

- Space-saving 22.5 mm design
- State-of-the-art automatic voltage switching capability available

700-FE

General Purpose Relays

Allen-Bradley relays and timers offer compatible and versatile solutions for control applications – from programmable controllers and motor starters to push buttons and terminal blocks. General purpose relays feature an excellent flexible design and industry-proven reliability. Each relay is tested during manufacturing – before it is used in your demanding application – and carries international approvals that assure you the relay will stand the test of time anywhere in the world.

700-HA

Control Relays

700-HB

700-HD

700-HF

	700-HA	700-HB	700-HD	700-HF
Mounting Style	Plug-in	Plug-in	Flange-mounted	Plug-in
Load Capacity [A]	10	15	15	10
2DPDT	✓	✓	✓	✓
3DPT	✓	✓	✓	✓
4DPT				✓
Options				
LED	✓	✓		✓
Manual Override	✓	✓		✓
Visible Indicator	✓	✓	✓	
Comparable w/ Plug Accessories Modules	✓	✓		

Interposing Relays

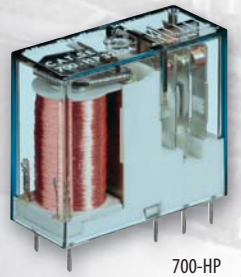
This line of interposing relays is designed to fit a wide range of industrial applications. We have solutions for almost all application needs such as tight cabinet space, low capacity-switching capability and hazardous locations, just to name a few.

700-HL

700-HK

Interposing Relays

700-HC



700-HP

	700-HL	700-HK	700-HC	700-HP
Ideal Applications	Space-saving PLC interfaces (Low-energy, solid-state and hazardous location versions available)	General Industrial (Versions with low-energy or max duty contacts available)	General industrial	General industrial
Mounting Style	DIN Rail	Plug-in	Plug-in	Plug-in
Load Capacity	6 A SPDT/10 A DPDT/2 A SSR DC/1 A SSR AC	16 A SPDT/8 A DPDT	10 A DPDT/7 A 4PDT	8 A DPDT
SPDT	✓	✓		
DPDT	✓	✓	✓	✓
4PDT			✓	
SSR AC	✓			
SSR DC	✓			
Options				
LED	Standard	✓	✓	
Manual Override		✓	✓	
Visual Indicator		✓	✓	
Comparable w/Plug Accessories Modules		✓	✓	✓

Solid-State Relays

If you are looking for a green, flexible yet rugged relay, our solid-state relays are the solution. Built for long life and high-frequency switching, these relays use less energy, but are highly compatible to reduce downtime and spare parts.

700-SH

700-SK

	700-SH	700-SK
Ideal Applications	High frequency switching and high shock vibration applications	Output module for typical SSR applications
Mounting Style	Panel	Plug-in
Load [A]	10-100	1.5-2
1 N.O. Contact	✓	✓
Optional LED	✓ (standard)	✓

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800T/H 30 mm Push Buttons

Allen-Bradley

Time-tested Durability, Industry Proven –
A Legacy of Leadership

LISTEN.
THINK.
SOLVE.®

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Imitated, But Never Duplicated

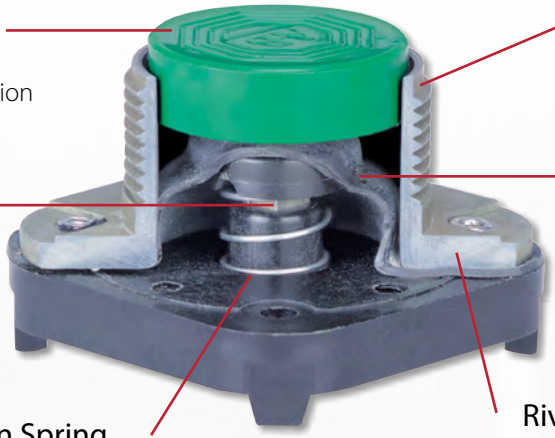
The Allen-Bradley Bulletin 800T and 800H push button product lines are in a class by themselves. They are designed and constructed to perform in the most demanding industrial environments. Bold yet functional, rugged yet attractive, Allen-Bradley's 30 mm push buttons represent the world's most innovative and unique offering.

Solid-Color Button Cap

Thermoplastic polyester resin delivers excellent resistance to corrosive agents/color identification is never lost (no insert to lose).

Actuator Shaft

Rugged, dependable performance assured by zinc alloy casting.



Operator Bushing

Die cast zinc alloy gives strength and stability in installation.

Diaphragm Seal

Provides a complete blanket of protection from liquids, particles and corrosive agents.

Return Spring

Stainless steel formed wire delivers consistent operation and long life.

Riveted Construction

Operator bushing, diaphragm seal and base plate are secured together by four steel rivets, providing durability and tamper resistance.

Fast, Easy Installation

Operator with factory installed contact blocks

Gaskets provide type 4/13 ingress protection

Legend plate

Thrust washer with anti-turn tab

Mounting ring

Worldwide Solutions

- Designed to worldwide standards

Switching Safety

Selector Switches

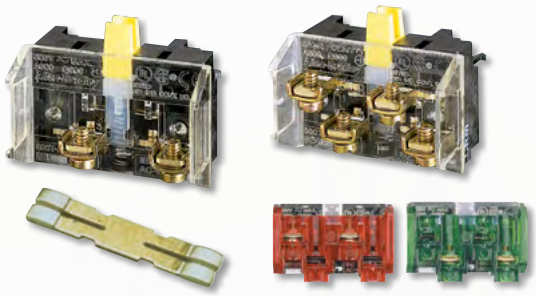
- Positive detent – prevents the switch from hanging up between positions
- Constant energy – minimizes accidental switching to an unwanted change in contact state

Advanced Switching Functionality

Allen-Bradley's wide range of contact blocks, offering features and capabilities found no where else in the industry, can address more applications and environments.

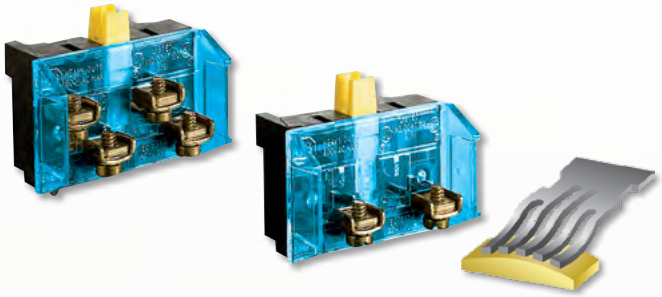
Standard Contact Blocks

- 10 A max., A600 rated – for general purpose use
- Flexible bifurcated spanner provides increased contact reliability
- Pure fine silver contacts resist corrosion
- Self-lifting saddle clamps simplify wiring
- Clear side plates allow easy inspection of contacts
- Optional color-coded finger safe (IP2X) versions



PenTUFF™ Contact Blocks

- 2.5 A max., C300 rated
- Low voltage switching reliability to 5V DC, 1 mA – ideal for interfacing with programmable logic controller input circuits
- Direct drive pentafurcated contact design
- Spanner made from corrosion resistant inert precious metals
- Optional finger-safe (IP2X) versions

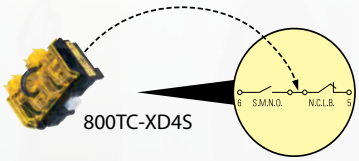


Explosion-Protected Contact Blocks

- Class I Div. 2 (Groups A, B, C and D) certified
- 1-NO, 1-NC, A600 rated (10 A max)
- Positive opening NC contact, conformance to global E-stop standards
- Rugged construction ideal for applications with high shock and vibration
- Stackable design allows maximum circuit flexibility

Self-Monitoring™ Contact Blocks

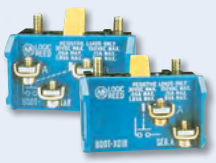
- Ensures that the normally closed contacts will open when the E-stop is actuated
- 10 A max., A600 rated
- Bifurcated spanner with pure fine silver contacts
- Color-coded yellow for easy identification
- IP2X finger safe protection standard



	Normal Operation	Actuated Button	Improperly Installed
S.M.N.O.	X	X	O
N.C.L.B	X	O	X
	X	O	O

Note: X = Closed O = Open

Logic Reed Blocks

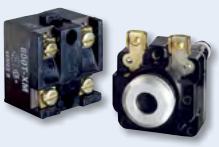


Sealed Switch Blocks

Mini Blocks

MaxDuty™ Blocks

Snap Action & Time Delay Blocks



Push Button Devices

Momentary Contact Push Buttons, Non-Illuminated

Contact Configuration	Color	Type 4/13 Metal (800T) Flush Head	Type 4/13 Metal (800T) Extended Head	Type 4/4X/13 Plastic (800H) Bootless Flush Head	Type 4/4X/13 Plastic (800H) Booted
1 N.O.	Green	800T-A1D1	800T-B1D1	800H-AR1D1	800H-R1D1
	Black	800T-A2D1	800T-B2D1	800H-AR2D1	800H-R1D1
	Red	800T-A6D1	800T-B6D1	800H-AR6D1	800H-R6D1
1 N.C.	Green	800T-A1D2	800T-B1D2	800H-AR1D2	800H-R1D2
	Black	800T-A2D2	800T-B2D2	800H-AR2D2	800H-R2D2
	Red	800T-A6D2	800T-B6D2	800H-AR6D2	800H-R6D2
1 N.O. – 1 N.C.	Green	800T-A1A	800T-B1A	800H-AR1A	800H-R1A
	Black	800T-A2A	RESET Pushbutton 2A	800H-AR2A	800H-R2A
	Red	800T-A6A	800T-B6A	800H-AR6A	800H-R6A

Other colors available: blue, gray, orange and white.

Momentary Contact Push Buttons, Non-Illuminated with Two-Color Molded Legend Cap

Contact Configuration	Button Color	Legend Color	Legend	Head Type	Type 4/13 Metal (800T)	Type 4/4X/13 Plastic (800H)
1 N.O. – 1 N.C.	Green	○	Start	Flush	800T-A103WA	800H-AR103WA
	Red	○	Stop	Extended	800T-B604WA	800H-BR604WA
1 N.O. – 1 N.C.	Black	○	Forward	Flush	800T-A210WA	800H-AR210WA
	Black	○	Reverse	Flush	800T-A210WA	800H-AR210WA
	Black	○	Jog	Flush	800T-A210WA	800H-AR212WA
	Black	○	Up	Flush	800T-A210WA	800H-AR213WA
	Black	○	Down	Flush	800T-A210WA	800H-AR214WA
	Blue	○	Reset	Flush	800T-A707WA	800H-AR707WA

Momentary Contact Push Buttons, Illuminated

Type	Color	Type 4/13 Metal (800T) Extended Head without Guard	Type 4/13 Metal (800T) Extended Head with Guard	Type 4/4X/13 Plastic (800H) Extended Head without Guard	Type 4/4X/13 Plastic (800H) Extended Head with Guard
Universal LED 12–130V AC/DC 1 N.O. – 1 N.C.	Red	800T-QBH2R	800T-QAH2R	800H-QRBH2R	800H-QRAH2R
	Green	800T-QBH2G	800T-QAH2G	800H-QRBH2G	800H-QRAH2G
	Yellow	800T-QBH2A	800T-QAH2A	800H-QRBH2A	800H-QRAH2A
Transformer LED 120V AC, 50/60 HZ 1 N.O. – 1 N.C.	Red	800T-PBH16R	800T-PAH16R	800H-PRBH16R	800H-PRAH16R
	Green	800T-PBH16G	800T-PAH16G	800H-PRBH16G	800H-PRAH16G
	Yellow	800T-PBH16A	800T-PAH16A	800H-PRBH16A	800H-PRAH16A

Other colors available: blue, clear, yellow and white.

Pilot Light Devices

Type	Color	Type 4/13 Metal (800T) Standard Type	Type 4/13 Metal (800T) Push-to-Test	Type 4/4X/13 Plastic (800H) Standard Type	Type 4/4X/13 Plastic (800H) Push-to-Test
Universal LED 12–130V AC/DC		800T-QH2R	800T-QTH2R	800H-QRH2R	800H-QRTH2R
		800T-QH2G	800T-QTH2G	800H-QRH2G	800H-QRTH2G
		800T-QH2A	800T-QTH2A	800H-QRH2A	800H-QRTH2A
Transformer LED 120V AC, 50/60 HZ		800T-PH16R	OFF Pilot Light H16R	800H-PRH16R	800H-PRTH16R
		800T-PH16G	RUN Pilot Light H16G	800H-PRH16G	800H-PRTH16G
		800T-PH16A	FAULT, HIGH TEMP, HIGH PRESSURE Pilot Lights H16A		800H-PRTH16A

Other colors available: blue, clear, white and yellow

Emergency-Stop and Push-Pull Devices

2-Position Push-Pull and Trigger Action, Non-Illuminated

Contact Configuration	Operator Position	Type 4/13 Metal (800T) Push-Pull	Type 4/13 Metal (800T) Trigger Action Twist Release	Type 4/13 Metal (800T) Trigger Action Key Release	Type 4/4X/13 Plastic (800H) Trigger Action Twist Release
	Maintained Out X In O				
(2) S.M.C.B.		800TC-FX6A5S	800TC-TFXT6A5S	800TC-TFXK6A5S	800HC-TFRXT6A5S
(2) N.C.L.B./(2) N.C.		800TC-FX6A5	800T-TFXT6A4	800T-TFXK6A4	800H-TFRXT6A4

2-Position Push-Pull and Trigger Action, Illuminated

Type	Operator Position	Type 4/13 Metal (800T) Push-Pull	Type 4/13 Metal (800T) Trigger Action Twist Release	Type 4/4X/13 Plastic (800H) Trigger Action Twist Release
	Maintained Out O X In X O			
Universal LED 12…130V AC/DC (1) N.O. (1) S.M.C.B.		800TC-FXQH2RA1S	800TC-TFXTQH2RA1S	800HC-TFRXTQH2RA1S
Transformer, LED 120V AC, 50/60 HZ (1) N.O. (1) N.C.L.B. /N.C.		800T-FXPH16RA1	800T-TFXTPH16RA1	800H-TFRXTPH16RA

3-Position Selector Switches, Non-Illuminated

Contact Configuration	Operator Type	Type 4/13 Metal (800T)			Type 4/4X/13 Plastic (800H)
		Standard Knob	Knob Lever	Cylinder Lock	Standard Knob
1 N.O. – 1 N.C.		800T-J2A RUN-OFF-REMOTE Selector		800T-J42A	800H-JR2A
		800T-J4A	800T-J18A	800T-J50A	800H-JR4A
		800T-J5A	800T-J19A	800T-J38A	800H-JR5A
		800T-J91A	800T-J20A	800T-J631A	800H-JR91A

3-Position Selector Switches, Illuminated

Type	Operator Type	Type 4/13 Metal (800T)	Type 4/4X/13 Plastic (800H)
		Standard Knob	Standard Knob
Universal LED 12-130V AC/DC Red Knob 1 N.O. – 1 N.C.		800T-2JRH2KB7AX	800H-2JRRH2KB7AX
		800T-2JRH4KB7AX	800H-2JRRH4KB7AX
		800T-2JRH5KB7AX	800H-2JRRH5KB7AX
Transformer Red LED 120V AC, 50/60 HZ 1 N.O. – 1 N.C.		800T-16JRH2KB7AX	800H-16JRRH2KB7AX
		800T-16JRH4KB7AX	800H-16JRRH4KB7AX
		800T-16JRH5KB7AX	800H-16JRRH5KB7AX

4-Position Selector Switches, Non-Illuminated

Contact Configuration	Operator Type	Type 4/13 Metal (800T)			Type 4/4X/13 Plastic (800H)
		Standard Knob	Knob Lever	Cylinder Lock	Standard Knob
2 N.O. – 2 N.C.		800T-N2KF4B	800T-N17KF4B	800T-N33KF4B	800H-NR2KF4B
		800T-N3KF4B	800T-N29KF4B	800T-N133KF4B	800H-NR3KF4B
		800T-N9KF4B	800T-N30KF4B	800T-N233KF4B	800H-NR9KF4B

Specialty Devices

Potentiometer Units

Cylinder Lock Push Buttons (800T only)

Momentary Contact Flip Lever Push Buttons (800H only)

Selector Push Button Units (800T only)

Momentary Wobble Stick Units (800T only)

1-2-3-4-Way Toggle Switches (800T only)

Mechanically Interlocked Maintained Push Buttons

Momentary Padlocking Mushroom Head Push Buttons (800T only)

Cluster Pilot Lights (800T only)

Assembled Stations

			Type 4/13 Metal (800T)	Type 4/4X/13 (800H)	
			Die Cast Aluminum	Stainless Steel (Booted Operator)	Glass Polyester (Booted Operator)
Contact Configuration	**Button Color**	**Legend Marking**			
One Push Button	●	Stop	**800T-1TA**	**800H-1HA4T**	**800H-1HA4R**
	●	Start	**800T-1TB**	**800H-1HB4T**	**800H-1HB4R**
	●	Emergency Stop	**800T-1TYM**	–	–
	●	Break Glass	**800T-NX114**	–	–
Two Push Buttons	●	Start	**800T-2TA**	**800H-2HA4T**	**800H-2HA4R**
	●	Stop			
Three-position Selector Switch	●	Hand-Off-Auto	**800T-R3TA**	–	–

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Harmonic Study

for

Downtown Area WWTF

Orleans, MA

Digitally signed by Robert Stockinger
Date: 2021.08.01 21:44:58 -05'00'

Prepared By:
Coordinated Power Systems, Inc.
9008 W. Forest Home Ave, Ste B
Greenfield, WI 53228
Telephone: (414) 425-5993
E-mail: cpsi@cpsistudies.com

CPSI# 21014
July 30, 2021

INTRODUCTION

A harmonic study has been prepared as called for in the specification for the subject facility. The study is based on the guidelines in IEEE standard 519-2014 (IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems).

The use of non-linear loads has become very common in most electric power systems. One of the most widely used non-linear loads are static power converters, such as those used for adjustable (variable) speed drives, which can convert ac to dc, dc to ac, etc.

Non-Linear loads change the sinusoidal nature of the ac power current, thereby resulting in the flow of harmonic currents in the ac power system. These harmonic currents can cause interference with communication circuits; excessive heating, pulsating and reduced torque in motors and generators; increased heating and voltage stress in capacitors; and mis-operation in electronics, switchgear and relaying.

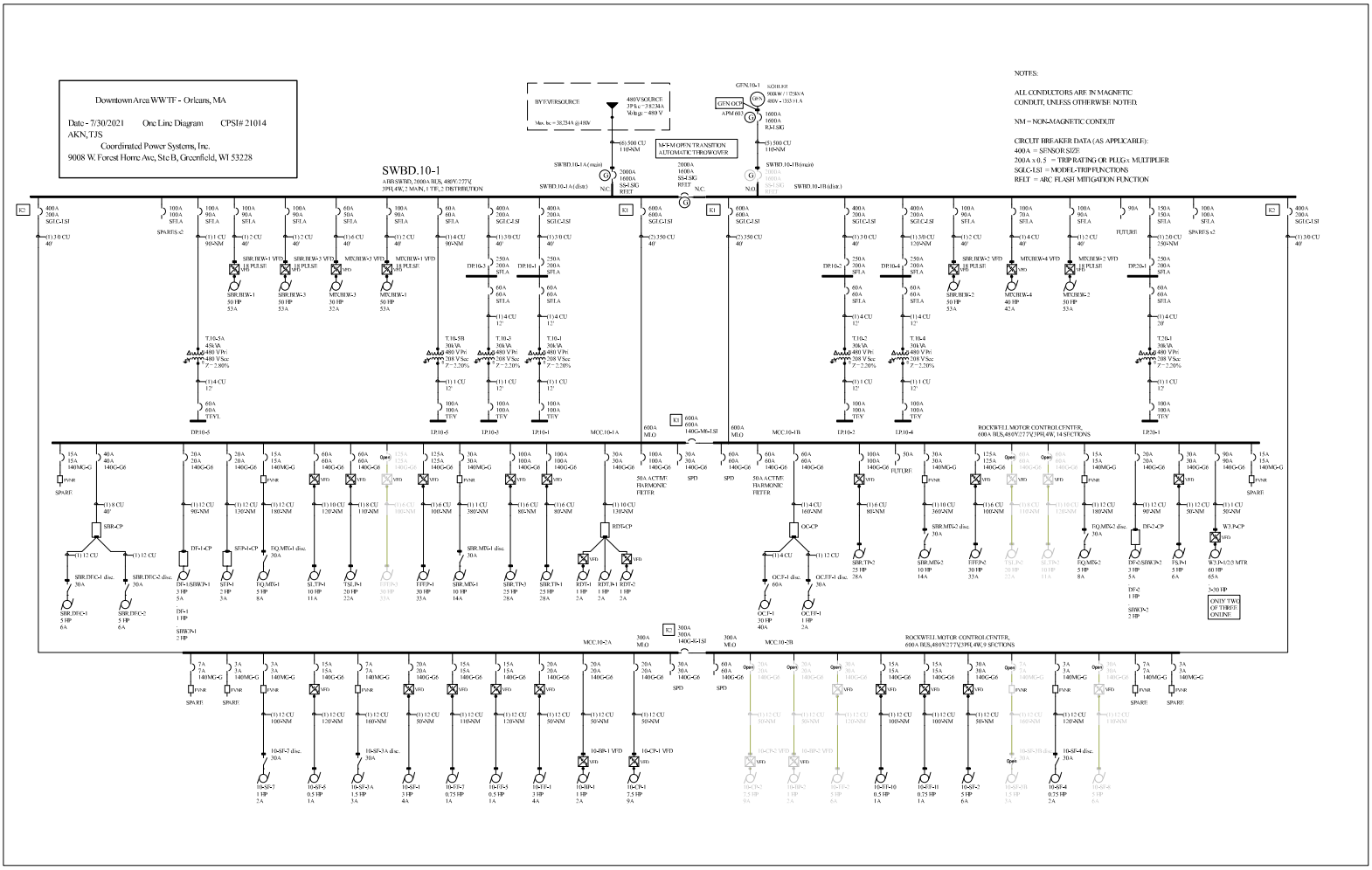
A harmonic analysis is used to simulate steady state harmonic distortion and resonance in the electric power system due to the presence of non-linear loads. The results of this simulation can be used as a basis for determining ways to mitigate the adverse effects of harmonics on the system.

We previously performed a short circuit study, protective device coordination study, and an arc flash and shock hazard analysis for the subject facility. The previous study data is being used as the starting point for the harmonic analysis.

The system reviewed by this study is shown on the following one line diagram.

CONCLUSION

Under the operating conditions defined in this study, and according to specification section 16260 and the loads defined under Attachment A of those specifications, **the harmonic limits specified are met** by the equipment proposed for this system.


Downtown Area WWTF - Orleans, MA
Date - 7/30/2021 One Line Diagram CPSI# 21014
AKN, TJS
Coordinated Power Systems, Inc.
9008 W. Forest Home Ave, Ste B, Greenfield, WI 53228
EVERSOURCE
480Y/SOURCE
3PH, 4W ~ 3823 A
Voltage ~ 480 V
Max. Isc = 38.234 kA @ 480V
GTN.10-1
GTN OCP
APM 603
SWBD.10-1
A BRS SWBD, 2000 A BUS, 480Y/277V,
3PH,4W, 2 MAIN, 1 TIE, 2 DISTRIBUTION
SWBD.10-1A (main)
SWBD.10-1A (disc)
SWBD.10-1B (main)
SWBD.10-1B (disc)
MCC.10-1A
MCC.10-1B
MCC.10-2A
MCC.10-2B
DP.10-1
DP.10-2
DP.10-3
DP.10-4
DP.20-1
LP.10-5
LP.10-3
LP.10-1
LP.10-2
LP.10-4
LP.20-1
T.10-5A
T.10-5B
T.10-3
T.10-1
T.10-2
T.10-4
T.20-1
ROCKWELL MOTOR CONTROL CENTER,
600 A BUS, 480Y/277V,3PH,4W, 14 SECTIONS
ROCKWELL MOTOR CONTROL CENTER,
600 A BUS, 480Y/277V,3PH,4W, 9 SECTIONS
SPARE
FUTURE
NOTES:
ALL CONDUCTORS ARE IN MAGNETIC CONDUIT, UNLESS OTHERWISE NOTED.
NM = NON-MAGNETIC CONDUIT
CIRCUIT BREAKER DATA (AS APPLICABLE):
400A = SENSOR SIZE
200A x 0.5 = TRIP RATING OR PLUG x MULTIPLIER
SGLC-LSI = MODEL-TRIP FUNCTIONS
RELT = ARC FLASH MITIGATION FUNCTION

HARMONIC ANALYSIS

Harmonic calculations were performed on the system as called for in the specifications for the subject facility and defined on the one line diagram and the accompanying computer printout.

IEEE-519 defines the voltage and current harmonic distortion allowed at the utility point of common coupling (PCC). For this system, the PCC (per IEEE-519) is at the 22,860V primary service. However the harmonic distortion at the 480V main switchboard SWBD.10-1 was reviewed instead, as called for in the specifications.

Utility Source: On 5/10/2021, Brian Mello of Eversource indicated the utility available fault current at this 480V service is 38,234A, based on a 1000kVA (1203FLA@480V) transformer being installed at this service. This value was therefore used as the starting point of the calculations.

Generator Source: The Kohler generator submittal indicates a 900kW generator is being provided for this project as called for on contract drawing 10 E-005. However, the alternator data sheet from the Kohler submittal provides per unit reactance values based on a 912kW alternator rating. Therefore, the calculations are based on the 912kW alternator rating (with the associated per unit reactances).

Source Transfers: The main and tie circuit breakers in the 480V main switchboard (SWBD.10-1) are electrically interlocked to prevent the utility and generator sources from being connected in parallel.

System Loads: The calculations in this analysis were based on the harmonic (ie. VFD controlled / non-linear) loads indicated in Attachment A of Specification 16260, as called for the in the specifications. The loads that are out of service (per Attachment A) are shown out of service on the one line diagram in this report.

Total Loads - Normal Source: The above loads yield about 602A of non-linear loads (~50% of the 1000kVA utility transformer capacity) and 362A of linear loads (~30% of transformer capacity), for a total load of 964A (~80% of transformer capacity).

Total Loads - Generator Source: In terms of the generator, the non-linear loads are about 45% of the 90kW generator capacity, and the linear loads are about 25% of generator capacity, with the total load being about 70% of the generator capacity.

VFDs: The AB/Rockwell shop drawings for the VFDs indicate the 50Hp motors will be operated through 18-pulse VFDs, as specified. By design, the 18-pulse VFDs limit the harmonic distortion to less than 5%. Therefore a typical harmonic model with 4.6% I_THD was used for these 50Hp non-linear loads in the calculations.

The AB/Rockwell shop drawings for the VFDs and the MCCs indicate the motors smaller than 50Hp are operated through 6-pulse VFDs (PowerFlex 753) with 5% line reactors. Published AB information indicate these VFDs are equipped with a 5% DC choke (ie. buffered). A 5% reactance generally corresponds to approximately 35% I_THD. Whereas a review of the Rockwell harmonic estimator for 6 pulse buffered drives yields only about 33% I_THD. The addition of the 5% line reactors brings the equivalent total reactance to around 8%, which equates to about 28% I_THD. Therefore a typical harmonic model with 28% I_THD was used in the calculations for all non-linear loads smaller than 50Hp.

Active Harmonic Filters: The AB/Rockwell shop drawings for the MCCs indicate two 50A active harmonic filters are proposed at MCC.10-1A and MCC.10-1B. Based the attached harmonic distortion calculator spreadsheet these filters are more than adequate to address the harmonic distortion expected from the non-linear loads in this system. One 50A filter is adequate when the system is fed by the utility (stronger) source, and two 50A filters are adequate when the system is fed by the generator (weaker) source. This is confirmed by the attached SKM HiWave harmonic distortion calculations (Case 1-ALT and Case 2-ALT).

Calculations: The following cases were analyzed as called for in the specifications:

Case 1 (normal):	SWBD.10-1 is switched the normal (utility) source. The active harmonic filters are off line.
Case 1 - ALT:	Same as Case 1, except for the following: The harmonic sources were removed from the 4-30Hp motors being fed from MCC.10-1A and MCC.10-1B. One of the 50A active harmonic filters is more than enough to account for the harmonic sources from these motors.
Case 2 (emergency):	SWBD.10-1 is switched to the emergency (generator) source. The active harmonic filters are off line.
Case 2 - ALT:	Same as Case 2, except for the following: The harmonic sources were removed from the 4-30Hp, 3-25Hp, and 1-20Hp motors fed from MCC.10-1A and MCC.10-1B. The two 50A active harmonic filters are more than enough to account for the harmonic sources from these motors.

The calculations were performed using the PowerTools for Windows (PTW) HI_WAVE computer program which was developed by SKM Systems Analysis, Inc. The program calculates percent Total Voltage Distortion (V_THD) at each node in the system and the percent Total Current Distortion (I_THD) across each conductor or transformer in the system.

The Harmonic calculation results are shown on the following printouts, and also summarized below. Pages 3 and 4 of each printout provide the harmonic source parameters used in the calculations. Pages 8-11 provide the percent Total Voltage Distortion (V_THD) at each piece of equipment. Pages 12-21 provide the percent Total Current Distortion (I_THD) across each conductor or transformer. Pages 22 and 23 detail the harmonic voltage and current distortion respectively by individual harmonics at SWBD.10.1.

The calculations in this report provide an estimate of harmonic distortion in this system based on the information and assumptions noted in this report. The calculation results may differ from actual system performance due to site and application variables, operating conditions, component tolerances and/or other unanticipated conditions. There is no guarantee associated with the calculations included in this report.

Summary of Results:

CASE 1 (normal)	Calculated Distortion V_THD	I_THD	IEEE 519 Limit V_THD	I_THD	Pass? V_THD	I_THD
Case 1 (normal) - no AHF	1.89%	11.158%	5%	8%	Yes	No
Case 1 (normal) - with AHF	1.30%	7.42%	5%	8%	Yes	Yes
Case 2 (emergency) - no AHF	5.82%	10.61%	8%	5%	Yes	No
Case 2 (emergency) - with AHF	2.39%	4.08%	8%	5%	Yes	Yes

Conclusions: Under the operating conditions defined in this study, the system is in compliance with the IEEE standard 519-2014 recommended limits for total harmonic voltage distortion (with or without the active harmonic filters) and for total harmonic current distortion (with the active harmonic filters).

Any increase in linear loads (pure motors or resistive loads) will further reduce the percentage of harmonic current distortion, but will not significantly impact the voltage distortion.

Whether these results are acceptable, based on the expected actual loading of this system, and/or whether any additional harmonic mitigating equipment is desired/required for this system should be reviewed by the engineer responsible for this facility.

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SKM POWER*TOOLS FOR WINDOWS
OUTPUT DATA REPORT
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Downtown Area WWTF - Orleans,
MA CASE 1 (normal / utility)

(without active harmonic filters)

STUDY CRITERIA

Studies Selected To Run:	
Load Flow:	Yes
Frequency Scan:	Yes
Harmonic Distortion:	Yes
Load Flow Study Setup Options	
Utility Impedance:	Yes
Transformer Phase Shift:	Yes
Solution Method:	Exact
Load Specification:	Connected Load
Generation Acceleration Factor:	1.00
Load Acceleration Factor:	1.00
Bus Voltage Drop:	5.00
Branch Voltage Drop:	3.00
HI_WAVE Study Setup Options	
Fundamental Frequency:	60 Hz
Max. Harmonic Order:	50
Include Triplet Harmonics Path (Static Load):	No
Include Triplet Harmonics Path (Ind. Motor):	No
Modify Motor Z by Load Factor (Ind. Motor):	No
Modify Load Z by Load Factor (Static Load):	No
HI_WAVE Study Setup Options for Frequency Scan	
Scan Impedance Option:	Scan Self Impedance
Use Positive Sequence Network:	Yes
Use Negative Sequence Network:	Yes
Use Zero Sequence Network:	No
Model Transformer Tap:	Yes
Model Transformer Phase Shift:	Yes
Report Bus Equivalent Impedance:	No
Number of Scan Steps Per Order:	1
HI_WAVE Study Setup Options for Distortion	
Use Positive Sequence Network:	Yes
Use Negative Sequence Network:	Yes
Use Zero Sequence Network:	Yes
Model Transformer Tap:	Yes
Model Transformer Phase Shift:	Yes
Fundamental Solution:	Use Load Flow Result
Report Option:	All Distortions and Violations
Current Limits:	IEEE 519-2014 Std, Current Distortion Limit Table 3 & 4, Selected buses as PCC

LOADS AND MOTORS WITH HARMONIC SOURCE MODELS

Bus Name	Voltage	Component Name	LF Current	Harmonic Library
10-EF-1	480	10-EF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-EF-10	480	10-EF-10 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-11	480	10-EF-11 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-EF-5	480	10-EF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-7	480	10-EF-7 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-SF-1	480	10-SF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-SF-2	480	10-SF-2 mtr	6.0	Six Pulse, Z=8%, THDi=28%
10-SF-5	480	10-SF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
EFF.P-1	480	EFF.P-1 mtr	31.5	Six Pulse, Z=8%, THDi=28%
EFF.P-2	480	EFF.P-2 mtr	31.5	Six Pulse, Z=8%, THDi=28%
FS.P-1	480	FS.P-1 mtr	6.0	Six Pulse, Z=8%, THDi=28%
MIX.BLW-1 VFD ou	480	MIX.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-2 VFD ou	480	MIX.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-3 VFD ou	480	MIX.BLW-3	30.5	Six Pulse, Z=8%, THDi=28%
MIX.BLW-4 VFD ou	480	MIX.BLW-4	40.7	Six Pulse, Z=8%, THDi=28%
RDT-1 VFD output	480	RDT-1	1.6	Six Pulse, Z=8%, THDi=28%
RDT-2 VFD output	480	RDT-2	1.6	Six Pulse, Z=8%, THDi=28%
SBR.BLW-1 VFD ou	480	SBR.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-2 VFD ou	480	SBR.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-3 VFD ou	480	SBR.BLW-3	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.TP-1	480	SBR.TP-1 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SBR.TP-2	480	SBR.TP-2 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SBR.TP-3	480	SBR.TP-3 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SL.TP-1	480	SL.TP-1 mtr	11.0	Six Pulse, Z=8%, THDi=28%
TSL.P-1	480	TSL.P-1 mtr	21.3	Six Pulse, Z=8%, THDi=28%
VFD 10-BP-1 outp	480	10-BP-1	1.6	Six Pulse, Z=8%, THDi=28%
VFD 10-CP-1 outp	480	10-CP-1	8.6	Six Pulse, Z=8%, THDi=28%
VFD W3.P-CP OUTP	480	W3.P-1/2/3 MTR	62.6	Six Pulse, Z=8%, THDi=28%

HARMONIC SOURCE		
Six Pulse, Z=8%, THDi=28%		
Order	Magnitude (%)	Angle (Degrees)
1	100.000	-12.60
5	26.000	107.40
7	9.030	-126.90
11	4.550	-93.20
13	3.200	-50.20
17	1.740	15.90
19	1.350	45.00

HARMONIC SOURCE		
18 Pulse Rockwell,THDi=4.6%		
Order	Magnitude (%)	Angle (Degrees)
1	100.000	-12.60
5	3.261	107.40
7	1.596	-126.90
11	1.632	-93.20
13	0.816	-50.20
17	1.371	15.90
19	1.579	45.00

H A R M O N I C S O U R C E I N D E X T A B L E
HARMONIC SOURCES HAVE BEEN FOUND AND INJECTED FOR EACH OF THE FOLLOWING HARMONIC ORDERS
5 7 11 13 17 19

PASSIVE FILTER DATA												
Filter Name	Bus Name	Bus Voltage	Rated Voltage	Connect	Filter Type	Capacitor KVAR	Tuned Order	Q	M	R (Ω)	L (H)	C (μF)
NO FILTER												

U T I L I T Y , G E N E R A T O R A N D M O T O R D A T A

Component Name	Component Type	Bus Name	Bus Voltage	Base Voltage	Base KVA	R1(pu) R2 R0	X1(pu) X2 X0
480V SOURCE	UTILITY	MVT.10-1 sec.	480	480	100000	0.3902 0.3902 0.3902	3.1216 3.1216 3.1216
GEN.10-1	SYNCH GENERATOR	GEN.10-1 output	480	480	100000	0.2803 0.4859 0.1592	6.5789 11.4035 3.7368

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
10-BP-1 VFD	480	469.76	42.7557	1.9258	
10-CP-1 VFD	480	468.38	43.0843	1.9468	
10-EF-1	480	479.54	47.8364	2.7241	
10-EF-10	480	479.81	42.9390	2.0574	
10-EF-11	480	479.68	43.5824	2.1455	
10-EF-5	480	479.75	43.2119	2.0737	
10-EF-7	480	479.64	43.8516	2.1617	
10-SF-1	480	479.54	47.8364	2.7241	
10-SF-2	480	479.23	51.1800	3.2144	
10-SF-3A disc.	480	468.75	42.7831	1.9256	
10-SF-4 disc.	480	469.69	42.4456	1.9068	
10-SF-5	480	479.75	43.2119	2.0737	
10-SF-7 disc.	480	469.50	42.7246	1.9231	
DF-1-CP	480	468.58	43.5649	1.9718	
DF-2-CP	480	468.51	43.6207	1.9752	
DP.10-1	480	470.30	42.2275	1.8946	
DP.10-2	480	470.30	42.2285	1.8947	
DP.10-3	480	470.30	42.2275	1.8946	
DP.10-4	480	470.30	42.2285	1.8947	
DP.10-5	480	470.30	42.2275	1.8946	
DP.20-1	480	470.30	42.2285	1.8947	
EFF.P-1	480	479.40	95.9086	9.3196	
EFF.P-2	480	479.40	95.9574	9.3226	
EQ.MIX-1 disc.	480	466.03	43.7690	1.9805	
EQ.MIX-2 disc.	480	465.96	43.8251	1.9840	
FS.P-1	480	479.24	52.2454	3.2775	
GEN.10-1 output	480	480.00	0.5000	0.0000	
LP.10-1	208	203.80	42.2275	1.8946	
LP.10-2	208	203.80	42.2285	1.8947	
LP.10-3	208	203.80	42.2275	1.8946	
LP.10-4	208	203.80	42.2285	1.8947	
LP.10-5	208	203.80	42.2275	1.8946	
LP.20-1	208	203.80	42.2285	1.8947	
MCC.10-1A	480	469.86	43.4640	1.9674	
MCC.10-1B	480	469.79	43.5196	1.9708	
MCC.10-2A	480	470.08	42.6794	1.9212	
MCC.10-2B	480	470.22	42.4047	1.9050	
MIX.BLW-1 VFD	480	469.35	43.1823	1.9151	
MIX.BLW-1 VFD ou	480	480.35	93.6172	3.7943	
MIX.BLW-2 VFD	480	469.35	43.1834	1.9151	

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
MIX.BLW-2 VFD ou	480	480.35	93.6181	3.7944	
MIX.BLW-3 VFD	480	469.04	43.1443	1.9492	
MIX.BLW-3 VFD ou	480	481.91	91.7942	8.9271	
MIX.BLW-4 VFD	480	469.19	43.3287	1.9597	
MIX.BLW-4 VFD ou	480	483.06	108.8252	11.3131	
MVT.10-1 sec.	480	471.65	38.2946	1.7177	
OC-CP	480	466.60	43.6021	1.9740	
OC.EF-1 disc.	480	466.60	43.6022	1.9740	
OC.F-1 disc.	480	466.60	43.6021	1.9740	
RDT-1 VFD output	480	480.13	45.3000	2.2989	
RDT-2 VFD output	480	480.13	45.3000	2.2989	
RDT-CP	480	468.38	43.8170	1.9884	
SBR-CP	480	469.27	43.4956	1.9687	
SBR.BLW-1 VFD	480	469.35	43.1823	1.9151	
SBR.BLW-1 VFD ou	480	480.35	93.6172	3.7943	
SBR.BLW-2 VFD	480	469.35	43.1834	1.9151	
SBR.BLW-2 VFD ou	480	480.35	93.6181	3.7944	
SBR.BLW-3 VFD	480	469.35	43.1823	1.9151	
SBR.BLW-3 VFD ou	480	480.35	93.6172	3.7943	
SBR.DEC-1 disc.	480	469.27	43.4957	1.9687	
SBR.DEC-2 disc.	480	469.27	43.4957	1.9687	
SBR.MIX-1 disc.	480	468.52	43.4271	1.9656	
SBR.MIX-2 disc.	480	461.13	44.1619	1.9983	
SBR.TP-1	480	479.77	87.2963	8.1558	
SBR.TP-2	480	479.77	87.3452	8.1589	
SBR.TP-3	480	479.77	87.2963	8.1558	
SEP-1-CP	480	468.63	43.5612	1.9716	
SL.TP-1	480	477.76	61.1120	4.4861	
SWBD.10-1A (dist	480	470.30	42.2275	1.8946	8.0
SWBD.10-1A (main	480	470.30	42.2252	1.8945	
SWBD.10-1B (dist	480	470.30	42.2285	1.8947	8.0
SWBD.10-1B (main	480	480.00	0.5000	0.0000	
T.10-1 pri.	480	470.30	42.2275	1.8946	
T.10-1 sec.	208	203.80	42.2275	1.8946	
T.10-2 pri.	480	470.30	42.2285	1.8947	
T.10-2 sec.	208	203.80	42.2285	1.8947	
T.10-3 pri.	480	470.30	42.2275	1.8946	
T.10-3 sec.	208	203.80	42.2275	1.8946	
T.10-4 pri.	480	470.30	42.2285	1.8947	
T.10-4 sec.	208	203.80	42.2285	1.8947	

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
T.10-5A pri.	480	470.30	42.2275	1.8946	
T.10-5A sec.	480	470.30	42.2275	1.8946	
T.10-5B pri.	480	470.30	42.2275	1.8946	
T.10-5B sec.	208	203.80	42.2275	1.8946	
T.20-1 pri.	480	470.30	42.2285	1.8947	
T.20-1 sec.	208	203.80	42.2285	1.8947	
TSL.P-1	480	478.00	78.6350	6.9133	
VFD 10-BP-1 outp	480	480.12	44.3849	2.2434	
VFD 10-CP-1 outp	480	480.35	55.6592	3.8338	
VFD 10-EF-1 outp	480	480.18	47.6661	2.7134	
VFD 10-EF-10 out	480	480.10	42.8645	2.0529	
VFD 10-EF-11 out	480	480.11	43.4732	2.1388	
VFD 10-EF-5 outp	480	480.10	43.1221	2.0682	
VFD 10-EF-7 outp	480	480.11	43.7310	2.1542	
VFD 10-SF-1 outp	480	480.18	47.6661	2.7134	
VFD 10-SF-2 outp	480	480.25	50.9022	3.1965	
VFD 10-SF-5 outp	480	480.10	43.1221	2.0682	
VFD EFF.P-1 outp	480	482.02	93.7674	9.1729	
VFD EFF.P-2 outp	480	482.02	93.8157	9.1759	
VFD FS.P-1 outpu	480	480.25	51.9646	3.2593	
VFD SBR.TP-1 out	480	481.56	85.8718	8.0606	
VFD SBR.TP-2 out	480	481.56	85.9203	8.0636	
VFD SBR.TP-3 out	480	481.56	85.8718	8.0606	
VFD SL.TP-1 outp	480	480.47	60.0716	4.4168	
VFD TSL.P-1 outp	480	481.11	76.8770	6.7935	
VFD W3.P-CP OUTP	480	486.51	146.4172	16.5316	
W3.P-CP	480	468.68	45.0990	2.0642	

VOLTAGE DISTORTION SUMMARY					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
480V SOURCE	MVT.10-1 sec.	480 480	962.13	0.031 0.031	1.403 1.403	97430.50			0.28 11.15	
C: 10-BP-1 VFD	MCC.10-2A 10-BP-1 VFD	480 480	2.33	0.002 0.000	0.000 0.000	339.31			0.00 20.25	
C: 10-CP-1 VFD	MCC.10-2A 10-CP-1 VFD	480 480	12.25	0.045 0.002	0.001 0.000	1777.25			0.00 20.19	
C: 10-EF-1	VFD 10-EF-1 outp 10-EF-1	480 480	3.91	0.005 0.000	0.000 0.000	776.56			0.00 28.17	
C: 10-EF-10	VFD 10-EF-10 out 10-EF-10	480 480	0.89	0.000 0.000	0.000 0.000	177.83			0.00 28.17	
C: 10-EF-11	VFD 10-EF-11 out 10-EF-11	480 480	1.30	0.001 0.000	0.000 0.000	258.75			0.00 28.17	
C: 10-EF-5	VFD 10-EF-5 outp 10-EF-5	480 480	0.89	0.001 0.000	0.000 0.000	177.86			0.00 28.17	
C: 10-EF-7	VFD 10-EF-7 outp 10-EF-7	480 480	1.30	0.001 0.000	0.000 0.000	258.77			0.00 28.17	
C: 10-SF-1	VFD 10-SF-1 outp 10-SF-1	480 480	3.91	0.005 0.000	0.000 0.000	776.56			0.00 28.17	
C: 10-SF-2	VFD 10-SF-2 outp 10-SF-2	480 480	6.19	0.011 0.001	0.000 0.000	1230.52			0.00 28.17	
C: 10-SF-3A disc	MCC.10-2A 10-SF-3A disc.	480 480	2.94	0.008 0.000	0.000 0.000	35.20			0.00 1.31	
C: 10-SF-4 disc.	MCC.10-2B 10-SF-4 disc.	480 480	1.57	0.002 0.000	0.000 0.000	18.65			0.00 1.30	
C: 10-SF-5	VFD 10-SF-5 outp 10-SF-5	480 480	0.89	0.001 0.000	0.000 0.000	177.86			0.00 28.17	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: 10-SF-7 disc.	MCC.10-2A 10-SF-7 disc.	480 480	2.06	0.003 0.000	0.000 0.000	24.65			0.00 1.31	
C: DF-1-CP	MCC.10-1A DF-1-CP	480 480	5.01	0.014 0.000	0.000 0.000	61.02			0.00 1.34	
C: DF-2-CP	MCC.10-1B DF-2-CP	480 480	5.01	0.014 0.000	0.000 0.000	61.10			0.00 1.34	
C: DP.10-1	SWBD.10-1A (dist DP.10-1	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-2	SWBD.10-1B (dist DP.10-2	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-3	SWBD.10-1A (dist DP.10-3	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-4	SWBD.10-1B (dist DP.10-4	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-5	T.10-5A sec. DP.10-5	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: DP.20-1	SWBD.10-1B (dist DP.20-1	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: EFF.P-1 disc.	VFD EFF.P-1 outp EFF.P-1	480 480	32.69	0.157 0.011	0.022 0.007	6498.90			0.00 28.17	
C: EFF.P-2	VFD EFF.P-2 outp EFF.P-2	480 480	32.69	0.157 0.011	0.022 0.007	6498.90			0.00 28.17	
C: EQ.MIX-1 disc	MCC.10-1A EQ.MIX-1 disc.	480 480	7.50	0.061 0.000	0.002 0.000	90.86			0.00 1.33	
C: EQ.MIX-2 disc	MCC.10-1B EQ.MIX-2 disc.	480 480	7.50	0.061 0.000	0.002 0.000	90.98			0.00 1.33	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: FS.P-1	VFD FS.P-1 outpu FS.P-1	480 480	6.19	0.011 0.001	0.000 0.000	1230.52			0.00 28.17	
C: GEN.10-1	GEN.10-1 output SWBD.10-1B (main	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-1	T.10-1 sec. LP.10-1	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-2	T.10-2 sec. LP.10-2	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-3	T.10-3 sec. LP.10-3	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-4	T.10-4 sec. LP.10-4	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-5	T.10-5B sec. LP.10-5	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.20-1	T.20-1 sec. LP.20-1	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: MCC.10-1A	SWBD.10-1A (dist MCC.10-1A	480 480	214.53	0.108 0.003	0.153 0.018	24340.17			0.00 15.73	15.0
C: MCC.10-1B	SWBD.10-1B (dist MCC.10-1B	480 480	246.92	0.143 0.004	0.199 0.020	25361.77			0.00 14.23	15.0
C: MCC.10-2A	SWBD.10-1A (dist MCC.10-2A	480 480	34.37	0.011 0.000	0.008 0.001	4225.38			0.00 17.05	20.0
C: MCC.10-2B	SWBD.10-1B (dist MCC.10-2B	480 480	12.98	0.002 0.000	0.001 0.000	1648.79			0.00 17.62	20.0
C: MIX.BLW-1 VFD	SWBD.10-1A (dist MIX.BLW-1 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: MIX.BLW-2 VF	SWBD.10-1B (dist MIX.BLW-2 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0
C: MIX.BLW-3 VFD	SWBD.10-1A (dist MIX.BLW-3 VFD	480 480	43.38	0.110 0.004	0.017 0.003	6301.22			0.00 20.21	15.0
C: MIX.BLW-4 VFD	SWBD.10-1B (dist MIX.BLW-4 VFD	480 480	57.80	0.124 0.005	0.028 0.005	8401.62			0.00 20.22	15.0
C: OC-CP	MCC.10-1B OC-CP	480 480	41.52	0.256 0.000	0.040 0.000	502.08			0.00 1.33	
C: OC.EF-1 disc.	OC-CP OC.EF-1 disc.	480 480	2.07	0.000 0.000	0.000 0.000	25.05			0.00 1.33	
C: OC.F-1 disc.	OC-CP OC.F-1 disc.	480 480	39.45	0.000 0.000	0.000 0.000	477.04			0.00 1.33	
C: RDT-CP	MCC.10-1A RDT-CP	480 480	6.71	0.021 0.000	0.001 0.000	653.78			0.00 13.50	
C: SBR-BLW-1 VFD	SWBD.10-1A (dist SBR.BLW-1 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0
C: SBR-BLW-2 VFD	SWBD.10-1B (dist SBR.BLW-2 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0
C: SBR-BLW-3 VFD	SWBD.10-1A (dist SBR.BLW-3 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0
C: SBR-CP	MCC.10-1A SBR-CP	480 480	12.75	0.015 0.000	0.001 0.000	155.53			0.00 1.34	
C: SBR.DEC-1 dis	SBR-CP SBR.DEC-1 disc.	480 480	6.37	0.000 0.000	0.000 0.000	77.76			0.00 1.34	
C: SBR.DEC-2 dis	SBR-CP SBR.DEC-2 disc.	480 480	6.37	0.000 0.000	0.000 0.000	77.76			0.00 1.34	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: SBR.MIX-1 dis	MCC.10-1A SBR.MIX-1 disc.	480 480	13.75	0.032 0.000	0.010 0.000	166.97			0.00 1.34	
C: SBR.MIX-2 dis	MCC.10-1B SBR.MIX-2 disc.	480 480	13.97	0.253 0.000	0.011 0.000	167.12			0.00 1.32	
C: SBR.TP-1	VFD SBR.TP-1 out SBR.TP-1	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SBR.TP-2	VFD SBR.TP-2 out SBR.TP-2	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SBR.TP-3	VFD SBR.TP-3 out SBR.TP-3	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SEP-1-CP	MCC.10-1A SEP-1-CP	480 480	3.34	0.009 0.000	0.000 0.000	40.68			0.00 1.34	
C: SL.TP-1	VFD SL.TP-1 outp SL.TP-1	480 480	11.44	0.056 0.004	0.003 0.001	2274.82			0.00 28.17	
C: SWBD.10-1 TIE	SWBD.10-1A (dist SWBD.10-1B (dist	480 480	458.52	0.001 0.000	0.000 0.000	46163.38			0.00 11.56	12.0
C: SWBD.10-1A	MVT.10-1 sec. SWBD.10-1A (main	480 480	962.13	1.379 0.021	2.101 0.139	97430.50			0.00 11.15	
C: SWBD.10-1A (d	SWBD.10-1A (main SWBD.10-1A (dist	480 480	962.13	0.002 0.001	0.001 0.000	97430.50			0.00 11.15	8.0
C: T.10-1	DP.10-1 T.10-1 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-2	DP.10-2 T.10-2 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-3	DP.10-3 T.10-3 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: T.10-4	DP.10-4 T.10-4 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-5A	SWBD.10-1A (dist T.10-5A pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: T.10-5B	SWBD.10-1A (dist T.10-5B pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: T.20-1	DP.20-1 T.20-1 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: TSL.P-1	VFD TSL.P-1 outp TSL.P-1	480 480	22.09	0.125 0.009	0.011 0.003	4390.85			0.00 28.17	
C: W3.P-CP	MCC.10-1B W3.P-CP	480 480	89.02	0.179 0.007	0.064 0.012	12925.46			0.00 20.20	
GEN.10-1	GEN.10-1 output	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
T.10-1	T.10-1 pri. T.10-1 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-2	T.10-2 pri. T.10-2 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-3	T.10-3 pri. T.10-3 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-4	T.10-4 pri. T.10-4 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-5A	T.10-5A pri. T.10-5A sec.	480 480	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-5B	T.10-5B pri. T.10-5B sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
T.20-1	T.20-1 pri. T.20-1 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
VFD 10-BP-1	10-BP-1 VFD VFD 10-BP-1 outp	480 480	2.33	0.149 0.000	0.844 0.000	339.31			0.00 20.25	
VFD 10-CP-1	10-CP-1 VFD VFD 10-CP-1 outp	480 480	12.25	0.779 0.000	4.419 0.000	1777.25			0.00 20.19	
VFD 10-EF-1	MCC.10-2A VFD 10-EF-1 outp	480 480	5.33	0.340 0.000	1.932 0.000	776.57			0.00 20.26	
VFD 10-EF-10	MCC.10-2B VFD 10-EF-10 out	480 480	1.22	0.078 0.000	0.442 0.000	177.83			0.00 20.27	
VFD 10-EF-11	MCC.10-2B VFD 10-EF-11 out	480 480	1.78	0.113 0.000	0.644 0.000	258.75			0.00 20.27	
VFD 10-EF-5	MCC.10-2A VFD 10-EF-5 outp	480 480	1.22	0.078 0.000	0.442 0.000	177.86			0.00 20.26	
VFD 10-EF-7	MCC.10-2A VFD 10-EF-7 outp	480 480	1.78	0.113 0.000	0.644 0.000	258.77			0.00 20.26	
VFD 10-SF-1	MCC.10-2A VFD 10-SF-1 outp	480 480	5.33	0.340 0.000	1.932 0.000	776.57			0.00 20.26	
VFD 10-SF-2	MCC.10-2B VFD 10-SF-2 outp	480 480	8.45	0.539 0.000	3.062 0.000	1230.53			0.00 20.27	
VFD 10-SF-5	MCC.10-2A VFD 10-SF-5 outp	480 480	1.22	0.078 0.000	0.442 0.000	177.86			0.00 20.26	
VFD EFF.P-1	MCC.10-1A VFD EFF.P-1 outp	480 480	44.66	2.849 0.000	16.175 0.000	6498.92			0.00 20.25	
VFD EFF.P-2	MCC.10-1B VFD EFF.P-2 outp	480 480	44.66	2.849 0.000	16.175 0.000	6498.92			0.00 20.25	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
VFD FS.P-1	MCC.10-1B VFD FS.P-1 outpu	480 480	8.46	0.539 0.000	3.062 0.000	1230.53			0.00 20.25	
VFD FS.P-2	W3.P-CP VFD W3.P-CP OUTP	480 480	89.02	5.666 0.000	32.138 0.000	12925.46			0.00 20.20	
VFD MIX.BLW-1	MIX.BLW-1 VFD MIX.BLW-1 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD MIX.BLW-2	MIX.BLW-2 VFD MIX.BLW-2 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD MIX.BLW-3	MIX.BLW-3 VFD MIX.BLW-3 VFD ou	480 480	43.38	2.771 0.000	15.675 0.000	6301.22			0.00 20.21	
VFD MIX.BLW-4	MIX.BLW-4 VFD MIX.BLW-4 VFD ou	480 480	57.80	3.683 0.000	20.890 0.000	8401.62			0.00 20.22	
VFD RDT-1	RDT-CP RDT-1 VFD output	480 480	2.34	0.149 0.000	0.844 0.000	339.31			0.00 20.19	
VFD RDT-2	RDT-CP RDT-2 VFD output	480 480	2.34	0.149 0.000	0.844 0.000	339.31			0.00 20.19	
VFD SBR-BLW-1	SBR.BLW-1 VFD SBR.BLW-1 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD SBR.BLW-2	SBR.BLW-2 VFD SBR.BLW-2 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD SBR.BLW-3	SBR.BLW-3 VFD SBR.BLW-3 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD SBR.TP-1	MCC.10-1A VFD SBR.TP-1 out	480 480	37.89	2.417 0.000	13.720 0.000	5514.09			0.00 20.25	
VFD SBR.TP-2	MCC.10-1B VFD SBR.TP-2 out	480 480	37.89	2.417 0.000	13.720 0.000	5514.09			0.00 20.25	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
VFD SBR.TP-3	MCC.10-1A VFD SBR.TP-3 out	480 480	37.89	2.417 0.000	13.720 0.000	5514.09			0.00 20.25	
VFD SL.TP-1	MCC.10-1A VFD SL.TP-1 outp	480 480	15.63	0.997 0.000	5.666 0.000	2274.82			0.00 20.25	
VFD TSL.P-1	MCC.10-1A VFD TSL.P-1 outp	480 480	30.17	1.925 0.000	10.935 0.000	4390.87			0.00 20.25	

TOTAL SYSTEM POWER LOSSES

Harmonic Losses		Total RMS Losses	
P(kW)	Q{kVAR)	P(kW)	Q(kVAR)
0.15	1.65	58.76	313.26

CURRENT DISTORTION SUMMARY

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
NO VIOLATION										

TOTAL SYSTEM POWER LOSSES

Harmonic Losses		Total RMS Losses	
P(kW)	Q{kVAR)	P(kW)	Q(kVAR)
0.15	1.65	58.76	313.26

HARMONIC VOLTAGE SPECTRUM REPORT

Bus: SWBD.10-1A (distr.) (480V)

Harmonic Order	Harmonic Voltages	Phase Angle	Distortion Percent	Limit
1	470.216	-1.09		
5	6.655	20.84	1.415	5.000
7	3.346	149.39	0.712	5.000
11	2.962	-171.86	0.630	5.000
13	2.313	-126.44	0.492	5.000
17	2.186	-55.68	0.465	5.000
19	2.232	-24.28	0.475	5.000

Voltage: 480.0 V_RMS: 470.30 V_THD(%): 1.89
LIMIT (THD%): 8.0

HARMONIC VOLTAGE SPECTRUM REPORT

Bus: SWBD.10-1B (distr.) (480V)

Harmonic Order	Harmonic Voltages	Phase Angle	Distortion Percent	Limit
1	470.216	-1.09		
5	6.655	20.83	1.415	5.000
7	3.346	149.37	0.712	5.000
11	2.962	-171.87	0.630	5.000
13	2.313	-126.45	0.492	5.000
17	2.186	-55.69	0.465	5.000
19	2.232	-24.29	0.475	5.000

Voltage: 480.0 V_RMS: 470.30 V_THD(%): 1.89
LIMIT (THD%): 8.0

HARMONIC CURRENT SPECTRUM REPORT

Device Name: C: SWBD.10-1A (d
From: SWBD.10-1A (main (480V)
To: SWBD.10-1A (dist (480V)
Point of Common Coupling (PCC): (Isc/Ilf = 36.566)

Harmonic Order	Harmonic Amperes	Phase Angle	Distortion Percent		Limit
1	956.206	-37.90			
5	97.105	113.05	10.155	>	7.000
7	34.886	-118.97	3.648		7.000
11	19.653	-80.73	2.055		3.500
13	12.990	-35.45	1.359		3.500
17	9.388	35.14	0.982		2.500
19	8.575	66.47	0.897		2.500

Voltage: 480.0 I_RMS: 962.13 I_TDD(%): 1.#J
I_THD(%): 11.15
kWLoss: 0.002 kVARLoss: 0.001
I_K: LIMIT (TDD%): 8.0

Case 1 (normal) - recommended active harmonic filter correction = 42A

Calculations are based on utility available fault current

e Industrial Systems

Harmonic Distortion Calculations

Service KVA	2500
Service Z%	5.75
Primary Voltage	12,000
Secondary Voltage	480

First Step - ENTER Service Data!

Second Step
ENTER ALL LOADS!!

Third Step
Evaluate Harmonic Mitigation Methods!!

Enter Short Circuit Current Manually

38,234 I_{sc} Amps

XFMR I_{sc} Calculation:	52,296 Amps
XFMR I_{sc} Calculation:	3,007 Amps
I_{load} Calculation:	1,125 Amps
I_{sc} / I_{load} Calculation:	33.99 Per IEEE 519

THD-I Estimation:	8.0 %
THD-I Required:	8.0 %
THD-V Estimation:	1.3 %
THD-V Required:	5.0 %

System IEEE519 Compliant?

THD-I	THD-V
YES	YES

42 Amps Correction Required

Apply Active Filter Solution

ACTIVE FILTER SOLUTION APPLIED

Project Name: _____
GE-SE: _____
Date: _____
Application Engineer: _____

NOTES: Distortion calculations are based on 0% background distortion, balanced input line voltage (+/-1%) and source impedance of 1.5% to 6%, and all non-linear and linear loads operating simultaneously at full load. Matrix Filters cannot operate linear loads (by pass) Actual distortion may change (increase) under other system conditions. Motor FLA=4 Pole NEC ratings. Filter selections are based on GE AF-300 P11 drives . PCC is defined as Buss (where drive connects to plant power). Filters are rated for GE AF-300 G11 & GE AF-300 P11 drives. THD-V per IEEE519-1992 is defined as 5% for most applications except for critical applications like Hospitals that are defined as 3%.
FOR ESTIMATION PURPOSES ONLY! ALL SOLUTIONS BASED ON GE PRODUCT!
Contact Mark Ritter - Fort Edward for multi drive Matrix Filter applications.

Non- Linear Loads

Linear Loads

Misc. Load in Amps: 362

QTY	HP	FLA	PROPOSED HARMONIC MITIGATION SOLUTION	QTY	HP	FLA	Line Reactor Part #		Line Reactor List Price
5	50	325	18 pulse Drive	0	0	0			
1	40	52	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G05512	$	728
5	30	200	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G04512	$	700
3	25	102	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G03512	$	578
1	20	27	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G03512	$	578
1	10	14	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G01812	$	436
2	5	15	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G00812	$	344
4	3	19	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G00412	$	316
4	1	8	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G00211	$	308
0	0	0	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0			
0	0	0	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0			
0		0	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0			
Totals		763				362			

Line Reactor External to Drive/MCC Cabinet - NEMA1 Enclosure

Matrix Filter External to Drive/MCC Cabinet - NEMA1 Enclosure

Matrix Filter Part #	Matrix Filter List Price	External Reactor for Matrix Filter Part #	External Reactor for Matrix Filter List Price

Recommended active harmonic filter ampere rating (42A)

CPSI#21014

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Downtown Area WWTF - Orleans, MA
CASE 1 - ALT (normal / utility)
with Active Harmonic Filters

STUDY CRITERIA

Studies Selected To Run:	
Load Flow:	Yes
Frequency Scan:	Yes
Harmonic Distortion:	Yes
Load Flow Study Setup Options	
Utility Impedance:	Yes
Transformer Phase Shift:	Yes
Solution Method:	Exact
Load Specification:	Connected Load
Generation Acceleration Factor:	1.00
Load Acceleration Factor:	1.00
Bus Voltage Drop:	5.00
Branch Voltage Drop:	3.00
HI_WAVE Study Setup Options	
Fundamental Frequency:	60 Hz
Max. Harmonic Order:	50
Include Triplet Harmonics Path (Static Load):	No
Include Triplet Harmonics Path (Ind. Motor):	No
Modify Motor Z by Load Factor (Ind. Motor):	No
Modify Load Z by Load Factor (Static Load):	No
HI_WAVE Study Setup Options for Frequency Scan	
Scan Impedance Option:	Scan Self Impedance
Use Positive Sequence Network:	Yes
Use Negative Sequence Network:	Yes
Use Zero Sequence Network:	No
Model Transformer Tap:	Yes
Model Transformer Phase Shift:	Yes
Report Bus Equivalent Impedance:	No
Number of Scan Steps Per Order:	1
HI_WAVE Study Setup Options for Distortion	
Use Positive Sequence Network:	Yes
Use Negative Sequence Network:	Yes
Use Zero Sequence Network:	Yes
Model Transformer Tap:	Yes
Model Transformer Phase Shift:	Yes
Fundamental Solution:	Use Load Flow Result
Report Option:	All Distortions and Violations
Current Limits:	IEEE 519-2014 Std, Current Distortion Limit Table 3 & 4, Selected buses as PCC

LOADS AND MOTORS WITH HARMONIC SOURCE MODELS

Bus Name	Voltage	Component Name	LF Current	Harmonic Library
10-EF-1	480	10-EF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-EF-10	480	10-EF-10 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-11	480	10-EF-11 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-EF-5	480	10-EF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-7	480	10-EF-7 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-SF-1	480	10-SF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-SF-2	480	10-SF-2 mtr	6.0	Six Pulse, Z=8%, THDi=28%
10-SF-5	480	10-SF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
FS.P-1	480	FS.P-1 mtr	6.0	Six Pulse, Z=8%, THDi=28%
MIX.BLW-1 VFD ou	480	MIX.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-2 VFD ou	480	MIX.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-3 VFD ou	480	MIX.BLW-3	30.5	Six Pulse, Z=8%, THDi=28%
MIX.BLW-4 VFD ou	480	MIX.BLW-4	40.7	Six Pulse, Z=8%, THDi=28%
RDT-1 VFD output	480	RDT-1	1.6	Six Pulse, Z=8%, THDi=28%
RDT-2 VFD output	480	RDT-2	1.6	Six Pulse, Z=8%, THDi=28%
SBR.BLW-1 VFD ou	480	SBR.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-2 VFD ou	480	SBR.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-3 VFD ou	480	SBR.BLW-3	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.TP-1	480	SBR.TP-1 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SBR.TP-2	480	SBR.TP-2 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SBR.TP-3	480	SBR.TP-3 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SL.TP-1	480	SL.TP-1 mtr	11.0	Six Pulse, Z=8%, THDi=28%
TSL.P-1	480	TSL.P-1 mtr	21.3	Six Pulse, Z=8%, THDi=28%
VFD 10-BP-1 outp	480	10-BP-1	1.6	Six Pulse, Z=8%, THDi=28%
VFD 10-CP-1 outp	480	10-CP-1	8.6	Six Pulse, Z=8%, THDi=28%

HARMONIC SOURCE		
Six Pulse, Z=8%, THDi=28%		
Order	Magnitude (%)	Angle (Degrees)
1	100.000	-12.60
5	26.000	107.40
7	9.030	-126.90
11	4.550	-93.20
13	3.200	-50.20
17	1.740	15.90
19	1.350	45.00

HARMONIC SOURCE		
18 Pulse Rockwell,THDi=4.6%		
Order	Magnitude (%)	Angle (Degrees)
1	100.000	-12.60
5	3.261	107.40
7	1.596	-126.90
11	1.632	-93.20
13	0.816	-50.20
17	1.371	15.90
19	1.579	45.00

H A R M O N I C S O U R C E I N D E X T A B L E
HARMONIC SOURCES HAVE BEEN FOUND AND INJECTED FOR EACH OF THE FOLLOWING HARMONIC ORDERS
5 7 11 13 17 19

P A S S I V E F I L T E R D A T A

Filter Name	Bus Name	Bus Voltage	Rated Voltage	Connect	Filter Type	Capacitor KVAR	Tuned Order	Q	M	R (Ω)	L (H)	C (μF)
NO FILTER												

U T I L I T Y , G E N E R A T O R A N D M O T O R D A T A

Component Name	Component Type	Bus Name	Bus Voltage	Base Voltage	Base KVA	R1(pu) R2 R0	X1(pu) X2 X0
480V SOURCE	UTILITY	MVT.10-1 sec.	480	480	100000	0.3902 0.3902 0.3902	3.1216 3.1216 3.1216
GEN.10-1	SYNCH GENERATOR	GEN.10-1 output	480	480	100000	0.2803 0.4859 0.1592	6.5789 11.4035 3.7368

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
10-BP-1 VFD	480	469.71	32.4238	1.3271	
10-CP-1 VFD	480	468.34	32.7216	1.3472	
10-EF-1	480	479.47	37.6183	2.1330	
10-EF-10	480	479.76	32.7946	1.4684	
10-EF-11	480	479.63	33.4232	1.5556	
10-EF-5	480	479.70	33.0653	1.4847	
10-EF-7	480	479.59	33.6909	1.5717	
10-SF-1	480	479.47	37.6183	2.1330	
10-SF-2	480	479.15	40.9275	2.6241	
10-SF-3A disc.	480	468.70	32.4336	1.3260	
10-SF-4 disc.	480	469.64	32.1157	1.3082	
10-SF-5	480	479.70	33.0653	1.4847	
10-SF-7 disc.	480	469.45	32.3893	1.3243	
DF-1-CP	480	468.53	32.8759	1.3525	
DF-2-CP	480	468.46	32.2746	1.3177	
DP.10-1	480	470.26	31.9112	1.2968	
DP.10-2	480	470.26	31.9118	1.2968	
DP.10-3	480	470.26	31.9112	1.2968	
DP.10-4	480	470.26	31.9118	1.2968	
DP.10-5	480	470.26	31.9112	1.2968	
DP.20-1	480	470.26	31.9118	1.2968	
EFF.P-1	480	477.36	30.0702	1.1398	
EFF.P-2	480	477.36	29.5195	1.1110	
EQ.MIX-1 disc.	480	465.98	33.0300	1.3585	
EQ.MIX-2 disc.	480	465.91	32.4259	1.3236	
FS.P-1	480	479.15	41.0147	2.6308	
GEN.10-1 output	480	480.00	0.5000	0.0000	
LP.10-1	208	203.78	31.9112	1.2968	
LP.10-2	208	203.78	31.9118	1.2968	
LP.10-3	208	203.78	31.9112	1.2968	
LP.10-4	208	203.78	31.9118	1.2968	
LP.10-5	208	203.78	31.9112	1.2968	
LP.20-1	208	203.78	31.9118	1.2968	
MCC.10-1A	480	469.81	32.7997	1.3495	
MCC.10-1B	480	469.74	32.1997	1.3148	
MCC.10-2A	480	470.04	32.3550	1.3229	
MCC.10-2B	480	470.17	32.0847	1.3070	
MIX.BLW-1 VFD	480	469.30	32.8604	1.3167	
MIX.BLW-1 VFD ou	480	480.25	83.7760	3.2148	
MIX.BLW-2 VFD	480	469.30	32.8611	1.3167	

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
MIX.BLW-2 VFD ou	480	480.25	83.7766	3.2148	
MIX.BLW-3 VFD	480	468.99	32.7920	1.3497	
MIX.BLW-3 VFD ou	480	481.67	81.6660	8.3508	
MIX.BLW-4 VFD	480	469.14	32.9770	1.3602	
MIX.BLW-4 VFD ou	480	482.76	98.7832	10.7390	
MVT.10-1 sec.	480	471.62	28.9390	1.1757	
OC-CP	480	466.55	32.2610	1.3169	
OC.EF-1 disc.	480	466.55	32.2610	1.3169	
OC.F-1 disc.	480	466.55	32.2609	1.3169	
RDT-1 VFD output	480	480.07	34.8129	1.6903	
RDT-2 VFD output	480	480.07	34.8129	1.6903	
RDT-CP	480	468.33	33.1194	1.3688	
SBR-CP	480	469.22	32.8236	1.3504	
SBR.BLW-1 VFD	480	469.30	32.8604	1.3167	
SBR.BLW-1 VFD ou	480	480.25	83.7760	3.2148	
SBR.BLW-2 VFD	480	469.30	32.8611	1.3167	
SBR.BLW-2 VFD ou	480	480.25	83.7766	3.2148	
SBR.BLW-3 VFD	480	469.30	32.8604	1.3167	
SBR.BLW-3 VFD ou	480	480.25	83.7760	3.2148	
SBR.DEC-1 disc.	480	469.22	32.8237	1.3504	
SBR.DEC-2 disc.	480	469.22	32.8237	1.3504	
SBR.MIX-1 disc.	480	468.47	32.7719	1.3483	
SBR.MIX-2 disc.	480	461.08	32.6754	1.3332	
SBR.TP-1	480	479.55	76.7762	7.5576	
SBR.TP-2	480	479.54	76.1771	7.5238	
SBR.TP-3	480	479.55	76.7762	7.5576	
SEP-1-CP	480	468.58	32.8731	1.3524	
SL.TP-1	480	477.64	50.4810	3.8788	
SWBD.10-1A (dist	480	470.26	31.9112	1.2968	8.0
SWBD.10-1A (main	480	470.26	31.9095	1.2967	
SWBD.10-1B (dist	480	470.26	31.9118	1.2968	8.0
SWBD.10-1B (main	480	480.00	0.5000	0.0000	
T.10-1 pri.	480	470.26	31.9112	1.2968	
T.10-1 sec.	208	203.78	31.9112	1.2968	
T.10-2 pri.	480	470.26	31.9118	1.2968	
T.10-2 sec.	208	203.78	31.9118	1.2968	
T.10-3 pri.	480	470.26	31.9112	1.2968	
T.10-3 sec.	208	203.78	31.9112	1.2968	
T.10-4 pri.	480	470.26	31.9118	1.2968	
T.10-4 sec.	208	203.78	31.9118	1.2968	

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
T.10-5A pri.	480	470.26	31.9112	1.2968	
T.10-5A sec.	480	470.26	31.9112	1.2968	
T.10-5B pri.	480	470.26	31.9112	1.2968	
T.10-5B sec.	208	203.78	31.9112	1.2968	
T.20-1 pri.	480	470.26	31.9118	1.2968	
T.20-1 sec.	208	203.78	31.9118	1.2968	
TSL.P-1	480	477.81	68.0441	6.3112	
VFD 10-BP-1 outp	480	480.07	34.2238	1.6534	
VFD 10-CP-1 outp	480	480.25	45.4159	3.2469	
VFD 10-EF-1 outp	480	480.11	37.4620	2.1231	
VFD 10-EF-10 out	480	480.05	32.7266	1.4642	
VFD 10-EF-11 out	480	480.06	33.3235	1.5494	
VFD 10-EF-5 outp	480	480.05	32.9834	1.4796	
VFD 10-EF-7 outp	480	480.06	33.5807	1.5648	
VFD 10-SF-1 outp	480	480.11	37.4620	2.1231	
VFD 10-SF-2 outp	480	480.16	40.6716	2.6075	
VFD 10-SF-5 outp	480	480.05	32.9834	1.4796	
VFD EFF.P-1 outp	480	480.03	29.9786	1.1365	
VFD EFF.P-2 outp	480	480.03	29.4298	1.1078	
VFD FS.P-1 outpu	480	480.16	40.7587	2.6142	
VFD SBR.TP-1 out	480	481.34	75.3924	7.4651	
VFD SBR.TP-2 out	480	481.32	74.7960	7.4315	
VFD SBR.TP-3 out	480	481.34	75.3924	7.4651	
VFD SL.TP-1 outp	480	480.35	49.5009	3.8133	
VFD TSL.P-1 outp	480	480.92	66.3562	6.1959	
VFD W3.P-CP OUTP	480	480.02	27.5631	0.9774	
W3.P-CP	480	468.62	32.2122	1.3156	

VOLTAGE DISTORTION SUMMARY					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
480V SOURCE	MVT.10-1 sec.	480 480	958.84	0.014 0.014	0.633 0.633	71485.05			0.19 7.42	
C: 10-BP-1 VFD	MCC.10-2A 10-BP-1 VFD	480 480	2.33	0.002 0.000	0.000 0.000	339.31			0.00 20.25	
C: 10-CP-1 VFD	MCC.10-2A 10-CP-1 VFD	480 480	12.25	0.045 0.002	0.001 0.000	1777.25			0.00 20.19	
C: 10-EF-1	VFD 10-EF-1 outp 10-EF-1	480 480	3.91	0.005 0.000	0.000 0.000	776.56			0.00 28.17	
C: 10-EF-10	VFD 10-EF-10 out 10-EF-10	480 480	0.89	0.000 0.000	0.000 0.000	177.83			0.00 28.17	
C: 10-EF-11	VFD 10-EF-11 out 10-EF-11	480 480	1.30	0.001 0.000	0.000 0.000	258.75			0.00 28.17	
C: 10-EF-5	VFD 10-EF-5 outp 10-EF-5	480 480	0.89	0.001 0.000	0.000 0.000	177.86			0.00 28.17	
C: 10-EF-7	VFD 10-EF-7 outp 10-EF-7	480 480	1.30	0.001 0.000	0.000 0.000	258.77			0.00 28.17	
C: 10-SF-1	VFD 10-SF-1 outp 10-SF-1	480 480	3.91	0.005 0.000	0.000 0.000	776.56			0.00 28.17	
C: 10-SF-2	VFD 10-SF-2 outp 10-SF-2	480 480	6.19	0.011 0.001	0.000 0.000	1230.52			0.00 28.17	
C: 10-SF-3A disc	MCC.10-2A 10-SF-3A disc.	480 480	2.94	0.008 0.000	0.000 0.000	25.95			0.00 0.88	
C: 10-SF-4 disc.	MCC.10-2B 10-SF-4 disc.	480 480	1.57	0.002 0.000	0.000 0.000	13.72			0.00 0.87	
C: 10-SF-5	VFD 10-SF-5 outp 10-SF-5	480 480	0.89	0.001 0.000	0.000 0.000	177.86			0.00 28.17	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: 10-SF-7 disc.	MCC.10-2A 10-SF-7 disc.	480 480	2.06	0.003 0.000	0.000 0.000	18.17			0.00 0.88	
C: DF-1-CP	MCC.10-1A DF-1-CP	480 480	5.01	0.014 0.000	0.000 0.000	44.78			0.00 0.90	
C: DF-2-CP	MCC.10-1B DF-2-CP	480 480	5.01	0.014 0.000	0.000 0.000	43.86			0.00 0.87	
C: DP.10-1	SWBD.10-1A (dist DP.10-1	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-2	SWBD.10-1B (dist DP.10-2	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-3	SWBD.10-1A (dist DP.10-3	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-4	SWBD.10-1B (dist DP.10-4	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-5	T.10-5A sec. DP.10-5	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: DP.20-1	SWBD.10-1B (dist DP.20-1	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: EFF.P-1 disc.	VFD EFF.P-1 outp EFF.P-1	480 480	31.47	0.146 0.000	0.015 0.000	263.93			0.00 0.76	
C: EFF.P-2	VFD EFF.P-2 outp EFF.P-2	480 480	31.47	0.146 0.000	0.015 0.000	258.55			0.00 0.73	
C: EQ.MIX-1 disc	MCC.10-1A EQ.MIX-1 disc.	480 480	7.50	0.061 0.000	0.002 0.000	66.67			0.00 0.89	
C: EQ.MIX-2 disc	MCC.10-1B EQ.MIX-2 disc.	480 480	7.50	0.061 0.000	0.002 0.000	65.31			0.00 0.87	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: FS.P-1	VFD FS.P-1 outpu FS.P-1	480 480	6.19	0.011 0.001	0.000 0.000	1230.52			0.00 28.17	
C: GEN.10-1	GEN.10-1 output SWBD.10-1B (main	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-1	T.10-1 sec. LP.10-1	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-2	T.10-2 sec. LP.10-2	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-3	T.10-3 sec. LP.10-3	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-4	T.10-4 sec. LP.10-4	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-5	T.10-5B sec. LP.10-5	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.20-1	T.20-1 sec. LP.20-1	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: MCC.10-1A	SWBD.10-1A (dist MCC.10-1A	480 480	213.32	0.107 0.002	0.145 0.010	17734.40			0.00 11.52	15.0
C: MCC.10-1B	SWBD.10-1B (dist MCC.10-1B	480 480	244.59	0.140 0.000	0.180 0.001	5477.30			0.00 3.27	15.0
C: MCC.10-2A	SWBD.10-1A (dist MCC.10-2A	480 480	34.38	0.011 0.000	0.008 0.001	4241.45			0.00 17.11	20.0
C: MCC.10-2B	SWBD.10-1B (dist MCC.10-2B	480 480	12.98	0.002 0.000	0.001 0.000	1653.83			0.00 17.68	20.0
C: MIX.BLW-1 VFD	SWBD.10-1A (dist MIX.BLW-1 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: MIX.BLW-2 VF	SWBD.10-1B (dist MIX.BLW-2 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0
C: MIX.BLW-3 VFD	SWBD.10-1A (dist MIX.BLW-3 VFD	480 480	43.38	0.110 0.004	0.017 0.003	6301.22			0.00 20.21	15.0
C: MIX.BLW-4 VFD	SWBD.10-1B (dist MIX.BLW-4 VFD	480 480	57.80	0.124 0.005	0.028 0.005	8401.62			0.00 20.22	15.0
C: OC-CP	MCC.10-1B OC-CP	480 480	41.51	0.256 0.000	0.040 0.000	360.42			0.00 0.86	
C: OC.EF-1 disc.	OC-CP OC.EF-1 disc.	480 480	2.07	0.000 0.000	0.000 0.000	17.98			0.00 0.86	
C: OC.F-1 disc.	OC-CP OC.F-1 disc.	480 480	39.44	0.000 0.000	0.000 0.000	342.44			0.00 0.86	
C: RDT-CP	MCC.10-1A RDT-CP	480 480	6.71	0.021 0.000	0.001 0.000	660.61			0.00 13.64	
C: SBR-BLW-1 VFD	SWBD.10-1A (dist SBR.BLW-1 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0
C: SBR-BLW-2 VFD	SWBD.10-1B (dist SBR.BLW-2 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0
C: SBR-BLW-3 VFD	SWBD.10-1A (dist SBR.BLW-3 VFD	480 480	70.83	0.120 0.000	0.035 0.000	6241.51			0.00 3.28	15.0
C: SBR-CP	MCC.10-1A SBR-CP	480 480	12.75	0.015 0.000	0.001 0.000	114.12			0.00 0.90	
C: SBR.DEC-1 dis	SBR-CP SBR.DEC-1 disc.	480 480	6.37	0.000 0.000	0.000 0.000	57.06			0.00 0.90	
C: SBR.DEC-2 dis	SBR-CP SBR.DEC-2 disc.	480 480	6.37	0.000 0.000	0.000 0.000	57.06			0.00 0.90	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: SBR.MIX-1 dis	MCC.10-1A SBR.MIX-1 disc.	480 480	13.75	0.032 0.000	0.010 0.000	122.52			0.00 0.89	
C: SBR.MIX-2 dis	MCC.10-1B SBR.MIX-2 disc.	480 480	13.97	0.253 0.000	0.011 0.000	119.97			0.00 0.85	
C: SBR.TP-1	VFD SBR.TP-1 out SBR.TP-1	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SBR.TP-2	VFD SBR.TP-2 out SBR.TP-2	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SBR.TP-3	VFD SBR.TP-3 out SBR.TP-3	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SEP-1-CP	MCC.10-1A SEP-1-CP	480 480	3.34	0.009 0.000	0.000 0.000	29.85			0.00 0.90	
C: SL.TP-1	VFD SL.TP-1 outp SL.TP-1	480 480	11.44	0.056 0.004	0.003 0.001	2274.82			0.00 28.17	
C: SWBD.10-1 TIE	SWBD.10-1A (dist SWBD.10-1B (dist	480 480	456.23	0.000 0.000	0.000 0.000	26624.36			0.00 5.69	12.0
C: SWBD.10-1A	MVT.10-1 sec. SWBD.10-1A (main	480 480	958.84	1.367 0.010	2.024 0.063	71485.05			0.00 7.42	
C: SWBD.10-1A (d	SWBD.10-1A (main SWBD.10-1A (dist	480 480	958.84	0.002 0.000	0.001 0.000	71485.05			0.00 7.42	8.0
C: T.10-1	DP.10-1 T.10-1 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-2	DP.10-2 T.10-2 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-3	DP.10-3 T.10-3 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: T.10-4	DP.10-4 T.10-4 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-5A	SWBD.10-1A (dist T.10-5A pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: T.10-5B	SWBD.10-1A (dist T.10-5B pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: T.20-1	DP.20-1 T.20-1 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: TSL.P-1	VFD TSL.P-1 outp TSL.P-1	480 480	22.09	0.125 0.009	0.011 0.003	4390.85			0.00 28.17	
C: W3.P-CP	MCC.10-1B W3.P-CP	480 480	87.26	0.171 0.000	0.053 0.000	482.07			0.00 0.45	
GEN.10-1	GEN.10-1 output	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
T.10-1	T.10-1 pri. T.10-1 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-2	T.10-2 pri. T.10-2 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-3	T.10-3 pri. T.10-3 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-4	T.10-4 pri. T.10-4 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-5A	T.10-5A pri. T.10-5A sec.	480 480	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-5B	T.10-5B pri. T.10-5B sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
T.20-1	T.20-1 pri. T.20-1 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
VFD 10-BP-1	10-BP-1 VFD VFD 10-BP-1 outp	480 480	2.33	0.149 0.000	0.844 0.000	339.31			0.00 20.25	
VFD 10-CP-1	10-CP-1 VFD VFD 10-CP-1 outp	480 480	12.25	0.779 0.000	4.419 0.000	1777.25			0.00 20.19	
VFD 10-EF-1	MCC.10-2A VFD 10-EF-1 outp	480 480	5.33	0.340 0.000	1.932 0.000	776.57			0.00 20.26	
VFD 10-EF-10	MCC.10-2B VFD 10-EF-10 out	480 480	1.22	0.078 0.000	0.442 0.000	177.83			0.00 20.27	
VFD 10-EF-11	MCC.10-2B VFD 10-EF-11 out	480 480	1.78	0.113 0.000	0.644 0.000	258.75			0.00 20.27	
VFD 10-EF-5	MCC.10-2A VFD 10-EF-5 outp	480 480	1.22	0.078 0.000	0.442 0.000	177.86			0.00 20.26	
VFD 10-EF-7	MCC.10-2A VFD 10-EF-7 outp	480 480	1.78	0.113 0.000	0.644 0.000	258.77			0.00 20.26	
VFD 10-SF-1	MCC.10-2A VFD 10-SF-1 outp	480 480	5.33	0.340 0.000	1.932 0.000	776.57			0.00 20.26	
VFD 10-SF-2	MCC.10-2B VFD 10-SF-2 outp	480 480	8.45	0.539 0.000	3.062 0.000	1230.53			0.00 20.27	
VFD 10-SF-5	MCC.10-2A VFD 10-SF-5 outp	480 480	1.22	0.078 0.000	0.442 0.000	177.86			0.00 20.26	
VFD EFF.P-1	MCC.10-1A VFD EFF.P-1 outp	480 480	43.77	2.849 0.000	16.175 0.000	264.37			0.00 0.54	
VFD EFF.P-2	MCC.10-1B VFD EFF.P-2 outp	480 480	43.78	2.849 0.000	16.175 0.000	259.00			0.00 0.53	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
VFD FS.P-1	MCC.10-1B VFD FS.P-1 outpu	480 480	8.46	0.539 0.000	3.062 0.000	1230.53			0.00 20.25	
VFD FS.P-2	W3.P-CP VFD W3.P-CP OUTP	480 480	87.26	5.666 0.000	32.138 0.000	482.07			0.00 0.45	
VFD MIX.BLW-1	MIX.BLW-1 VFD MIX.BLW-1 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD MIX.BLW-2	MIX.BLW-2 VFD MIX.BLW-2 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD MIX.BLW-3	MIX.BLW-3 VFD MIX.BLW-3 VFD ou	480 480	43.38	2.771 0.000	15.675 0.000	6301.22			0.00 20.21	
VFD MIX.BLW-4	MIX.BLW-4 VFD MIX.BLW-4 VFD ou	480 480	57.80	3.683 0.000	20.890 0.000	8401.62			0.00 20.22	
VFD RDT-1	RDT-CP RDT-1 VFD output	480 480	2.34	0.149 0.000	0.844 0.000	339.31			0.00 20.19	
VFD RDT-2	RDT-CP RDT-2 VFD output	480 480	2.34	0.149 0.000	0.844 0.000	339.31			0.00 20.19	
VFD SBR-BLW-1	SBR.BLW-1 VFD SBR.BLW-1 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD SBR.BLW-2	SBR.BLW-2 VFD SBR.BLW-2 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD SBR.BLW-3	SBR.BLW-3 VFD SBR.BLW-3 VFD ou	480 480	70.83	4.603 0.000	26.113 0.000	6241.51			0.00 3.28	
VFD SBR.TP-1	MCC.10-1A VFD SBR.TP-1 out	480 480	37.89	2.417 0.000	13.720 0.000	5514.09			0.00 20.25	
VFD SBR.TP-2	MCC.10-1B VFD SBR.TP-2 out	480 480	37.89	2.417 0.000	13.720 0.000	5514.09			0.00 20.25	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
VFD SBR.TP-3	MCC.10-1A VFD SBR.TP-3 out	480 480	37.89	2.417 0.000	13.720 0.000	5514.09			0.00 20.25	
VFD SL.TP-1	MCC.10-1A VFD SL.TP-1 outp	480 480	15.63	0.997 0.000	5.666 0.000	2274.82			0.00 20.25	
VFD TSL.P-1	MCC.10-1A VFD TSL.P-1 outp	480 480	30.17	1.925 0.000	10.935 0.000	4390.87			0.00 20.25	

TOTAL SYSTEM POWER LOSSES

Harmonic Losses		Total RMS Losses	
P(kW)	Q{kVAR)	P(kW)	Q(kVAR)
0.08	0.75	58.69	312.36

CURRENT DISTORTION SUMMARY

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
NO VIOLATION										

TOTAL SYSTEM POWER LOSSES

Harmonic Losses		Total RMS Losses	
P(kW)	Q{kVAR)	P(kW)	Q(kVAR)
0.08	0.75	58.69	312.36

HARMONIC VOLTAGE SPECTRUM REPORT

Bus: SWBD.10-1A (distr.) (480V)

Harmonic Order	Harmonic Voltages	Phase Angle	Distortion Percent	Limit
1	470.216	-1.09		
5	4.400	20.83	0.936	5.000
7	2.247	149.38	0.478	5.000
11	2.086	-171.88	0.444	5.000
13	1.587	-126.46	0.337	5.000
17	1.662	-55.71	0.353	5.000
19	1.772	-24.31	0.377	5.000

Voltage: 480.0 V_RMS: 470.26 V_THD(%): 1.30
LIMIT (THD%): 8.0

HARMONIC VOLTAGE SPECTRUM REPORT

Bus: SWBD.10-1B (distr.) (480V)

Harmonic Order	Harmonic Voltages	Phase Angle	Distortion Percent	Limit
1	470.216	-1.09		
5	4.400	20.82	0.936	5.000
7	2.247	149.37	0.478	5.000
11	2.086	-171.89	0.444	5.000
13	1.587	-126.47	0.337	5.000
17	1.662	-55.72	0.353	5.000
19	1.772	-24.32	0.377	5.000

Voltage: 480.0 V_RMS: 470.26 V_THD(%): 1.30
LIMIT (THD%): 8.0

HARMONIC CURRENT SPECTRUM REPORT

Device Name: C: SWBD.10-1A (d
From: SWBD.10-1A (main (480V)
To: SWBD.10-1A (dist (480V)
Point of Common Coupling (PCC): (Isc/Ilf = 36.566)

Harmonic Order	Harmonic Amperes	Phase Angle	Distortion Percent	Limit
1	956.206	-37.90		
5	64.206	113.04	6.715	7.000
7	23.427	-118.98	2.450	7.000
11	13.841	-80.75	1.447	3.500
13	8.911	-35.46	0.932	3.500
17	7.136	35.11	0.746	2.500
19	6.810	66.44	0.712	2.500

Voltage: 480.0 I_RMS: 958.84 I_TDD(%): 1.#J
I_THD(%): 7.42
kWLoss: 0.002 kVARLoss: 0.001
I_K: LIMIT (TDD%): 8.0

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Downtown Area WWTF - Orleans, MA
CASE 2 (emergency / generator)

(without active harmonic filters)

S T U D Y C R I T E R I A

Studies Selected To Run:	
Load Flow:	Yes
Frequency Scan:	Yes
Harmonic Distortion:	Yes
Load Flow Study Setup Options	
Utility Impedance:	Yes
Transformer Phase Shift:	Yes
Solution Method:	Exact
Load Specification:	Connected Load
Generation Acceleration Factor:	1.00
Load Acceleration Factor:	1.00
Bus Voltage Drop:	5.00
Branch Voltage Drop:	3.00
HI_WAVE Study Setup Options	
Fundamental Frequency:	60 Hz
Max. Harmonic Order:	50
Include Triplet Harmonics Path (Static Load):	No
Include Triplet Harmonics Path (Ind. Motor):	No
Modify Motor Z by Load Factor (Ind. Motor):	No
Modify Load Z by Load Factor (Static Load):	No
HI_WAVE Study Setup Options for Frequency Scan	
Scan Impedance Option:	Scan Self Impedance
Use Positive Sequence Network:	Yes
Use Negative Sequence Network:	Yes
Use Zero Sequence Network:	No
Model Transformer Tap:	Yes
Model Transformer Phase Shift:	Yes
Report Bus Equivalent Impedance:	No
Number of Scan Steps Per Order:	1
HI_WAVE Study Setup Options for Distortion	
Use Positive Sequence Network:	Yes
Use Negative Sequence Network:	Yes
Use Zero Sequence Network:	Yes
Model Transformer Tap:	Yes
Model Transformer Phase Shift:	Yes
Fundamental Solution:	Use Load Flow Result
Report Option:	All Distortions and Violations
Current Limits:	IEEE 519-2014 Std, Current Distortion Limit Table 3 & 4, Selected buses as PCC

LOADS AND MOTORS WITH HARMONIC SOURCE MODELS

Bus Name	Voltage	Component Name	LF Current	Harmonic Library
10-EF-1	480	10-EF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-EF-10	480	10-EF-10 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-11	480	10-EF-11 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-EF-5	480	10-EF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-7	480	10-EF-7 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-SF-1	480	10-SF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-SF-2	480	10-SF-2 mtr	6.0	Six Pulse, Z=8%, THDi=28%
10-SF-5	480	10-SF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
EFF.P-1	480	EFF.P-1 mtr	31.5	Six Pulse, Z=8%, THDi=28%
EFF.P-2	480	EFF.P-2 mtr	31.5	Six Pulse, Z=8%, THDi=28%
FS.P-1	480	FS.P-1 mtr	6.0	Six Pulse, Z=8%, THDi=28%
MIX.BLW-1 VFD ou	480	MIX.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-2 VFD ou	480	MIX.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-3 VFD ou	480	MIX.BLW-3	30.5	Six Pulse, Z=8%, THDi=28%
MIX.BLW-4 VFD ou	480	MIX.BLW-4	40.7	Six Pulse, Z=8%, THDi=28%
RDT-1 VFD output	480	RDT-1	1.6	Six Pulse, Z=8%, THDi=28%
RDT-2 VFD output	480	RDT-2	1.6	Six Pulse, Z=8%, THDi=28%
SBR.BLW-1 VFD ou	480	SBR.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-2 VFD ou	480	SBR.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-3 VFD ou	480	SBR.BLW-3	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.TP-1	480	SBR.TP-1 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SBR.TP-2	480	SBR.TP-2 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SBR.TP-3	480	SBR.TP-3 mtr	26.7	Six Pulse, Z=8%, THDi=28%
SL.TP-1	480	SL.TP-1 mtr	11.0	Six Pulse, Z=8%, THDi=28%
TSL.P-1	480	TSL.P-1 mtr	21.3	Six Pulse, Z=8%, THDi=28%
VFD 10-BP-1 outp	480	10-BP-1	1.6	Six Pulse, Z=8%, THDi=28%
VFD 10-CP-1 outp	480	10-CP-1	8.6	Six Pulse, Z=8%, THDi=28%
VFD W3.P-CP OUTP	480	W3.P-1/2/3 MTR	62.6	Six Pulse, Z=8%, THDi=28%

HARMONIC SOURCE		
Six Pulse, Z=8%, THDi=28%		
Order	Magnitude (%)	Angle (Degrees)
1	100.000	-12.60
5	26.000	107.40
7	9.030	-126.90
11	4.550	-93.20
13	3.200	-50.20
17	1.740	15.90
19	1.350	45.00

HARMONIC SOURCE		
18 Pulse Rockwell,THDi=4.6%		
Order	Magnitude (%)	Angle (Degrees)
1	100.000	-12.60
5	3.261	107.40
7	1.596	-126.90
11	1.632	-93.20
13	0.816	-50.20
17	1.371	15.90
19	1.579	45.00

H A R M O N I C S O U R C E I N D E X T A B L E
HARMONIC SOURCES HAVE BEEN FOUND AND INJECTED FOR EACH OF THE FOLLOWING HARMONIC ORDERS
5 7 11 13 17 19

PASSIVE FILTER DATA												
Filter Name	Bus Name	Bus Voltage	Rated Voltage	Connect	Filter Type	Capacitor KVAR	Tuned Order	Q	M	R (Ω)	L (H)	C (μF)
NO FILTER												

U T I L I T Y , G E N E R A T O R A N D M O T O R D A T A

Component Name	Component Type	Bus Name	Bus Voltage	Base Voltage	Base KVA	R1(pu) R2 R0	X1(pu) X2 X0
480V SOURCE	UTILITY	MVT.10-1 sec.	480	480	100000	0.3902 0.3902 0.3902	3.1216 3.1216 3.1216
GEN.10-1	SYNCH GENERATOR	GEN.10-1 output	480	480	100000	0.2803 0.4859 0.1592	6.5789 11.4035 3.7368

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
10-BP-1 VFD	480	461.94	114.5038	5.8549	
10-CP-1 VFD	480	460.54	115.0519	5.8862	
10-EF-1	480	480.36	115.9534	6.4728	
10-EF-10	480	480.51	111.1503	5.8040	
10-EF-11	480	480.40	111.7979	5.8938	
10-EF-5	480	480.46	111.4189	5.8201	
10-EF-7	480	480.37	112.0605	5.9096	
10-SF-1	480	480.36	115.9534	6.4728	
10-SF-2	480	480.14	119.2334	6.9615	
10-SF-3A disc.	480	460.91	114.6646	5.8617	
10-SF-4 disc.	480	461.86	114.2009	5.8361	
10-SF-5	480	480.46	111.4189	5.8201	
10-SF-7 disc.	480	461.67	114.5016	5.8538	
DF-1-CP	480	460.75	115.4316	5.9077	
DF-2-CP	480	460.68	115.4704	5.9102	
DP.10-1	480	462.48	113.9029	5.8197	
DP.10-2	480	462.48	113.9016	5.8196	
DP.10-3	480	462.48	113.9029	5.8197	
DP.10-4	480	462.48	113.9016	5.8196	
DP.10-5	480	462.48	113.9029	5.8197	
DP.20-1	480	462.48	113.9016	5.8196	
EFF.P-1	480	481.35	162.0335	13.0105	
EFF.P-2	480	481.35	162.0555	13.0121	
EQ.MIX-1 disc.	480	458.15	115.9943	5.9351	
EQ.MIX-2 disc.	480	458.08	116.0335	5.9376	
FS.P-1	480	480.16	120.1997	7.0201	
GEN.10-1 output	480	464.10	109.1163	5.5997	
LP.10-1	208	200.41	113.9029	5.8197	
LP.10-2	208	200.41	113.9016	5.8196	
LP.10-3	208	200.41	113.9029	5.8197	
LP.10-4	208	200.41	113.9016	5.8196	
LP.10-5	208	200.41	113.9029	5.8197	
LP.20-1	208	200.41	113.9016	5.8196	
MCC.10-1A	480	462.04	115.1533	5.8942	
MCC.10-1B	480	461.98	115.1919	5.8967	
MCC.10-2A	480	462.26	114.3757	5.8477	
MCC.10-2B	480	462.40	114.0863	5.8305	
MIX.BLW-1 VFD	480	461.52	114.9827	5.8477	
MIX.BLW-1 VFD ou	480	481.35	160.2509	7.5056	
MIX.BLW-2 VFD	480	461.52	114.9814	5.8476	

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
MIX.BLW-2 VFD ou	480	481.35	160.2498	7.5055	
MIX.BLW-3 VFD	480	461.21	115.0179	5.8846	
MIX.BLW-3 VFD ou	480	483.80	157.7260	12.6012	
MIX.BLW-4 VFD	480	461.37	115.1735	5.8941	
MIX.BLW-4 VFD ou	480	485.35	173.8832	14.9706	
MVT.10-1 sec.	480	480.00	0.5000	0.0000	
OC-CP	480	458.73	115.4391	5.9077	
OC.EF-1 disc.	480	458.72	115.4393	5.9077	
OC.F-1 disc.	480	458.72	115.4391	5.9077	
RDT-1 VFD output	480	480.87	113.3519	6.0395	
RDT-2 VFD output	480	480.87	113.3519	6.0395	
RDT-CP	480	460.54	115.7285	5.9263	
SBR-CP	480	461.45	115.2421	5.8984	
SBR.BLW-1 VFD	480	461.52	114.9827	5.8477	
SBR.BLW-1 VFD ou	480	481.35	160.2509	7.5056	
SBR.BLW-2 VFD	480	461.52	114.9814	5.8476	
SBR.BLW-2 VFD ou	480	481.35	160.2498	7.5055	
SBR.BLW-3 VFD	480	461.52	114.9827	5.8477	
SBR.BLW-3 VFD ou	480	481.35	160.2509	7.5056	
SBR.DEC-1 disc.	480	461.45	115.2425	5.8984	
SBR.DEC-2 disc.	480	461.45	115.2425	5.8984	
SBR.MIX-1 disc.	480	460.68	115.0680	5.8892	
SBR.MIX-2 disc.	480	453.15	116.9697	5.9827	
SBR.TP-1	480	481.53	153.7229	11.8493	
SBR.TP-2	480	481.53	153.7448	11.8509	
SBR.TP-3	480	481.53	153.7229	11.8493	
SEP-1-CP	480	460.79	115.4212	5.9072	
SL.TP-1	480	478.90	128.9643	8.2273	
SWBD.10-1A (dist	480	462.48	113.9029	5.8197	8.0
SWBD.10-1A (main	480	480.00	0.5000	0.0000	
SWBD.10-1B (dist	480	462.48	113.9016	5.8196	8.0
SWBD.10-1B (main	480	462.48	113.8991	5.8195	
T.10-1 pri.	480	462.48	113.9029	5.8197	
T.10-1 sec.	208	200.41	113.9029	5.8197	
T.10-2 pri.	480	462.48	113.9016	5.8196	
T.10-2 sec.	208	200.41	113.9016	5.8196	
T.10-3 pri.	480	462.48	113.9029	5.8197	
T.10-3 sec.	208	200.41	113.9029	5.8197	
T.10-4 pri.	480	462.48	113.9016	5.8196	
T.10-4 sec.	208	200.41	113.9016	5.8196	

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
T.10-5A pri.	480	462.48	113.9029	5.8197	
T.10-5A sec.	480	462.48	113.9029	5.8197	
T.10-5B pri.	480	462.48	113.9029	5.8197	
T.10-5B sec.	208	200.41	113.9029	5.8197	
T.20-1 pri.	480	462.48	113.9016	5.8196	
T.20-1 sec.	208	200.41	113.9016	5.8196	
TSL.P-1	480	479.55	145.7016	10.6292	
VFD 10-BP-1 outp	480	480.86	112.5128	5.9883	
VFD 10-CP-1 outp	480	481.37	123.3780	7.5644	
VFD 10-EF-1 outp	480	481.00	115.6950	6.4574	
VFD 10-EF-10 out	480	480.81	111.0352	5.7974	
VFD 10-EF-11 out	480	480.83	111.6297	5.8841	
VFD 10-EF-5 outp	480	480.81	111.2805	5.8121	
VFD 10-EF-7 outp	480	480.83	111.8752	5.8989	
VFD 10-SF-1 outp	480	481.00	115.6950	6.4574	
VFD 10-SF-2 outp	480	481.15	118.8164	6.9361	
VFD 10-SF-5 outp	480	480.81	111.2805	5.8121	
VFD EFF.P-1 outp	480	483.94	159.5600	12.8427	
VFD EFF.P-2 outp	480	483.94	159.5819	12.8443	
VFD FS.P-1 outpu	480	481.17	119.7804	6.9945	
VFD SBR.TP-1 out	480	483.30	152.0725	11.7398	
VFD SBR.TP-2 out	480	483.30	152.0943	11.7414	
VFD SBR.TP-3 out	480	483.30	152.0725	11.7398	
VFD SL.TP-1 outp	480	481.59	127.5619	8.1380	
VFD TSL.P-1 outp	480	482.63	143.5372	10.4851	
VFD W3.P-CP OUTP	480	489.66	209.5322	20.1623	
W3.P-CP	480	460.86	116.9387	5.9995	

VOLTAGE DISTORTION SUMMARY					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
480V SOURCE	MVT.10-1 sec.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: 10-BP-1 VFD	MCC.10-2A 10-BP-1 VFD	480 480	2.37	0.002 0.000	0.000 0.000	339.31			0.00 19.88	
C: 10-CP-1 VFD	MCC.10-2A 10-CP-1 VFD	480 480	12.47	0.047 0.002	0.001 0.000	1777.25			0.00 19.82	
C: 10-EF-1	VFD 10-EF-1 outp 10-EF-1	480 480	3.91	0.005 0.000	0.000 0.000	776.56			0.00 28.17	
C: 10-EF-10	VFD 10-EF-10 out 10-EF-10	480 480	0.89	0.000 0.000	0.000 0.000	177.83			0.00 28.17	
C: 10-EF-11	VFD 10-EF-11 out 10-EF-11	480 480	1.30	0.001 0.000	0.000 0.000	258.75			0.00 28.17	
C: 10-EF-5	VFD 10-EF-5 outp 10-EF-5	480 480	0.89	0.001 0.000	0.000 0.000	177.86			0.00 28.17	
C: 10-EF-7	VFD 10-EF-7 outp 10-EF-7	480 480	1.30	0.001 0.000	0.000 0.000	258.77			0.00 28.17	
C: 10-SF-1	VFD 10-SF-1 outp 10-SF-1	480 480	3.91	0.005 0.000	0.000 0.000	776.56			0.00 28.17	
C: 10-SF-2	VFD 10-SF-2 outp 10-SF-2	480 480	6.19	0.011 0.001	0.000 0.000	1230.52			0.00 28.17	
C: 10-SF-3A disc	MCC.10-2A 10-SF-3A disc.	480 480	3.00	0.009 0.000	0.000 0.000	95.59			0.00 4.04	
C: 10-SF-4 disc.	MCC.10-2B 10-SF-4 disc.	480 480	1.60	0.002 0.000	0.000 0.000	50.87			0.00 4.04	
C: 10-SF-5	VFD 10-SF-5 outp 10-SF-5	480 480	0.89	0.001 0.000	0.000 0.000	177.86			0.00 28.17	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: 10-SF-7 disc.	MCC.10-2A 10-SF-7 disc.	480 480	2.10	0.003 0.000	0.000 0.000	66.93			0.00 4.05	
C: DF-1-CP	MCC.10-1A DF-1-CP	480 480	5.10	0.014 0.000	0.000 0.000	163.59			0.00 4.07	
C: DF-2-CP	MCC.10-1B DF-2-CP	480 480	5.11	0.014 0.000	0.000 0.000	163.63			0.00 4.07	
C: DP.10-1	SWBD.10-1A (dist DP.10-1	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-2	SWBD.10-1B (dist DP.10-2	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-3	SWBD.10-1A (dist DP.10-3	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-4	SWBD.10-1B (dist DP.10-4	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-5	T.10-5A sec. DP.10-5	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: DP.20-1	SWBD.10-1B (dist DP.20-1	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: EFF.P-1 disc.	VFD EFF.P-1 outp EFF.P-1	480 480	32.69	0.157 0.011	0.022 0.007	6498.90			0.00 28.17	
C: EFF.P-2	VFD EFF.P-2 outp EFF.P-2	480 480	32.69	0.157 0.011	0.022 0.007	6498.90			0.00 28.17	
C: EQ.MIX-1 disc	MCC.10-1A EQ.MIX-1 disc.	480 480	7.65	0.063 0.000	0.002 0.000	243.60			0.00 4.04	
C: EQ.MIX-2 disc	MCC.10-1B EQ.MIX-2 disc.	480 480	7.65	0.063 0.000	0.002 0.000	243.65			0.00 4.04	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: FS.P-1	VFD FS.P-1 outpu FS.P-1	480 480	6.19	0.011 0.001	0.000 0.000	1230.52			0.00 28.17	
C: GEN.10-1	GEN.10-1 output SWBD.10-1B (main	480 480	979.40	1.714 0.024	2.599 0.158	95125.28			0.00 10.61	
C: LP.10-1	T.10-1 sec. LP.10-1	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-2	T.10-2 sec. LP.10-2	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-3	T.10-3 sec. LP.10-3	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-4	T.10-4 sec. LP.10-4	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-5	T.10-5B sec. LP.10-5	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.20-1	T.20-1 sec. LP.20-1	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: MCC.10-1A	SWBD.10-1A (dist MCC.10-1A	480 480	218.22	0.112 0.003	0.157 0.017	23484.54			0.00 14.87	12.0
C: MCC.10-1B	SWBD.10-1B (dist MCC.10-1B	480 480	251.17	0.148 0.003	0.204 0.018	24065.66			0.00 13.22	12.0
C: MCC.10-2A	SWBD.10-1A (dist MCC.10-2A	480 480	34.97	0.012 0.000	0.009 0.001	4128.53			0.00 16.34	15.0
C: MCC.10-2B	SWBD.10-1B (dist MCC.10-2B	480 480	13.21	0.002 0.000	0.001 0.000	1618.38			0.00 16.97	20.0
C: MIX.BLW-1 VFD	SWBD.10-1A (dist MIX.BLW-1 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: MIX.BLW-2 VF	SWBD.10-1B (dist MIX.BLW-2 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0
C: MIX.BLW-3 VFD	SWBD.10-1A (dist MIX.BLW-3 VFD	480 480	44.15	0.114 0.004	0.018 0.003	6301.22			0.00 19.84	15.0
C: MIX.BLW-4 VFD	SWBD.10-1B (dist MIX.BLW-4 VFD	480 480	58.83	0.129 0.005	0.029 0.005	8401.63			0.00 19.86	15.0
C: OC-CP	MCC.10-1B OC-CP	480 480	42.32	0.267 0.000	0.042 0.000	1344.62			0.00 4.03	
C: OC.EF-1 disc.	OC-CP OC.EF-1 disc.	480 480	2.11	0.000 0.000	0.000 0.000	67.08			0.00 4.04	
C: OC.F-1 disc.	OC-CP OC.F-1 disc.	480 480	40.21	0.000 0.000	0.000 0.000	1277.54			0.00 4.03	
C: RDT-CP	MCC.10-1A RDT-CP	480 480	6.82	0.022 0.000	0.001 0.000	614.09			0.00 12.42	
C: SBR-BLW-1 VFD	SWBD.10-1A (dist SBR.BLW-1 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0
C: SBR-BLW-2 VFD	SWBD.10-1B (dist SBR.BLW-2 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0
C: SBR-BLW-3 VFD	SWBD.10-1A (dist SBR.BLW-3 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0
C: SBR-CP	MCC.10-1A SBR-CP	480 480	12.99	0.016 0.000	0.001 0.000	416.96			0.00 4.08	
C: SBR.DEC-1 dis	SBR-CP SBR.DEC-1 disc.	480 480	6.50	0.000 0.000	0.000 0.000	208.48			0.00 4.08	
C: SBR.DEC-2 dis	SBR-CP SBR.DEC-2 disc.	480 480	6.50	0.000 0.000	0.000 0.000	208.48			0.00 4.08	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: SBR.MIX-1 dis	MCC.10-1A SBR.MIX-1 disc.	480 480	14.01	0.034 0.000	0.010 0.000	447.62			0.00 4.06	
C: SBR.MIX-2 dis	MCC.10-1B SBR.MIX-2 disc.	480 480	14.25	0.263 0.000	0.011 0.000	447.56			0.00 3.99	
C: SBR.TP-1	VFD SBR.TP-1 out SBR.TP-1	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SBR.TP-2	VFD SBR.TP-2 out SBR.TP-2	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SBR.TP-3	VFD SBR.TP-3 out SBR.TP-3	480 480	27.74	0.090 0.006	0.013 0.004	5514.07			0.00 28.17	
C: SEP-1-CP	MCC.10-1A SEP-1-CP	480 480	3.40	0.009 0.000	0.000 0.000	109.06			0.00 4.07	
C: SL.TP-1	VFD SL.TP-1 outp SL.TP-1	480 480	11.44	0.056 0.004	0.003 0.001	2274.82			0.00 28.17	
C: SWBD.10-1 TIE	SWBD.10-1A (dist SWBD.10-1B (dist	480 480	512.69	0.001 0.000	0.000 0.000	50344.64			0.00 10.31	8.0
C: SWBD.10-1A	MVT.10-1 sec. SWBD.10-1A (main	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: SWBD.10-1B (d	SWBD.10-1B (main SWBD.10-1B (dist	480 480	979.40	0.003 0.001	0.001 0.000	95125.28			0.00 10.61	5.0
C: T.10-1	DP.10-1 T.10-1 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-2	DP.10-2 T.10-2 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-3	DP.10-3 T.10-3 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: T.10-4	DP.10-4 T.10-4 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-5A	SWBD.10-1A (dist T.10-5A pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: T.10-5B	SWBD.10-1A (dist T.10-5B pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: T.20-1	DP.20-1 T.20-1 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: TSL.P-1	VFD TSL.P-1 outp TSL.P-1	480 480	22.09	0.125 0.009	0.011 0.003	4390.85			0.00 28.17	
C: W3.P-CP	MCC.10-1B W3.P-CP	480 480	90.61	0.185 0.007	0.066 0.012	12925.47			0.00 19.83	
GEN.10-1	GEN.10-1 output	480 480	979.40	0.073 0.073	4.433 4.433	95125.28			7.54 10.61	
T.10-1	T.10-1 pri. T.10-1 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-2	T.10-2 pri. T.10-2 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-3	T.10-3 pri. T.10-3 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-4	T.10-4 pri. T.10-4 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-5A	T.10-5A pri. T.10-5A sec.	480 480	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-5B	T.10-5B pri. T.10-5B sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
T.20-1	T.20-1 pri. T.20-1 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
VFD 10-BP-1	10-BP-1 VFD VFD 10-BP-1 outp	480 480	2.37	0.149 0.000	0.844 0.000	339.31			0.00 19.88	
VFD 10-CP-1	10-CP-1 VFD VFD 10-CP-1 outp	480 480	12.47	0.779 0.000	4.419 0.000	1777.25			0.00 19.82	
VFD 10-EF-1	MCC.10-2A VFD 10-EF-1 outp	480 480	5.43	0.340 0.000	1.932 0.000	776.57			0.00 19.89	
VFD 10-EF-10	MCC.10-2B VFD 10-EF-10 out	480 480	1.24	0.078 0.000	0.442 0.000	177.83			0.00 19.90	
VFD 10-EF-11	MCC.10-2B VFD 10-EF-11 out	480 480	1.81	0.113 0.000	0.644 0.000	258.75			0.00 19.90	
VFD 10-EF-5	MCC.10-2A VFD 10-EF-5 outp	480 480	1.24	0.078 0.000	0.442 0.000	177.86			0.00 19.89	
VFD 10-EF-7	MCC.10-2A VFD 10-EF-7 outp	480 480	1.81	0.113 0.000	0.644 0.000	258.77			0.00 19.89	
VFD 10-SF-1	MCC.10-2A VFD 10-SF-1 outp	480 480	5.43	0.340 0.000	1.932 0.000	776.57			0.00 19.89	
VFD 10-SF-2	MCC.10-2B VFD 10-SF-2 outp	480 480	8.60	0.539 0.000	3.062 0.000	1230.53			0.00 19.90	
VFD 10-SF-5	MCC.10-2A VFD 10-SF-5 outp	480 480	1.24	0.078 0.000	0.442 0.000	177.86			0.00 19.89	
VFD EFF.P-1	MCC.10-1A VFD EFF.P-1 outp	480 480	45.45	2.849 0.000	16.175 0.000	6498.92			0.00 19.88	
VFD EFF.P-2	MCC.10-1B VFD EFF.P-2 outp	480 480	45.46	2.849 0.000	16.175 0.000	6498.92			0.00 19.88	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
VFD FS.P-1	MCC.10-1B VFD FS.P-1 outpu	480 480	8.61	0.539 0.000	3.062 0.000	1230.53			0.00 19.88	
VFD FS.P-2	W3.P-CP VFD W3.P-CP OUTP	480 480	90.61	5.666 0.000	32.138 0.000	12925.47			0.00 19.83	
VFD MIX.BLW-1	MIX.BLW-1 VFD MIX.BLW-1 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD MIX.BLW-2	MIX.BLW-2 VFD MIX.BLW-2 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD MIX.BLW-3	MIX.BLW-3 VFD MIX.BLW-3 VFD ou	480 480	44.15	2.771 0.000	15.675 0.000	6301.22			0.00 19.84	
VFD MIX.BLW-4	MIX.BLW-4 VFD MIX.BLW-4 VFD ou	480 480	58.83	3.683 0.000	20.890 0.000	8401.63			0.00 19.86	
VFD RDT-1	RDT-CP RDT-1 VFD output	480 480	2.38	0.149 0.000	0.844 0.000	339.31			0.00 19.82	
VFD RDT-2	RDT-CP RDT-2 VFD output	480 480	2.38	0.149 0.000	0.844 0.000	339.31			0.00 19.82	
VFD SBR-BLW-1	SBR.BLW-1 VFD SBR.BLW-1 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD SBR.BLW-2	SBR.BLW-2 VFD SBR.BLW-2 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD SBR.BLW-3	SBR.BLW-3 VFD SBR.BLW-3 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD SBR.TP-1	MCC.10-1A VFD SBR.TP-1 out	480 480	38.56	2.417 0.000	13.720 0.000	5514.09			0.00 19.88	
VFD SBR.TP-2	MCC.10-1B VFD SBR.TP-2 out	480 480	38.57	2.417 0.000	13.720 0.000	5514.09			0.00 19.88	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
VFD SBR.TP-3	MCC.10-1A VFD SBR.TP-3 out	480 480	38.56	2.417 0.000	13.720 0.000	5514.09			0.00 19.88	
VFD SL.TP-1	MCC.10-1A VFD SL.TP-1 outp	480 480	15.91	0.997 0.000	5.666 0.000	2274.82			0.00 19.88	
VFD TSL.P-1	MCC.10-1A VFD TSL.P-1 outp	480 480	30.71	1.925 0.000	10.935 0.000	4390.87			0.00 19.88	

TOTAL SYSTEM POWER LOSSES

Harmonic Losses		Total RMS Losses	
P(kW)	Q{kVAR)	P(kW)	Q(kVAR)
0.34	4.83	59.36	316.94

CURRENT DISTORTION SUMMARY

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
NO VIOLATION										

TOTAL SYSTEM POWER LOSSES

Harmonic Losses		Total RMS Losses	
P(kW)	Q{kVAR)	P(kW)	Q(kVAR)
0.34	4.83	59.36	316.94

HARMONIC VOLTAGE SPECTRUM REPORT

Bus: SWBD.10-1A (distr.) (480V)

Harmonic Order	Harmonic Voltages	Phase Angle	Distortion Percent	Limit
1	461.701	-2.43		
5	22.069	21.69	4.780	5.000
7	6.680	149.71	1.447	5.000
11	9.824	-171.87	2.128	5.000
13	4.619	-126.67	1.000	5.000
17	7.253	-56.03	1.571	5.000
19	4.456	-24.79	0.965	5.000

Voltage: 480.0 V_RMS: 462.48 V_THD(%): 5.82
LIMIT (THD%): 8.0

HARMONIC VOLTAGE SPECTRUM REPORT

Bus: SWBD.10-1B (distr.) (480V)

Harmonic Order	Harmonic Voltages	Phase Angle	Distortion Percent	Limit
1	461.702	-2.43		
5	22.069	21.69	4.780	5.000
7	6.680	149.72	1.447	5.000
11	9.824	-171.86	2.128	5.000
13	4.619	-126.66	1.000	5.000
17	7.252	-56.03	1.571	5.000
19	4.456	-24.79	0.965	5.000

Voltage: 480.0 V_RMS: 462.48 V_THD(%): 5.82
LIMIT (THD%): 8.0

HARMONIC CURRENT SPECTRUM REPORT

Device Name: C: SWBD.10-1B (d
From: SWBD.10-1B (main (480V)
To: SWBD.10-1B (dist (480V)
Point of Common Coupling (PCC): (Isc/Ilf = 18.164)

Harmonic Order	Harmonic Amperes	Phase Angle	Distortion Percent		Limit
1	973.936	-39.25			
5	93.900	112.92	9.641	>	4.000
7	34.390	-119.00	3.531		4.000
11	19.001	-80.77	1.951		2.000
13	12.805	-35.46	1.315		2.000
17	9.076	35.13	0.932		1.500
19	8.453	66.48	0.868		1.500

Voltage: 480.0 I_RMS: 979.40 I_TDD(%): 1.#J
I_THD(%): 10.61
kWLoss: 0.003 kVARLoss: 0.001
I_K: LIMIT (TDD%): 5.0

Case 2 (emergency) - recommended active harmonic filter correction = 73A

Calculations are based on generator available fault current

e Industrial Systems

Harmonic Distortion Calculations

Enter Short Circuit Current Manually

18,283 I_{sc} Amps

XFMR I_{sc} Calculation:	52,296 Amps
XFMR I_{sc} Calculation:	3,007 Amps
I_{load} Calculation:	1,125 Amps
I_{sc} / I_{load} Calculation:	16.25 Per IEEE 519

Project Name: _____

GE-SE: _____

Date: _____

Application Engineer: _____

Service KVA	2500
Service Z%	5.75
Primary Voltage	12,000
Secondary Voltage	480

THD-I Estimation:	5.0 %
THD-I Required:	5.0 %
THD-V Estimation:	0.8 %
THD-V Required:	5.0 %

System IEEE519 Compliant?

THD-I	THD-V
YES	YES

73 Amps Correction Required

Apply Active Filter Solution

ACTIVE FILTER SOLUTION APPLIED

NOTES: Distortion calculations are based on 0% background distortion, balanced input line voltage (+/-1%) and source impedance of 1.5% to 6%, and all non-linear and linear loads operating simultaneously at full load. Matrix Filters cannot operate linear loads (by pass) Actual distortion may change (increase) under other system conditions. Motor FLA=4 Pole NEC ratings. Filter selections are based on GE AF-300 P11 drives . PCC is defined as Buss (where drive connects to plant power). Filters are rated for GE AF-300 G11 & GE AF-300 P11 drives. THD-V per IEEE519-1992 is defined as 5% for most applications except for critical applications like Hospitals that are defined as 3%. FOR ESTIMATION PURPOSES ONLY! ALL SOLUTIONS BASED ON GE PRODUCT! Contact Mark Ritter - Fort Edward for multi drive Matrix Filter applications.

First Step - ENTER Service Data!

Second Step
ENTER ALL LOADS!!

Third Step
Evaluate Harmonic Mitigation Methods!!

Non- Linear Loads

Linear Loads

Misc. Load in Amps: 362

Line Reactor External to Drive/MCC Cabinet - NEMA1 Enclosure

Matrix Filter External to Drive/MCC Cabinet - NEMA1 Enclosure

QTY	HP	FLA	PROPOSED HARMONIC MITIGATION SOLUTION	QTY	HP	FLA	Line Reactor Part #		Line Reactor List Price	Matrix Filter Part #	Matrix Filter List Price	External Reactor for Matrix Filter Part #	External Reactor for Matrix Filter List Price
5	50	325	18 pulse Drive	0	0	0							
1	40	52	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G05512	$	728				
5	30	200	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G04512	$	700				
3	25	102	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G03512	$	578				
1	20	27	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G03512	$	578				
1	10	14	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G01812	$	436				
2	5	15	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G00812	$	344				
4	3	19	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G00412	$	316				
4	1	8	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0	37G00211	$	308				
0	0	0	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0							
0	0	0	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0							
0		0	6 pulse drive with 3% Line Reactor & DC Link Reactor	0	0	0							
Totals		763				362							

Recommended active harmonic filter ampere rating (73A)

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Downtown Area WWTF - Orleans, MA
CASE 2 - ALT (emergency / generator)
with Active Harmonic Filters

S T U D Y C R I T E R I A

Studies Selected To Run:	
Load Flow:	Yes
Frequency Scan:	Yes
Harmonic Distortion:	Yes
Load Flow Study Setup Options	
Utility Impedance:	Yes
Transformer Phase Shift:	Yes
Solution Method:	Exact
Load Specification:	Connected Load
Generation Acceleration Factor:	1.00
Load Acceleration Factor:	1.00
Bus Voltage Drop:	5.00
Branch Voltage Drop:	3.00
HI_WAVE Study Setup Options	
Fundamental Frequency:	60 Hz
Max. Harmonic Order:	50
Include Triplet Harmonics Path (Static Load):	No
Include Triplet Harmonics Path (Ind. Motor):	No
Modify Motor Z by Load Factor (Ind. Motor):	No
Modify Load Z by Load Factor (Static Load):	No
HI_WAVE Study Setup Options for Frequency Scan	
Scan Impedance Option:	Scan Self Impedance
Use Positive Sequence Network:	Yes
Use Negative Sequence Network:	Yes
Use Zero Sequence Network:	No
Model Transformer Tap:	Yes
Model Transformer Phase Shift:	Yes
Report Bus Equivalent Impedance:	No
Number of Scan Steps Per Order:	1
HI_WAVE Study Setup Options for Distortion	
Use Positive Sequence Network:	Yes
Use Negative Sequence Network:	Yes
Use Zero Sequence Network:	Yes
Model Transformer Tap:	Yes
Model Transformer Phase Shift:	Yes
Fundamental Solution:	Use Load Flow Result
Report Option:	All Distortions and Violations
Current Limits:	IEEE 519-2014 Std, Current Distortion Limit Table 3 & 4, Selected buses as PCC

LOADS AND MOTORS WITH HARMONIC SOURCE MODELS

Bus Name	Voltage	Component Name	LF Current	Harmonic Library
10-EF-1	480	10-EF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-EF-10	480	10-EF-10 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-11	480	10-EF-11 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-EF-5	480	10-EF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
10-EF-7	480	10-EF-7 mtr	1.3	Six Pulse, Z=8%, THDi=28%
10-SF-1	480	10-SF-1 mtr	3.8	Six Pulse, Z=8%, THDi=28%
10-SF-2	480	10-SF-2 mtr	6.0	Six Pulse, Z=8%, THDi=28%
10-SF-5	480	10-SF-5 mtr	0.9	Six Pulse, Z=8%, THDi=28%
FS.P-1	480	FS.P-1 mtr	6.0	Six Pulse, Z=8%, THDi=28%
MIX.BLW-1 VFD ou	480	MIX.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-2 VFD ou	480	MIX.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
MIX.BLW-3 VFD ou	480	MIX.BLW-3	30.5	Six Pulse, Z=8%, THDi=28%
MIX.BLW-4 VFD ou	480	MIX.BLW-4	40.7	Six Pulse, Z=8%, THDi=28%
RDT-1 VFD output	480	RDT-1	1.6	Six Pulse, Z=8%, THDi=28%
RDT-2 VFD output	480	RDT-2	1.6	Six Pulse, Z=8%, THDi=28%
SBR.BLW-1 VFD ou	480	SBR.BLW-1	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-2 VFD ou	480	SBR.BLW-2	50.9	18 Pulse Rockwell,THDi=4.6%
SBR.BLW-3 VFD ou	480	SBR.BLW-3	50.9	18 Pulse Rockwell,THDi=4.6%
SL.TP-1	480	SL.TP-1 mtr	11.0	Six Pulse, Z=8%, THDi=28%
VFD 10-BP-1 outp	480	10-BP-1	1.6	Six Pulse, Z=8%, THDi=28%
VFD 10-CP-1 outp	480	10-CP-1	8.6	Six Pulse, Z=8%, THDi=28%

HARMONIC SOURCE		
Six Pulse, Z=8%, THDi=28%		
Order	Magnitude (%)	Angle (Degrees)
1	100.000	-12.60
5	26.000	107.40
7	9.030	-126.90
11	4.550	-93.20
13	3.200	-50.20
17	1.740	15.90
19	1.350	45.00

HARMONIC SOURCE		
18 Pulse Rockwell,THDi=4.6%		
Order	Magnitude (%)	Angle (Degrees)
1	100.000	-12.60
5	3.261	107.40
7	1.596	-126.90
11	1.632	-93.20
13	0.816	-50.20
17	1.371	15.90
19	1.579	45.00

H A R M O N I C S O U R C E I N D E X T A B L E
HARMONIC SOURCES HAVE BEEN FOUND AND INJECTED FOR EACH OF THE FOLLOWING HARMONIC ORDERS
5 7 11 13 17 19

PASSIVE FILTER DATA												
Filter Name	Bus Name	Bus Voltage	Rated Voltage	Connect	Filter Type	Capacitor KVAR	Tuned Order	Q	M	R (Ω)	L (H)	C (μF)
NO FILTER												

U T I L I T Y , G E N E R A T O R A N D M O T O R D A T A

Component Name	Component Type	Bus Name	Bus Voltage	Base Voltage	Base KVA	R1(pu) R2 R0	X1(pu) X2 X0
480V SOURCE	UTILITY	MVT.10-1 sec.	480	480	100000	0.3902 0.3902 0.3902	3.1216 3.1216 3.1216
GEN.10-1	SYNCH GENERATOR	GEN.10-1 output	480	480	100000	0.2803 0.4859 0.1592	6.5789 11.4035 3.7368

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
10-BP-1 VFD	480	461.28	61.2807	2.4189	
10-CP-1 VFD	480	459.88	61.6674	2.4406	
10-EF-1	480	479.59	64.5551	3.1410	
10-EF-10	480	479.85	59.9189	2.4916	
10-EF-11	480	479.73	60.5302	2.5771	
10-EF-5	480	479.80	60.1834	2.5075	
10-EF-7	480	479.69	60.7908	2.5929	
10-SF-1	480	479.59	64.5551	3.1410	
10-SF-2	480	479.30	67.7285	3.6217	
10-SF-3A disc.	480	460.25	61.3458	2.4199	
10-SF-4 disc.	480	461.21	60.9773	2.4002	
10-SF-5	480	479.80	60.1834	2.5075	
10-SF-7 disc.	480	461.02	61.2583	2.4166	
DF-1-CP	480	460.08	60.9551	2.3989	
DF-2-CP	480	460.01	60.8500	2.3933	
DP.10-1	480	461.83	60.7414	2.3876	
DP.10-2	480	461.83	60.7406	2.3876	
DP.10-3	480	461.83	60.7414	2.3876	
DP.10-4	480	461.83	60.7406	2.3876	
DP.10-5	480	461.83	60.7414	2.3876	
DP.20-1	480	461.83	60.7406	2.3876	
EFF.P-1	480	477.42	54.7471	1.9866	
EFF.P-2	480	477.42	54.6453	1.9820	
EQ.MIX-1 disc.	480	457.48	61.2534	2.4101	
EQ.MIX-2 disc.	480	457.41	61.1479	2.4044	
FS.P-1	480	479.30	67.4656	3.6096	
GEN.10-1 output	480	463.49	58.1253	2.2956	
LP.10-1	208	200.13	60.7414	2.3876	
LP.10-2	208	200.13	60.7406	2.3876	
LP.10-3	208	200.13	60.7414	2.3876	
LP.10-4	208	200.13	60.7406	2.3876	
LP.10-5	208	200.13	60.7414	2.3876	
LP.20-1	208	200.13	60.7406	2.3876	
MCC.10-1A	480	461.38	60.8075	2.3934	
MCC.10-1B	480	461.31	60.7026	2.3877	
MCC.10-2A	480	461.61	61.1907	2.4140	
MCC.10-2B	480	461.75	60.9158	2.3979	
MIX.BLW-1 VFD	480	460.86	61.7509	2.4102	
MIX.BLW-1 VFD ou	480	480.43	110.3571	4.2315	
MIX.BLW-2 VFD	480	460.87	61.7501	2.4102	

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
MIX.BLW-2 VFD ou	480	480.43	110.3565	4.2315	
MIX.BLW-3 VFD	480	460.55	61.6983	2.4426	
MIX.BLW-3 VFD ou	480	482.07	106.7649	9.2907	
MIX.BLW-4 VFD	480	460.70	61.8695	2.4529	
MIX.BLW-4 VFD ou	480	483.26	123.3771	11.6707	
MVT.10-1 sec.	480	480.00	0.5000	0.0000	
OC-CP	480	458.06	60.8337	2.3923	
OC.EF-1 disc.	480	458.06	60.8337	2.3923	
OC.F-1 disc.	480	458.06	60.8336	2.3923	
RDT-1 VFD output	480	480.17	61.0282	2.6608	
RDT-2 VFD output	480	480.17	61.0282	2.6608	
RDT-CP	480	459.87	61.2146	2.4150	
SBR-CP	480	460.78	60.8546	2.3951	
SBR.BLW-1 VFD	480	460.86	61.7509	2.4102	
SBR.BLW-1 VFD ou	480	480.43	110.3571	4.2315	
SBR.BLW-2 VFD	480	460.87	61.7501	2.4102	
SBR.BLW-2 VFD ou	480	480.43	110.3565	4.2315	
SBR.BLW-3 VFD	480	460.86	61.7509	2.4102	
SBR.BLW-3 VFD ou	480	480.43	110.3571	4.2315	
SBR.DEC-1 disc.	480	460.78	60.8548	2.3951	
SBR.DEC-2 disc.	480	460.78	60.8548	2.3951	
SBR.MIX-1 disc.	480	460.01	60.7625	2.3914	
SBR.MIX-2 disc.	480	452.48	61.6434	2.4229	
SBR.TP-1	480	478.28	55.2349	2.0256	
SBR.TP-2	480	478.28	55.1317	2.0206	
SBR.TP-3	480	478.28	55.2349	2.0256	
SEP-1-CP	480	460.13	60.9496	2.3987	
SL.TP-1	480	477.84	76.1311	4.8119	
SWBD.10-1A (dist	480	461.83	60.7414	2.3876	8.0
SWBD.10-1A (main	480	480.00	0.5000	0.0000	
SWBD.10-1B (dist	480	461.83	60.7406	2.3876	8.0
SWBD.10-1B (main	480	461.83	60.7393	2.3876	
T.10-1 pri.	480	461.83	60.7414	2.3876	
T.10-1 sec.	208	200.13	60.7414	2.3876	
T.10-2 pri.	480	461.83	60.7406	2.3876	
T.10-2 sec.	208	200.13	60.7406	2.3876	
T.10-3 pri.	480	461.83	60.7414	2.3876	
T.10-3 sec.	208	200.13	60.7414	2.3876	
T.10-4 pri.	480	461.83	60.7406	2.3876	
T.10-4 sec.	208	200.13	60.7406	2.3876	

TOTAL VOLTAGE DISTORTION					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT
T.10-5A pri.	480	461.83	60.7414	2.3876	
T.10-5A sec.	480	461.83	60.7414	2.3876	
T.10-5B pri.	480	461.83	60.7414	2.3876	
T.10-5B sec.	208	200.13	60.7414	2.3876	
T.20-1 pri.	480	461.83	60.7406	2.3876	
T.20-1 sec.	208	200.13	60.7406	2.3876	
TSL.P-1	480	476.96	56.0286	2.0813	
VFD 10-BP-1 outp	480	480.17	61.2728	2.6718	
VFD 10-CP-1 outp	480	480.43	71.9483	4.2305	
VFD 10-EF-1 outp	480	480.24	64.3648	3.1300	
VFD 10-EF-10 out	480	480.15	59.8353	2.4870	
VFD 10-EF-11 out	480	480.16	60.4078	2.5703	
VFD 10-EF-5 outp	480	480.15	60.0828	2.5019	
VFD 10-EF-7 outp	480	480.16	60.6557	2.5853	
VFD 10-SF-1 outp	480	480.24	64.3648	3.1300	
VFD 10-SF-2 outp	480	480.31	67.4191	3.6033	
VFD 10-SF-5 outp	480	480.15	60.0828	2.5019	
VFD EFF.P-1 outp	480	480.09	54.5804	1.9808	
VFD EFF.P-2 outp	480	480.09	54.4792	1.9763	
VFD FS.P-1 outpu	480	480.31	67.1568	3.5913	
VFD SBR.TP-1 out	480	480.10	55.1213	2.0217	
VFD SBR.TP-2 out	480	480.10	55.0183	2.0167	
VFD SBR.TP-3 out	480	480.10	55.1213	2.0217	
VFD SL.TP-1 outp	480	480.54	75.0189	4.7418	
VFD TSL.P-1 outp	480	480.10	55.7704	2.0721	
VFD W3.P-CP OUTP	480	480.07	51.0219	1.7452	
W3.P-CP	480	460.17	60.7315	2.3894	

VOLTAGE DISTORTION SUMMARY					
Bus Name	Voltage	V_RMS(V)	V_TIF	V_THD(%)	LIMIT

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
480V SOURCE	MVT.10-1 sec.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: 10-BP-1 VFD	MCC.10-2A 10-BP-1 VFD	480 480	2.37	0.002 0.000	0.000 0.000	339.31			0.00 19.88	
C: 10-CP-1 VFD	MCC.10-2A 10-CP-1 VFD	480 480	12.47	0.047 0.002	0.001 0.000	1777.25			0.00 19.82	
C: 10-EF-1	VFD 10-EF-1 outp 10-EF-1	480 480	3.91	0.005 0.000	0.000 0.000	776.56			0.00 28.17	
C: 10-EF-10	VFD 10-EF-10 out 10-EF-10	480 480	0.89	0.000 0.000	0.000 0.000	177.83			0.00 28.17	
C: 10-EF-11	VFD 10-EF-11 out 10-EF-11	480 480	1.30	0.001 0.000	0.000 0.000	258.75			0.00 28.17	
C: 10-EF-5	VFD 10-EF-5 outp 10-EF-5	480 480	0.89	0.001 0.000	0.000 0.000	177.86			0.00 28.17	
C: 10-EF-7	VFD 10-EF-7 outp 10-EF-7	480 480	1.30	0.001 0.000	0.000 0.000	258.77			0.00 28.17	
C: 10-SF-1	VFD 10-SF-1 outp 10-SF-1	480 480	3.91	0.005 0.000	0.000 0.000	776.56			0.00 28.17	
C: 10-SF-2	VFD 10-SF-2 outp 10-SF-2	480 480	6.19	0.011 0.001	0.000 0.000	1230.52			0.00 28.17	
C: 10-SF-3A disc	MCC.10-2A 10-SF-3A disc.	480 480	3.00	0.009 0.000	0.000 0.000	47.85			0.00 1.55	
C: 10-SF-4 disc.	MCC.10-2B 10-SF-4 disc.	480 480	1.60	0.002 0.000	0.000 0.000	25.41			0.00 1.55	
C: 10-SF-5	VFD 10-SF-5 outp 10-SF-5	480 480	0.89	0.001 0.000	0.000 0.000	177.86			0.00 28.17	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: 10-SF-7 disc.	MCC.10-2A 10-SF-7 disc.	480 480	2.10	0.003 0.000	0.000 0.000	33.51			0.00 1.56	
C: DF-1-CP	MCC.10-1A DF-1-CP	480 480	5.10	0.014 0.000	0.000 0.000	80.75			0.00 1.54	
C: DF-2-CP	MCC.10-1B DF-2-CP	480 480	5.10	0.014 0.000	0.000 0.000	80.59			0.00 1.53	
C: DP.10-1	SWBD.10-1A (dist DP.10-1	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-2	SWBD.10-1B (dist DP.10-2	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-3	SWBD.10-1A (dist DP.10-3	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-4	SWBD.10-1B (dist DP.10-4	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: DP.10-5	T.10-5A sec. DP.10-5	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: DP.20-1	SWBD.10-1B (dist DP.20-1	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: EFF.P-1 disc.	VFD EFF.P-1 outp EFF.P-1	480 480	31.47	0.146 0.000	0.015 0.000	476.79			0.00 1.32	
C: EFF.P-2	VFD EFF.P-2 outp EFF.P-2	480 480	31.47	0.146 0.000	0.015 0.000	475.77			0.00 1.31	
C: EQ.MIX-1 disc	MCC.10-1A EQ.MIX-1 disc.	480 480	7.64	0.063 0.000	0.002 0.000	120.24			0.00 1.53	
C: EQ.MIX-2 disc	MCC.10-1B EQ.MIX-2 disc.	480 480	7.65	0.063 0.000	0.002 0.000	120.00			0.00 1.52	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: FS.P-1	VFD FS.P-1 outpu FS.P-1	480 480	6.19	0.011 0.001	0.000 0.000	1230.52			0.00 28.17	
C: GEN.10-1	GEN.10-1 output SWBD.10-1B (main	480 480	974.75	1.694 0.004	2.466 0.025	48326.65			0.00 4.08	
C: LP.10-1	T.10-1 sec. LP.10-1	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-2	T.10-2 sec. LP.10-2	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-3	T.10-3 sec. LP.10-3	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-4	T.10-4 sec. LP.10-4	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.10-5	T.10-5B sec. LP.10-5	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: LP.20-1	T.20-1 sec. LP.20-1	208 208	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: MCC.10-1A	SWBD.10-1A (dist MCC.10-1A	480 480	215.85	0.109 0.000	0.140 0.000	1181.16			0.00 0.91	12.0
C: MCC.10-1B	SWBD.10-1B (dist MCC.10-1B	480 480	249.01	0.145 0.000	0.186 0.000	1780.62			0.00 0.37	12.0
C: MCC.10-2A	SWBD.10-1A (dist MCC.10-2A	480 480	34.99	0.012 0.000	0.009 0.001	4208.52			0.00 16.70	15.0
C: MCC.10-2B	SWBD.10-1B (dist MCC.10-2B	480 480	13.21	0.002 0.000	0.001 0.000	1643.49			0.00 17.27	20.0
C: MIX.BLW-1 VFD	SWBD.10-1A (dist MIX.BLW-1 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: MIX.BLW-2 VF	SWBD.10-1B (dist MIX.BLW-2 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0
C: MIX.BLW-3 VFD	SWBD.10-1A (dist MIX.BLW-3 VFD	480 480	44.15	0.114 0.004	0.018 0.003	6301.22			0.00 19.84	15.0
C: MIX.BLW-4 VFD	SWBD.10-1B (dist MIX.BLW-4 VFD	480 480	58.83	0.129 0.005	0.029 0.005	8401.63			0.00 19.86	15.0
C: OC-CP	MCC.10-1B OC-CP	480 480	42.30	0.266 0.000	0.041 0.000	662.23			0.00 1.52	
C: OC.EF-1 disc.	OC-CP OC.EF-1 disc.	480 480	2.11	0.000 0.000	0.000 0.000	33.04			0.00 1.52	
C: OC.F-1 disc.	OC-CP OC.F-1 disc.	480 480	40.19	0.000 0.000	0.000 0.000	629.19			0.00 1.52	
C: RDT-CP	MCC.10-1A RDT-CP	480 480	6.83	0.022 0.000	0.001 0.000	647.64			0.00 13.19	
C: SBR-BLW-1 VFD	SWBD.10-1A (dist SBR.BLW-1 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0
C: SBR-BLW-2 VFD	SWBD.10-1B (dist SBR.BLW-2 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0
C: SBR-BLW-3 VFD	SWBD.10-1A (dist SBR.BLW-3 VFD	480 480	72.15	0.125 0.000	0.036 0.000	6241.51			0.00 3.22	15.0
C: SBR-CP	MCC.10-1A SBR-CP	480 480	12.98	0.016 0.000	0.001 0.000	205.81			0.00 1.54	
C: SBR.DEC-1 dis	SBR-CP SBR.DEC-1 disc.	480 480	6.49	0.000 0.000	0.000 0.000	102.90			0.00 1.54	
C: SBR.DEC-2 dis	SBR-CP SBR.DEC-2 disc.	480 480	6.49	0.000 0.000	0.000 0.000	102.90			0.00 1.54	

T O T A L C U R R E N T D I S T O R T I O N

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: SBR.MIX-1 dis	MCC.10-1A SBR.MIX-1 disc.	480 480	14.01	0.034 0.000	0.010 0.000	220.94			0.00 1.53	
C: SBR.MIX-2 dis	MCC.10-1B SBR.MIX-2 disc.	480 480	14.24	0.263 0.000	0.011 0.000	220.43			0.00 1.50	
C: SBR.TP-1	VFD SBR.TP-1 out SBR.TP-1	480 480	26.70	0.084 0.000	0.009 0.000	410.13			0.00 1.36	
C: SBR.TP-2	VFD SBR.TP-2 out SBR.TP-2	480 480	26.70	0.084 0.000	0.009 0.000	409.31			0.00 1.35	
C: SBR.TP-3	VFD SBR.TP-3 out SBR.TP-3	480 480	26.70	0.084 0.000	0.009 0.000	410.13			0.00 1.36	
C: SEP-1-CP	MCC.10-1A SEP-1-CP	480 480	3.40	0.009 0.000	0.000 0.000	53.83			0.00 1.54	
C: SL.TP-1	VFD SL.TP-1 outp SL.TP-1	480 480	11.44	0.056 0.004	0.003 0.001	2274.82			0.00 28.17	
C: SWBD.10-1 TIE	SWBD.10-1A (dist SWBD.10-1B (dist	480 480	510.49	0.001 0.000	0.000 0.000	28450.15			0.00 4.44	8.0
C: SWBD.10-1A	MVT.10-1 sec. SWBD.10-1A (main	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: SWBD.10-1B (d	SWBD.10-1B (main SWBD.10-1B (dist	480 480	974.75	0.002 0.000	0.001 0.000	48326.65			0.00 4.08	5.0
C: T.10-1	DP.10-1 T.10-1 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-2	DP.10-2 T.10-2 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-3	DP.10-3 T.10-3 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
C: T.10-4	DP.10-4 T.10-4 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: T.10-5A	SWBD.10-1A (dist T.10-5A pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: T.10-5B	SWBD.10-1A (dist T.10-5B pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	20.0
C: T.20-1	DP.20-1 T.20-1 pri.	480 480	0.00	0.000 0.000	0.000 0.000	0.00			0.00 0.00	
C: TSL.P-1	VFD TSL.P-1 outp TSL.P-1	480 480	21.26	0.116 0.000	0.008 0.000	330.02			0.00 1.39	
C: W3.P-CP	MCC.10-1B W3.P-CP	480 480	88.88	0.178 0.000	0.055 0.000	886.76			0.00 0.80	
GEN.10-1	GEN.10-1 output	480 480	974.75	0.011 0.011	0.684 0.684	48326.65			2.90 4.08	
T.10-1	T.10-1 pri. T.10-1 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-2	T.10-2 pri. T.10-2 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-3	T.10-3 pri. T.10-3 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-4	T.10-4 pri. T.10-4 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-5A	T.10-5A pri. T.10-5A sec.	480 480	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
T.10-5B	T.10-5B pri. T.10-5B sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
T.20-1	T.20-1 pri. T.20-1 sec.	480 208	0.00	0.000 0.000	0.000 0.000	0.00	0.00	0.00	0.00 0.00	
VFD 10-BP-1	10-BP-1 VFD VFD 10-BP-1 outp	480 480	2.37	0.149 0.000	0.844 0.000	339.31			0.00 19.88	
VFD 10-CP-1	10-CP-1 VFD VFD 10-CP-1 outp	480 480	12.47	0.779 0.000	4.419 0.000	1777.25			0.00 19.82	
VFD 10-EF-1	MCC.10-2A VFD 10-EF-1 outp	480 480	5.43	0.340 0.000	1.932 0.000	776.57			0.00 19.89	
VFD 10-EF-10	MCC.10-2B VFD 10-EF-10 out	480 480	1.24	0.078 0.000	0.442 0.000	177.83			0.00 19.90	
VFD 10-EF-11	MCC.10-2B VFD 10-EF-11 out	480 480	1.81	0.113 0.000	0.644 0.000	258.75			0.00 19.90	
VFD 10-EF-5	MCC.10-2A VFD 10-EF-5 outp	480 480	1.24	0.078 0.000	0.442 0.000	177.86			0.00 19.89	
VFD 10-EF-7	MCC.10-2A VFD 10-EF-7 outp	480 480	1.81	0.113 0.000	0.644 0.000	258.77			0.00 19.89	
VFD 10-SF-1	MCC.10-2A VFD 10-SF-1 outp	480 480	5.43	0.340 0.000	1.932 0.000	776.57			0.00 19.89	
VFD 10-SF-2	MCC.10-2B VFD 10-SF-2 outp	480 480	8.60	0.539 0.000	3.062 0.000	1230.53			0.00 19.90	
VFD 10-SF-5	MCC.10-2A VFD 10-SF-5 outp	480 480	1.24	0.078 0.000	0.442 0.000	177.86			0.00 19.89	
VFD EFF.P-1	MCC.10-1A VFD EFF.P-1 outp	480 480	44.58	2.849 0.000	16.175 0.000	477.05			0.00 0.93	
VFD EFF.P-2	MCC.10-1B VFD EFF.P-2 outp	480 480	44.59	2.849 0.000	16.175 0.000	476.04			0.00 0.93	

TOTAL CURRENT DISTORTION										
Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
VFD FS.P-1	MCC.10-1B VFD FS.P-1 outpu	480 480	8.61	0.539 0.000	3.062 0.000	1230.53			0.00 19.88	
VFD FS.P-2	W3.P-CP VFD W3.P-CP OUTP	480 480	88.88	5.666 0.000	32.138 0.000	886.76			0.00 0.80	
VFD MIX.BLW-1	MIX.BLW-1 VFD MIX.BLW-1 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD MIX.BLW-2	MIX.BLW-2 VFD MIX.BLW-2 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD MIX.BLW-3	MIX.BLW-3 VFD MIX.BLW-3 VFD ou	480 480	44.15	2.771 0.000	15.675 0.000	6301.22			0.00 19.84	
VFD MIX.BLW-4	MIX.BLW-4 VFD MIX.BLW-4 VFD ou	480 480	58.83	3.683 0.000	20.890 0.000	8401.63			0.00 19.86	
VFD RDT-1	RDT-CP RDT-1 VFD output	480 480	2.38	0.149 0.000	0.844 0.000	339.31			0.00 19.82	
VFD RDT-2	RDT-CP RDT-2 VFD output	480 480	2.38	0.149 0.000	0.844 0.000	339.31			0.00 19.82	
VFD SBR-BLW-1	SBR.BLW-1 VFD SBR.BLW-1 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD SBR.BLW-2	SBR.BLW-2 VFD SBR.BLW-2 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD SBR.BLW-3	SBR.BLW-3 VFD SBR.BLW-3 VFD ou	480 480	72.15	4.603 0.000	26.113 0.000	6241.51			0.00 3.22	
VFD SBR.TP-1	MCC.10-1A VFD SBR.TP-1 out	480 480	37.82	2.417 0.000	13.720 0.000	410.35			0.00 0.96	
VFD SBR.TP-2	MCC.10-1B VFD SBR.TP-2 out	480 480	37.83	2.417 0.000	13.720 0.000	409.53			0.00 0.95	

TOTAL CURRENT DISTORTION

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
VFD SBR.TP-3	MCC.10-1A VFD SBR.TP-3 out	480 480	37.82	2.417 0.000	13.720 0.000	410.35			0.00 0.96	
VFD SL.TP-1	MCC.10-1A VFD SL.TP-1 outp	480 480	15.91	0.997 0.000	5.666 0.000	2274.82			0.00 19.88	
VFD TSL.P-1	MCC.10-1A VFD TSL.P-1 outp	480 480	30.12	1.925 0.000	10.935 0.000	330.19			0.00 0.98	

TOTAL SYSTEM POWER LOSSES

Harmonic Losses		Total RMS Losses	
P(kW)	Q{kVAR)	P(kW)	Q(kVAR)
0.09	0.77	59.10	312.89

C U R R E N T D I S T O R T I O N S U M M A R Y

Device Name	Bus Name From/To	Voltage From/To	I_RMS(A)	kWLoss Tot/Harm	kVARLoss Tot/Harm	IT	HLF	KF	I_TDD(%)/ I_THD(%)	LIMIT
NO VIOLATION										

T O T A L S Y S T E M P O W E R L O S S E S

Harmonic Losses		Total RMS Losses	
P(kW)	Q{kVAR)	P(kW)	Q(kVAR)
0.09	0.77	59.10	312.89

HARMONIC VOLTAGE SPECTRUM REPORT

Bus: SWBD.10-1A (distr.) (480V)

Harmonic Order	Harmonic Voltages	Phase Angle	Distortion Percent	Limit
1	461.701	-2.43		
5	8.263	21.52	1.790	5.000
7	2.691	149.60	0.583	5.000
11	4.383	-172.00	0.949	5.000
13	1.977	-126.79	0.428	5.000
17	3.916	-56.16	0.848	5.000
19	2.747	-24.91	0.595	5.000

Voltage: 480.0 V_RMS: 461.83 V_THD(%): 2.39
LIMIT (THD%): 8.0

HARMONIC VOLTAGE SPECTRUM REPORT

Bus: SWBD.10-1B (distr.) (480V)

Harmonic Order	Harmonic Voltages	Phase Angle	Distortion Percent	Limit
1	461.702	-2.43		
5	8.263	21.52	1.790	5.000
7	2.691	149.61	0.583	5.000
11	4.383	-172.00	0.949	5.000
13	1.977	-126.79	0.428	5.000
17	3.916	-56.15	0.848	5.000
19	2.747	-24.90	0.595	5.000

Voltage: 480.0 V_RMS: 461.83 V_THD(%): 2.39
LIMIT (THD%): 8.0

HARMONIC CURRENT SPECTRUM REPORT

Device Name: C: SWBD.10-1B (d
From: SWBD.10-1B (main (480V)
To: SWBD.10-1B (dist (480V)
Point of Common Coupling (PCC): (Isc/Ilf = 18.164)

Harmonic Order	Harmonic Amperes	Phase Angle	Distortion Percent	Limit
1	973.936	-39.25		
5	35.158	112.75	3.610	4.000
7	13.853	-119.12	1.422	4.000
11	8.477	-80.90	0.870	2.000
13	5.481	-35.58	0.563	2.000
17	4.901	35.01	0.503	1.500
19	5.211	66.37	0.535	1.500

Voltage: 480.0 I_RMS: 974.75 I_TDD(%): 1.#J
I_THD(%): 4.08
kWLoss: 0.002 kVARLoss: 0.001
I_K: LIMIT (TDD%): 5.0

WARRANTY

It is the intent of Coordinated Power Systems, Inc. to provide a study which is accurate and based on sound professional judgment. If it is found that any portion of this study does not satisfy this goal, Coordinated Power Systems, Inc. will correct that portion of the study at no charge providing we are notified in writing within one year of submission of the study. The warranty does not include modifications to the study resulting from design changes to the system after the study has been initiated.

LIMITATION OF LIABILITY

The foregoing warranty represents the sole responsibility of the company. Coordinated Power Systems, Inc. shall not be liable for any consequential damages. It does not assume responsibility or liability for loss, injury or damage to equipment that may result from the failure of equipment or the system to operate in accordance of the predictions or recommendations of the study.

Project Group

PROJECT:	Orleans, MA Downtown Area Collection System and Pumping Stations	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-02	DATE RETURNED:	
SUBMITTAL NO:	538 (01030-128)	REVIEWER:	M. Salsbury
SUBJECT:	O&M Manual for Pump Station #01	SPECIFICATION:	01030 – Special Requirements

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only
(6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	Section 9.1 - Pumps	2	Annotate the submittal to only include the pump information that has to do with the specific pump station, including: - Equipment List - Pump Data Sheets - Pump Motors - Pump Test Records
2.	Section 9.4 - Pump Start-Up Report	2	Annotate the submittal to only include the pump information that has to do with the specific pumps for Pump Station 1.
3.	Section 10.2 – Portable Hoist	2	Annotate the submittal to show which hoist has been installed – Model 5PT10 or 5PT20.
REVIEWER SIGNTATURE	Salsbury, Makenna Digitally signed by Salsbury, Makenna DN: cn=Salsbury, Makenna, ou=USCHL1, email=Makenna.Salsbury@aecom.com Date: 2023.01.26 16:19:49 -05'00'		
APPROVER SIGNATURE	Galligan, Chris Digitally signed by Galligan, Chris DN: cn=Galligan, Chris, ou=USCHL1, email=Chris.Galligan@aecom.com Date: 2023.01.27 09:49:59 -05'00'		

Project Group

PROJECT:	Orleans, MA Downtown Area Collection System and Pumping Stations	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-02	DATE RETURNED:	2/27/2023
SUBMITTAL NO:	538 (01030-128)	REVIEWER:	Amy Hunter
SUBJECT:	O&M Manual for Pump Station #01	SPECIFICATION:	01030 – Special Requirements

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only (6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	01030 1.28.C	2	Submit Operation and Maintenance Manual Review checklist with final O&M Manual.
2.	O&M Manual Instructions	3	Please see check-marked O&M Manual Layout instructions attached and incorporate the lines marked with a red “X”.
3.	O&M Manual Instructions	2	Upon final approval, please provide the material outlined in yellow for hard copies.
4.	Front Cover	3	Update AECOM’s address on the front page of the O&M to: AECOM 9 Jonathan Bourne Dr, Pocasset, MA 02559
5.	TOC	3	Revise TOC to list the subsection page number not number of pages (e.g. 8.1 Ballcentric Plug Valve…page 21)
6.	O&M Manual Instructions	3	On United’s cover sheet for each piece of equipment, please include manufacturer name and model/part number (e.g. section 8.1 should have the name “Pratt” and include the model/part number of the Ballcentric Plug Valve)
7.	1.2 Access Hatches	3	Remove sheets relevant not relevant to PS1
8.	8.3 Swing Flex Check Valve	3	Indicate if optional features are provided on swing-flex check valve
9.	9.1 Pumps	3	Remove test reports not relevant to PS1; update pump test reports for replacement pump - see AECOM letter dated 2/22/23
10.	9.2 Instrument Controls	3	Confirm that Keller 0407.02007.021358.13 was installed, if so, delete KPSI 700 level transducer product info if not used, update list of materials accordingly (14.1 PS-1 Shop Drawing)
11.	9.4 Pump Startup Report	3	Remove pages not relevant to PS1 and update pump start up reports upon final testing of replacement pump as of 2/10/23; see AECOM letter dated 2/22/23

ITEM NUMBER	REFERENCE	CODE	COMMENT
12.	14.1 – PS-1 Shop Drawings	2	Provide title sheet for section
REVIEWER SIGNTATURE	Amy Hunter, 2/27/2023		
APPROVER SIGNATURE	Thomas E. Parece, P.E. 2/27/2023		

Orleans, MA 2019-02 Downtown Area Collection System and Pumping Stations

O&M Manual Layout Requirements

- Follow the requirements specified in 01030 SPECIAL REQUIREMENTS Section 1.28
  - Submit Operation and Maintenance Manual Review checklist with O&M Manual (referenced in Specification 01030 SPECIAL REQUIREMENTS Section 1.28 C)
- The front cover shall be used in three (3) places.
  - It shall be inserted in the clear pocket of the exterior front of the binder
  - It shall be the first page when you open the binder
  - A properly sized version of the front cover shall be inserted in the clear pocket of the exterior spine of the binder.
- The front cover shall include: *United's cover sheet for each equipment section in this submittal
  - Name of manufacturer
  - Name of equipment included, along with model number(s)
  - State the words "Operation & Maintenance Manual"
  - State the project title
    "Town of Orleans, Massachusetts
    Contract No. 2019-02 – Downtown Area Collection System and Pumping Stations"
  - State the project number "AECOM Project No. 60587515"
- The next page shall begin the Table of Contents for the Binder. The TOC shall be organized by sections and list out all subjects under each section.
- The sections shall be separated by tabs that clearly label the section name and number.
- The binder shall make use of a header throughout that includes the name of the manufacturer, equipment and section name.
- The binder shall make use of a footer throughout that includes the project number, the section name and "page *number* of *number*" for the section the page falls under.
- Three (3) hard copies and an electronic copy in PDF format shall be provided to the Contractor.

DOWNTOWN AREA COLLECTION SYSTEM AND PUMPING STATIONS
CONTRACT NO. 2019-02 & SRF NO. 4486
ORLEANS, MA

General Contractor: Robert B. Our Co., Inc.
Engineer: AECOM Technical Services, Inc.
Submittal Number: 01030-128 O&M Manual for Pump Station #01
Deviations: None: __X__ ; As Listed:
Reference Specification Section: 01030-1.28
Reference Drawing Number:

Representation is made to the Owner and Engineer that the Contractor has (a) reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents; (b) determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto; (c) determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and (d) determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

Contractor: Robert B. Our Co., Inc.

Signature: _____

Date: December 16, 2022

ENGINEER STAMP

24 Great Western Rd., P.O. Box 1539, Harwich, MA 02645 - Tel. 508-432-0530 Fax. 508-432-4385

UNITED CONCRETE PRODUCTS INC.
BUILDING GROUP

LETTER OF TRANSMITTAL

UCP #	27087
DATE	12/6/2022
ATTN	Zach Ellis
Project	Downtown Area Collection Systemand Pump Stations
	Orleans, MA

To: Robert B. Our
24 Great Western Rd
Harwich, MA 02645

LADIES / GENTLEMEN:

WE ARE SENDING YOU [X] ATTACHED [ ] UNDER SEPARATE COVER VIA_____ THE FOLLOWING ITEMS:

[ ] SHOP DRAWINGS [ ] PRINTS [ ] PLANS [ ] SAMPLES [ ]

[ ] COPY OF LETTER [ ] CHANGE ORDERS [ ]

COPIES	DATE	PAGES	DESCRIPTION
1	12/6/2022	651	O&M Manual (Electronic Copy)

THESE ARE TRANSMITTED AS CHECKED BELOW:

[X] FOR APPROVAL [ ] APPROVED AS SUBMITTED [ ] RESUBMITTED COPIES FOR APPROVAL

[X] FOR YOUR USE [ ] APPROVED AS NOTED [ ] SUBMIT

[ ] AS REQUESTED [ ] REQUEST FOR PROPOSAL [ ] RETURN CORRECTED PRINTS

[ ] FOR REVIEW AND COMMENT [ ] RETURN PLANS & SPECS

[ ] FOR BIDS DUE [ ] PRINTS RETURNED AFTER LOAN TO US

REMARKS

If enclosures are not as noted, kindly notify us at once.

COPY TO: FILE,

SIGNED: Tyler McIntyre

Downtown Area Collection System and Pump Stations
Orleans, MA
OPERATION & MAINTENANCE MANUAL

Pump Station #1

OWNER:	Town of Orleans, MA. Department of Public Works 19 School Road Orleans, MA. 02653
ENGINEER:	AECOM 55 Walker Brook Drive Reading, MA. 01867
CONTRACTOR:	Robert B. Our 24 Great Western Rd Harwich, MA 02645

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

UNITED CONCRETE PRODUCTS INC
BUILDING GROUP

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Downtown Area Collection System and Pump Stations
Orleans, MA

Tuesday, December 6, 2022

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Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

1.1 - Warranties

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

UNITED CONCRETE PRODUCTS INC.

Phase 1 Collection & Conveyance System
North Pump Station Control Building
Westhampton Beach, NY.

PRE-FABRICATED CONTROL BUILDING
COMPREHENSIVE
LIMITED WARRANTY

One Year Limited Warranty

United Concrete Products, Inc. warrants the outfitted pre-fabricated Meter Building an Booster Station's building exterior and interior finish, including the internal components(supplied by United Concrete Products, Inc.) to be free from defects in design, materials and workmanship for a period of one (1) year from the installation date of ***5/11/2022***. Certain materials and equipment supplied by United Concrete Products, Inc. will be replaced under the manufacturer's standard warranty. Items that are not covered under the manufacturer's warranty, will be covered by United Concrete Products, Inc. Damage due to conditions beyond the control of United Concrete Products, Inc. **IS NOT COVERED BY THIS WARRANTY.** This warranty will not apply to failures resulting from misuse, negligence, accidents, acts of God, etc.

United Concrete Products, Inc. will repair or replace items which are found to be defective within the above specified warranty period. Any and all repairs or modifications to the structure not performed by United directly shall be inspected and approved in writing by United Concrete Products, Inc. before any work is completed. The approval of, and associated compensation for, any repair work performed prior to notifying United Concrete Products, Inc. will be at their discretion.

President – Building Group
United Concrete Products, Inc.

July 18, 2022
Date

United Concrete Products, Inc. - 173 Church Street - Yalesville, Connecticut 06492
Phone: (203) 269-3119 Fax: (203) 265-4941

Phase 1 Collection & Conveyance System
North Pump Station Control Building
Westhampton Beach, NY.

PRE-FABRICATED BUILDING STRUCTURE LIMITED WARRANTY

Twenty-Five Year Limited Warranty

United Concrete Products, Inc. warrants the precast concrete structure and Stucco Brick to be free from defects in material and workmanship and not to deteriorate for a period of Twenty-Five (25) years after ***May 11, 2022***. Damage due to conditions beyond the control of United Concrete Products, Inc. **IS NOT COVERED BY THIS WARRANTY.** This warranty will not apply to failures resulting from misuse, negligence, accidents, acts of God, etc.

United Concrete Products, Inc. will repair defects which are found to be an issue within the above specified warranty period. Any and all repairs or modifications to the structure not performed by United directly shall be inspected and approved in writing by United Concrete Products, Inc. before any work is completed. The approval of, and associated compensation for, any repair work performed prior to notifying United Concrete Products, Inc. will be at their discretion.

President – Building Group
United Concrete Products, Inc.

July 18, 2022
Date

United Concrete Products, Inc. - 173 Church Street - Yalesville, Connecticut 06492
Phone: (203) 269-3119 Fax: (203) 265-4941

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

1.2 - Access Hatches

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

USF FABRICATION

AN EAGLE MANUFACTURING COMPANY

Type THS & THD

AASHTO H20-44 ALUMINUM FLOOR ACCESS DOORS

TABLE OF CONTENTS

Vendor Data

Material Data Sheet

Specification

Component Parts List

Storage, Handling, Installation & Maintenance Instructions

Limited Warranty

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VENDOR DATA

U.S.F. FABRICATION, INC.

3200 W. 84 ST.

HIALEAH, FL 33018

PH:305.556.1661

TOLL FREE: 800.258.6873

FAX: 305.882.1577

EMAIL: SERVICE@USFFAB.COM

WEBSITE: WWW.USFFAB.COM

CONTACT: LEAH STENBERG

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Type THS & THD

AASHTO H20-44 ALUMINUM FLOOR ACCESS DOORS

MATERIAL DATA SHEET

1. Door leaf shall be ¼-in. thick mill finish type 5052 aluminum diamond pattern plate, reinforced with a ¼-in. aluminum flat bar to achieve an AASHTO H-20-44 wheel load rating.

2. Frame members shall be ¼-in. thick 6063-T5 mill finish aluminum extrusion.

3. The following items shall be Type 316 Stainless Steel: hinges, hold-open arm and all attaching hardware.

4. Units shall carry a Ten (10) year Guarantee against defects in material and/or workmanship.

***5052 has excellent resistance to corrosion--especially in a marine environment, good workability, weld ability, and good finishing characteristics.**

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Type THS & THD

AASHTO H20-44 ALUMINUM FLOOR ACCESS DOORS

STANDARD FEATURES:

316 stainless steel hold-open arms with secondary latch mechanism/release handle

316 stainless steel hinges and tamper resistant attaching hardware

Cast aluminum lift handle

EDPM odor reduction gasket

1 ½" threaded drain coupling

Stainless steel open horizontal springs

316 stainless steel watertight slam lock with threaded plug

Single or double leaf construction

AASHTO H20-44 wheel load rating

10 Year warranty against defects in material and workmanship

Adhesive backed vinyl covering to protect the cover during shipping and installation.

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Type THS & THD

AASHTO H20-44 ALUMINUM FLOOR ACCESS DOORS

SPECIFICATION

The floor access door shall be Model THS (single leaf) or THD (double leaf) as manufactured by U.S.F. Fabrication, Inc. with the size being specified on the plans.

Door leaf shall 1/4-inch thick aluminum diamond plate reinforced to an AASHTO H20-44 live wheel load. (The floor access door is designed for off-street locations that may occasionally receive AASHTO H-20-44 wheel loads).

The drainable frame shall be minimum 1/4" in. thick extruded aluminum with an integral anchor flange and door seat on all four sides.

The floor access door shall be equipped with a flush lifting handle that does not protrude above the cover, and a 316 stainless steel hold open arm with a secondary latching mechanism/release handle that secures the cover in its full upright, open position.

The door shall have 316 stainless steel hinges with 316 stainless steel tamper resistant bolts/locknuts.

The door shall have stainless steel open horizontal springs to assist in opening the cover and reducing the force during closing.

The door shall be equipped with a 316 stainless steel watertight slamlock with threaded plug, removable outside key and fixed inside handle. The slam lock latches onto a 316 stainless steel striker plate that is bolted to the frame.

All parts of the frame in contact with the concrete shall have a coating of bituminous paint.

An adhesive backed vinyl material that protects the product during shipping and installation shall cover the entire top of the frame and cover.

Installation shall be in accordance with the manufacturer's attached instructions. The door shall be manufactured and assembled in the United States.

Manufacturer shall guarantee the door against defects in materials and workmanship for a period of ten (10) years.

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Type THS & THD

AASHTO H20-44 ALUMINUM FLOOR ACCESS DOORS

STORAGE, HANDLING, INSTALLATION and MAINTENANCE

STORAGE:

Prior to installation floor access doors should be stored in a dry area that is free of dirt and debris. Floor access doors should be stored on the original shipping pallets.

HANDLING:

Standard practice precautions should be taken whenever handling or moving palletized floor access doors by forklift.

INSTALLATION:

For proper installation, U.S.F. Fabrication, Inc. recommends the following:

1. Formwork must be flush to the inside of frame.

2. Secure unit to formwork using standard construction practices.

3. When pouring concrete, cover should be in the closed position.

4. Concrete to finish flush with top of unit framework.

5. Unit shall be left in framework for not less than 24 hours.

6. Clean all excess concrete from frame, cover seat; and in the case of a trough type frame, the drainage coupling.

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MAINTENANCE:

Since all components of the floor access doors manufactured by U.S.F. Fabrication, Inc. are manufactured of aluminum or stainless steel, they require minimal maintenance. For optimum product life the manufacturer recommends the following procedures be performed annually:

1. **Apply graphite to the interior of all locking devices.**
2. **Apply a light coating of machine oil to all hinges and hardware.**
3. **Remove all debris from the cover seat and around hinges.**
4. **Check and tighten any loose hardware.**
5. **In the case of a trough frame model, remove loose debris from the trough.**

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QP1090-1 LIMITED WARRANTY

USF Fabrication Inc. warrants the following products against defects in material or workmanship from the time of delivery:

- **Steel Hatches and Access Doors- 5 years**
- **Aluminum Hatches and Access Doors- 10 years**
- **Miscellaneous Fabrication- 1 year**

USF Fabrication Inc. will pay labor and standard freight costs for warranty service for the product warranty period from the time of delivery.

USF Fabrication Inc. sole obligation under said warranty is to repair, or at its option, replace the defective part. The buyer shall have no other remedy. All special, incidental and consequential damages are excluded.

The warranty shall be voided by alterations of equipment except by USF Fabrication Inc., or tampering with, improper installation or maintenance, accident or misuse. This warranty expressly excludes all damage to these products resulting from careless or neglectful transportation.

USF Fabrication Inc. will not be responsible for any warranty work done without first obtaining USF Fabrication's written consent.

Except as provided herein, USF Fabrication Inc. shall have no LIABILITY OR RESPONSIBILITY to customer or any other person or entity with respect of liability, loss or damage, or alleged to be caused directly or indirectly by our products.

For Warranty service, customers must contact USF Fabrication Inc. - Customer Service Department Toll free at 1-800-258-6873.

This warranty gives you - the Consumer specific legal rights, and you may also have other rights which vary from state to state.

USF FABRICATION - 3200 W. 84 ST. - HIALEAH, FL 33018

PH: 305.364.8200 **TOLL FREE:** 800.258.6873 **FAX:** 305.882.1577

EMAIL: SERVICE@USFFAB.COM

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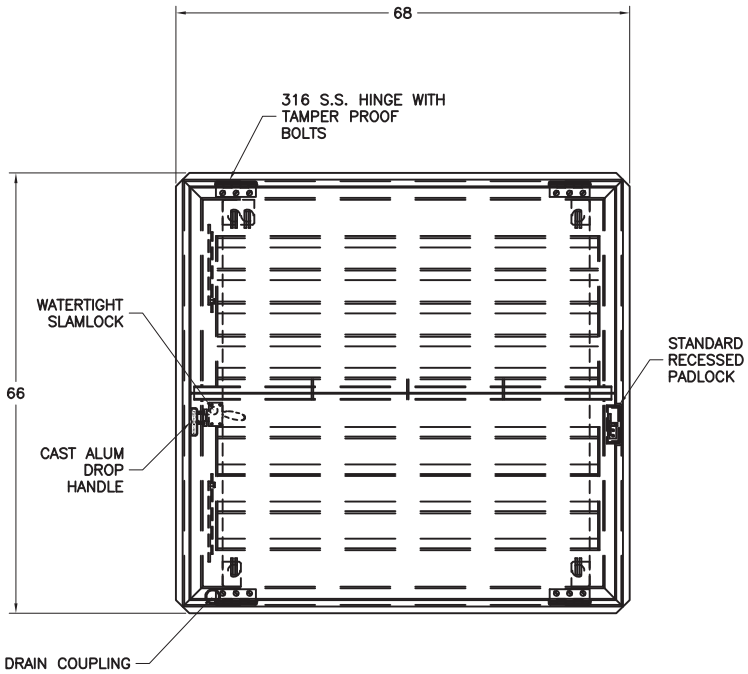
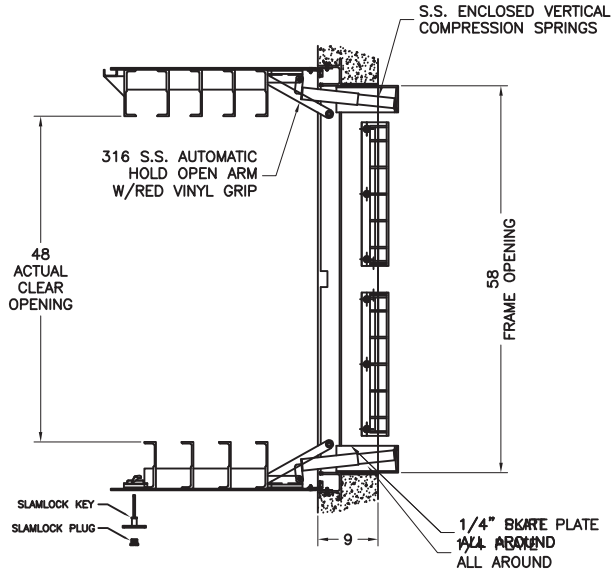
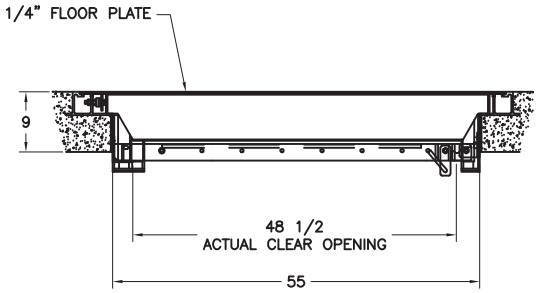
Pump Station No. 1 Valve Vault Equipment

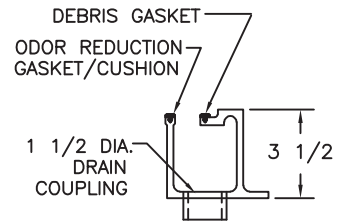






SELECTED FEATURES
1. DEBRIS FREE FRAME
2. BOLT–ON ENCLOSED VERTICAL SPRINGS
3. SLAMLOCK
4. STD. RECESSED PADLOCK
5. SKIRT FOR 9" DEEP SLAB
6. SAFETY GRATING
7. BITUMINOUS COATING
7. 2" STD. INSULATION

NOTES
1. MATERIAL: ALUMINUM
2. FINISH: MILL
3. LOADING: DESIGNED FOR AASHTO H–20 WHEEL LOADS WITH MAX DEFL OF 1/150 OF THE SPAN DESIGNED FOR OCCASIONAL TRAFFIC ONLY.
4. 316 SS NUTS & BOLTS
5. AREA OF FRAME IN CONTACT WITH CONCRETE TO BE PAINTED WITH BITUMINOUS COATING
6. SAFETY GRATING TO BE PAINTED WITH SAFETY ORANGE POWDER COAT
7. APPROX HATCH WT: 493.18 LBS



1/4" EXTRUDED TROUGH SECTION W/INTEGRAL CONT. ANCHOR FLANGE & GROOVE FOR GASKET/CUSHION FRAME MAT'L: ALUMINUM 6063–T5

DEBRIS FREE FRAME DETAIL

NOTE:
AS AN AUTOMATED DRAWING, THE DESIGN HAS NOT BEEN REVIEWED BY USFF ENGINEERING AND IS THEREFORE TO BE USED FOR REFERENCE ONLY. USFF RESERVES THE RIGHT TO ADJUST DIMENSIONS TO INSURE ADHERENCE TO CUSTOMER REQUIREMENTS AND PROPER OPERATION OF THE PRODUCT.

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INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

BREAK ALL SHARP CORNERS & EDGES TO 0.01

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONAL

<10' = ± 1/8

>10' = ± 1/4

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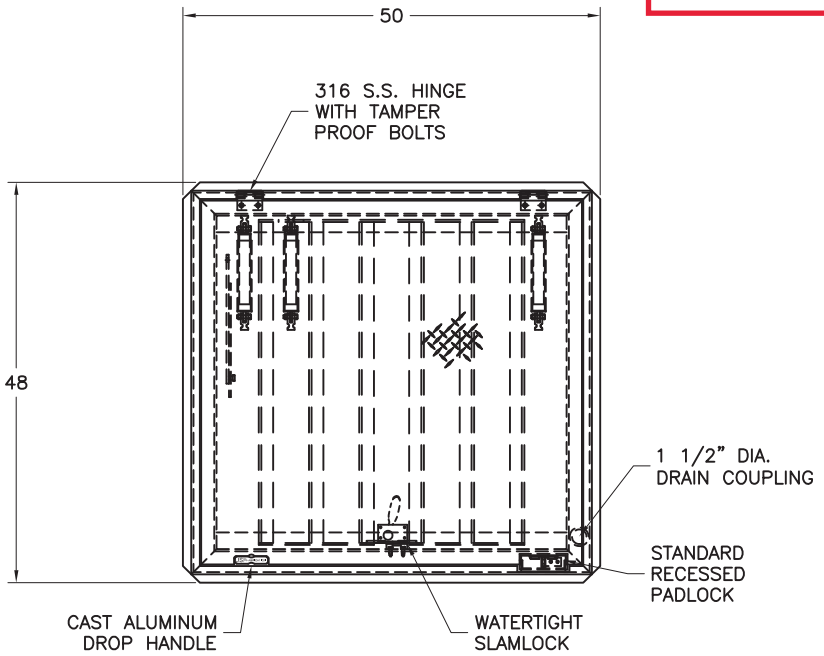
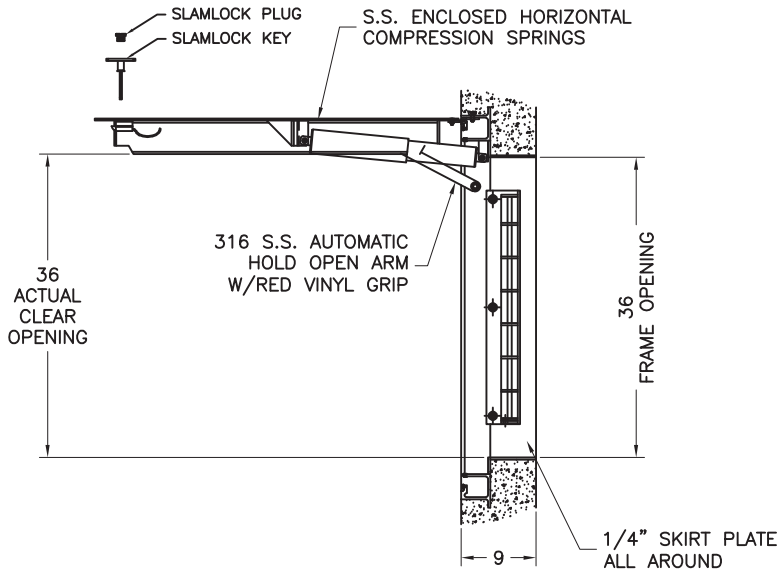
U.S.F. FABRICATION INC.
HIALEAH, FL

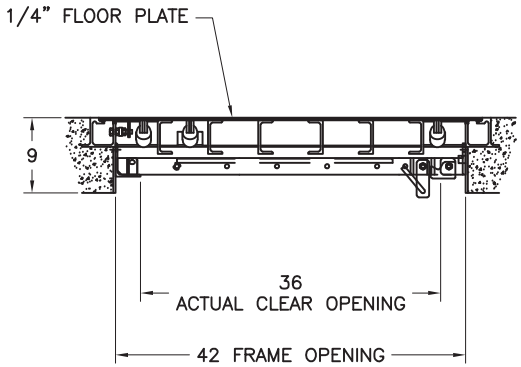
HATCH THD 55 X 58 ALUM

DWN. BY:	SCALE:	SHEET:	DATE:
BOB	1:30	1 OF 1	03/13/20
CHK. BY:	DWG #:	SHEET SIZE:	REV:
BOB	1000150178	A	0

Pump Station No.1 Valve Vault Access

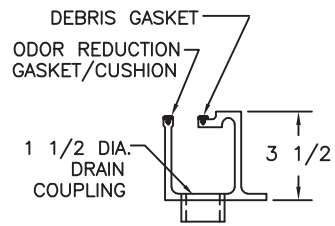






SELECTED FEATURES
1. DEBRIS FREE FRAME
2. ENCLOSED HORIZONTAL SPRINGS
3. SLAMLOCK
4. STD. RECESSED PADLOCK
5. SKIRT FOR 9" DEEP SLAB
6. SAFETY GRATING
7. BITUMINOUS COATING
7. 2" STD. INSULATION

NOTES
1. MATERIAL: ALUMINUM
2. FINISH: MILL
3. LOADING: DESIGNED FOR AASHTO H-20 WHEEL LOADS WITH MAX DEFL OF 1/150 OF THE SPAN DESIGNED FOR OCCASIONAL TRAFFIC ONLY.
4. 316 SS NUTS & BOLTS
5. AREA OF FRAME IN CONTACT WITH CONCRETE TO BE PAINTED WITH BITUMINOUS COATING
6. SAFETY GRATING TO BE PAINTED WITH SAFETY ORANGE POWDER COAT
7. APPROX HATCH WT: 242.83 LBS



1/4" EXTRUDED TROUGH SECTION W/INTEGRAL CONT. ANCHOR FLANGE & GROOVE FOR GASKET/CUSHION FRAME MAT'L: ALUMINUM 6063-T5

DEBRIS FREE FRAME DETAIL

NOTE:
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INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

BREAK ALL SHARP CORNERS & EDGES TO 0.01

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONAL

<10' = ± 1/8

>10' = ± 1/4

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U.S.F. FABRICATION INC.
HIALEAH, FL

HATCH THS 36 X 42 ALUM

DWN. BY:	SCALE:	SHEET:	DATE:
BOB	1:24	1 OF 1	03/13/20
CHK. BY:	DWG #	SHEET SIZE:	REV:
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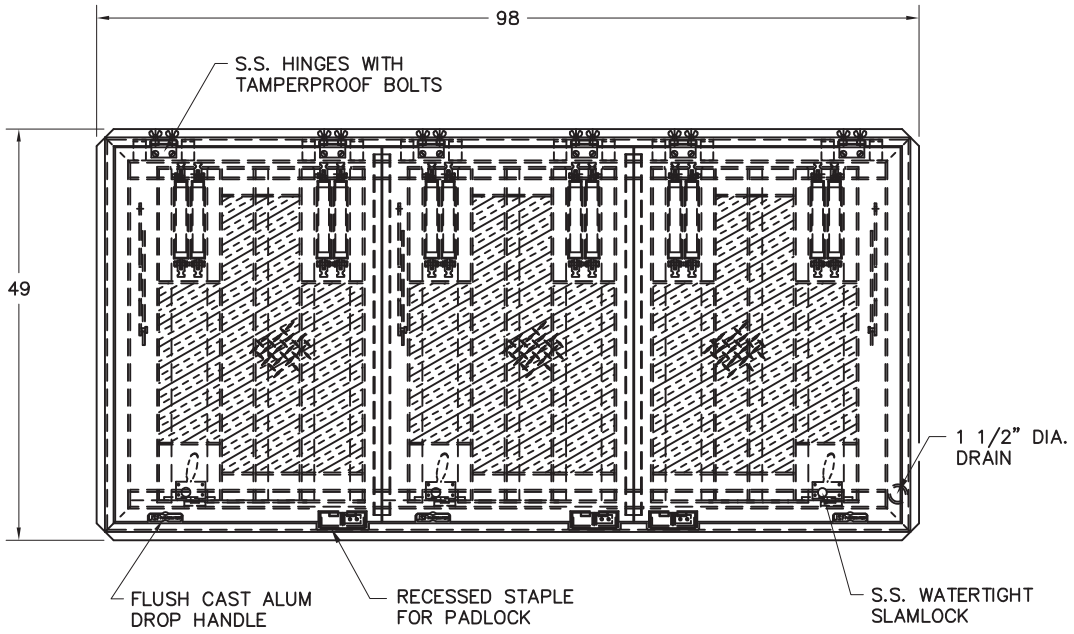
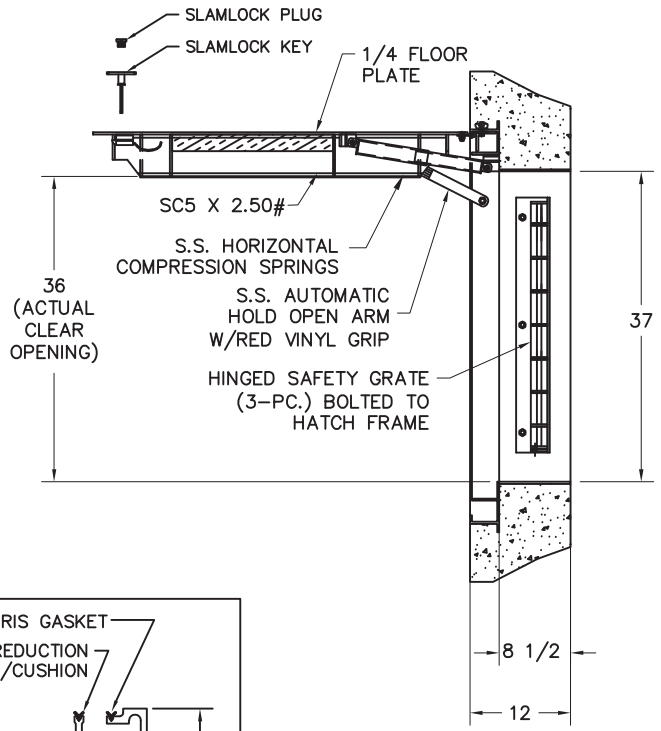
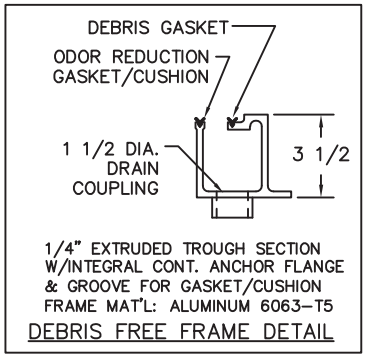
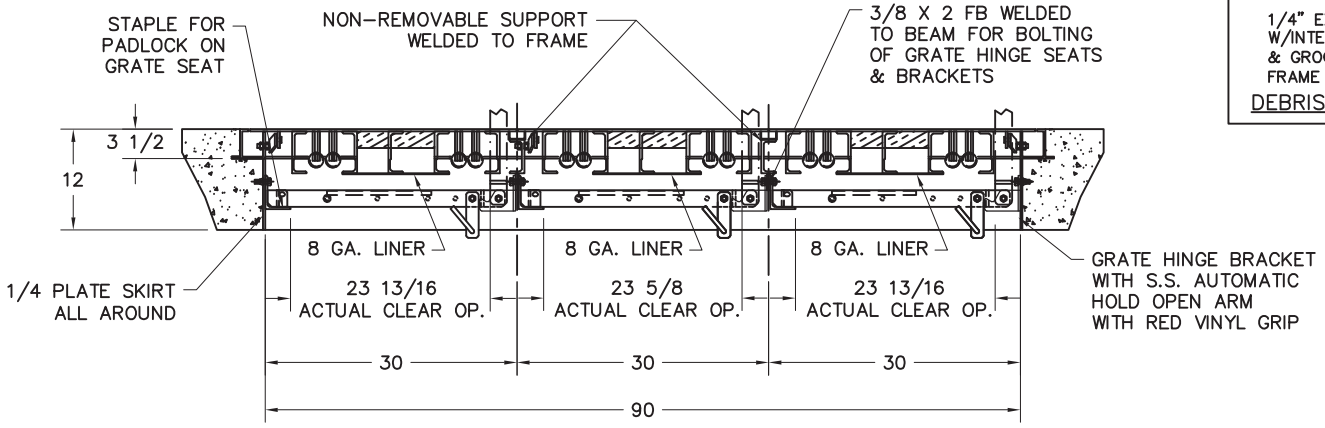
Pump Station No.1 Wet Well









NOTES:
1- MATERIAL: ALUMINUM
2- LOADING: DESIGNED FOR OFF STREET LOCATIONS WHICH MAY OCCASIONALLY RECEIVE H-20 WHEEL LOADS
3- STAINLESS STEEL 316 NUTS & BOLTS
4- AREA OF FRAME IN CONTACT WITH CONCRETE TO BE PAINTED WITH BITUMINOUS COATING
5- SAFETY GRATE TO BE PAINTED WITH SAFETY ORANGE POWDER COAT

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INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

BREAK ALL SHARP CORNERS & EDGES TO 0.01

TOLERANCES UNLESS OTHERWISE SPECIFIED:
INCHES = ± 1/16
1/16 = ± 1/32
1/32 = ± 1/64

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U.S.F. FABRICATION INC.
HIALEAH, FLORIDA

HATCH THT 37 X 90 ALUMINUM W/ENCLOSED SPRINGS, SLAMLOCK, REC'D PADLOCK, SKIRT, BIT. PAINT, INSULATION & SAFETY GRATE

DRAWN BY:	SCALE:	SHEET:	DATE:
LE	1=12	1 OF 1	08/24/20
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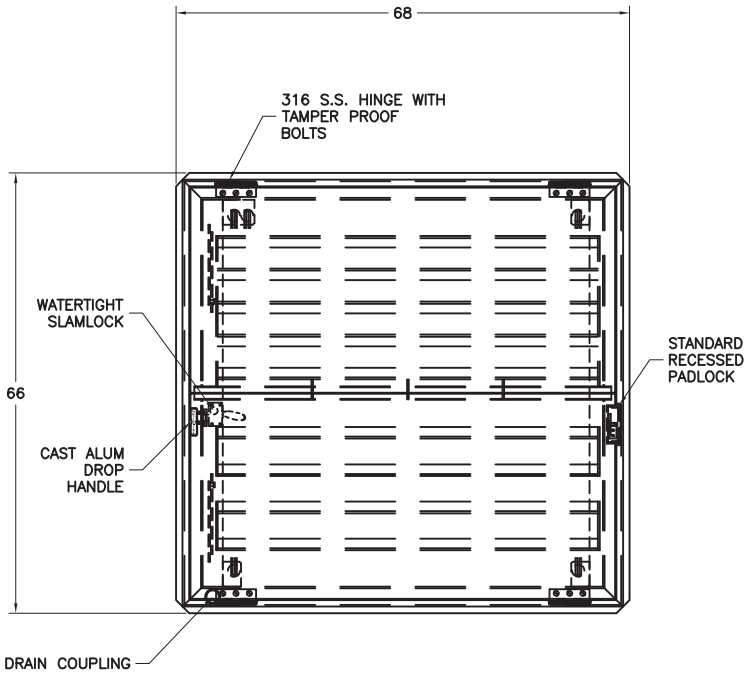
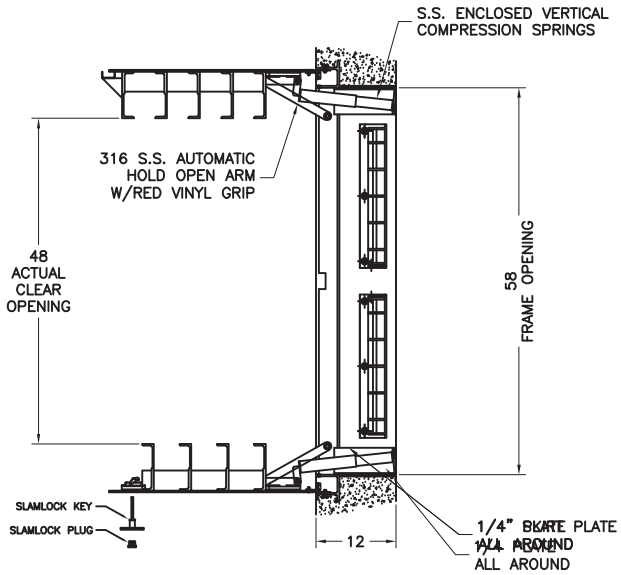
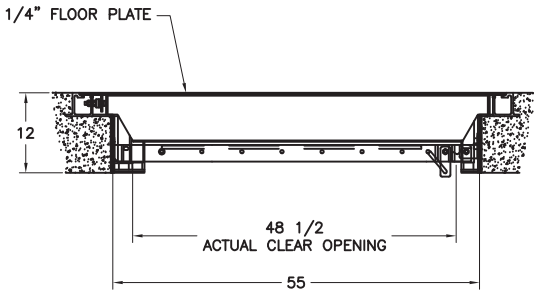
Pump Station No. 2 & 3 Valve Vault Equipment

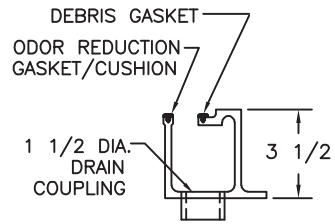






SELECTED FEATURES
1. DEBRIS FREE FRAME
2. ENCLOSED VERTICAL SPRINGS
3. SLAMLOCK
4. STD. RECESSED PADLOCK
5. SKIRT FOR 12" DEEP SLAB
6. SAFETY GRATING
7. BITUMINOUS COATING
7. 2" STD. INSULATION

NOTES
1. MATERIAL: ALUMINUM
2. FINISH: MILL
3. LOADING: DESIGNED FOR AASHTO H-20 WHEEL LOADS WITH MAX DEFL OF 1/150 OF THE SPAN DESIGNED FOR OCCASIONAL TRAFFIC ONLY.
4. 316 SS NUTS & BOLTS
5. AREA OF FRAME IN CONTACT WITH CONCRETE TO BE PAINTED WITH BITUMINOUS COATING
6. SAFETY GRATING TO BE PAINTED WITH SAFETY ORANGE POWDER COAT
7. APPROX HATCH WT: 509.44 LBS



1/4" EXTRUDED TROUGH SECTION W/INTEGRAL CONT. ANCHOR FLANGE & GROOVE FOR GASKET/CUSHION FRAME MAT'L: ALUMINUM 6063-T5

DEBRIS FREE FRAME DETAIL

NOTE:
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INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

BREAK ALL SHARP CORNERS & EDGES TO 0.01

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONAL

<10' = ± 1/8

>10' = ± 1/4

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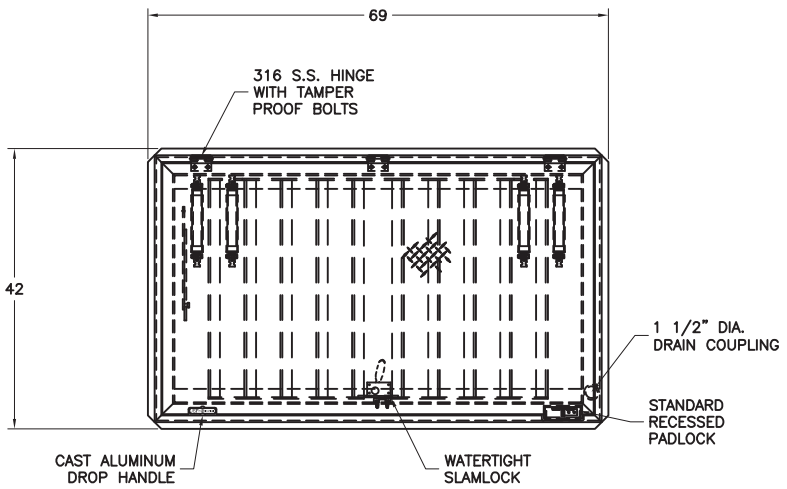
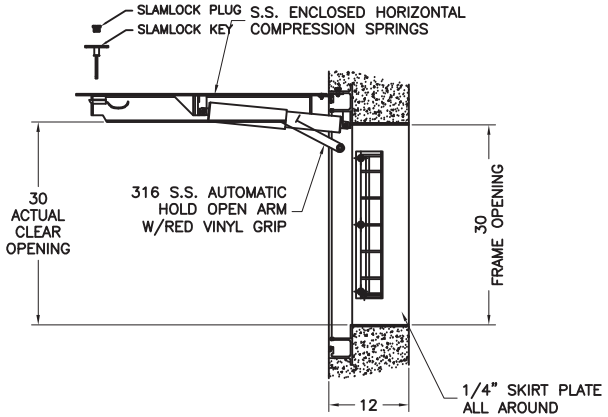
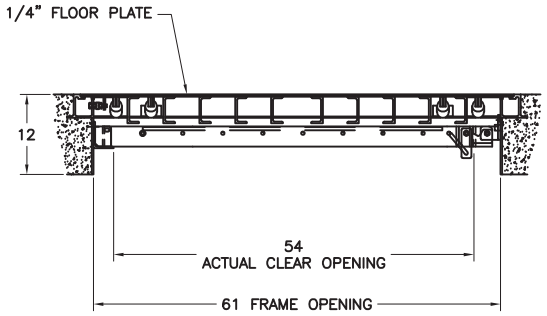
HATCH THD 55 X 58 ALUM

DWN. BY:	SCALE:	SHEET:	DATE:
BOB	1:30	1 OF 1	03/13/20
CHK. BY:	DWG #:	SHEET SIZE:	REV:
BOB	1000150184	A	0

Pump Station No. 2 & 3 Wet Well

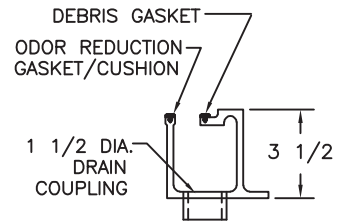






SELECTED FEATURES
1. DEBRIS FREE FRAME
2. ENCLOSED HORIZONTAL SPRINGS
3. SLAMLOCK
4. STD. RECESSED PADLOCK
5. SKIRT FOR 12" DEEP SLAB
6. SAFETY GRATING
7. BITUMINOUS COATING
7. 2" STD. INSULATION

NOTES
1. MATERIAL: ALUMINUM
2. FINISH: MILL
3. LOADING: DESIGNED FOR AASHTO H-20 WHEEL LOADS WITH MAX DEFL OF 1/150 OF THE SPAN DESIGNED FOR OCCASIONAL TRAFFIC ONLY.
4. 316 SS NUTS & BOLTS
5. AREA OF FRAME IN CONTACT WITH CONCRETE TO BE PAINTED WITH BITUMINOUS COATING
6. SAFETY GRATING TO BE PAINTED WITH SAFETY ORANGE POWDER COAT
7. APPROX HATCH WT: 323.37 LBS



1/4" EXTRUDED TROUGH SECTION W/INTEGRAL CONT. ANCHOR FLANGE & GROOVE FOR GASKET/CUSHION FRAME MAT'L: ALUMINUM 6063-T5

DEBRIS FREE FRAME DETAIL

NOTE:
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INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

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TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONAL

<10' = ± 1/8

>10' = ± 1/4

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HATCH THS 30 X 61 ALUM

DWN. BY:	SCALE:	SHEET:	DATE:
BOB	1:30	1 OF 1	03/13/20
CHK. BY:	DWG #	SHEET SIZE:	REV:
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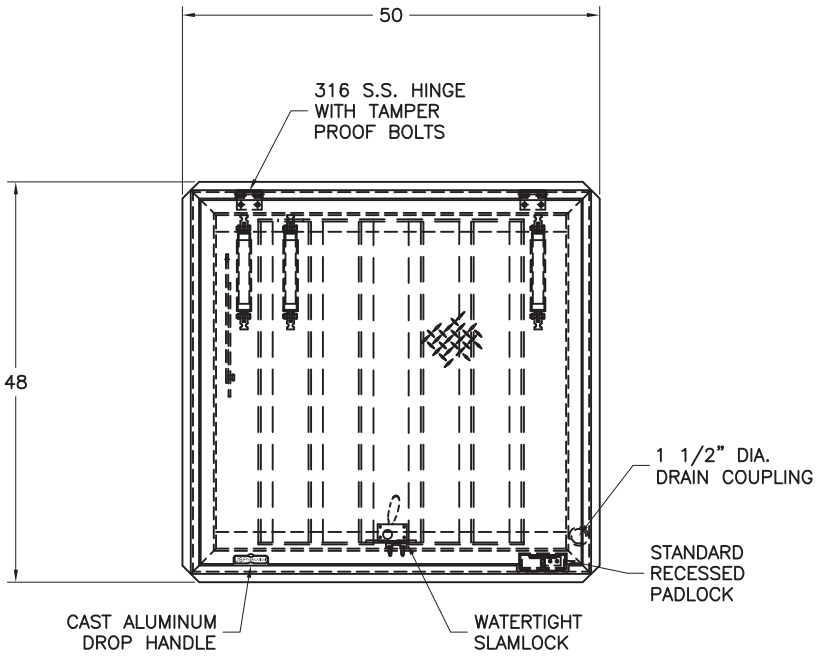
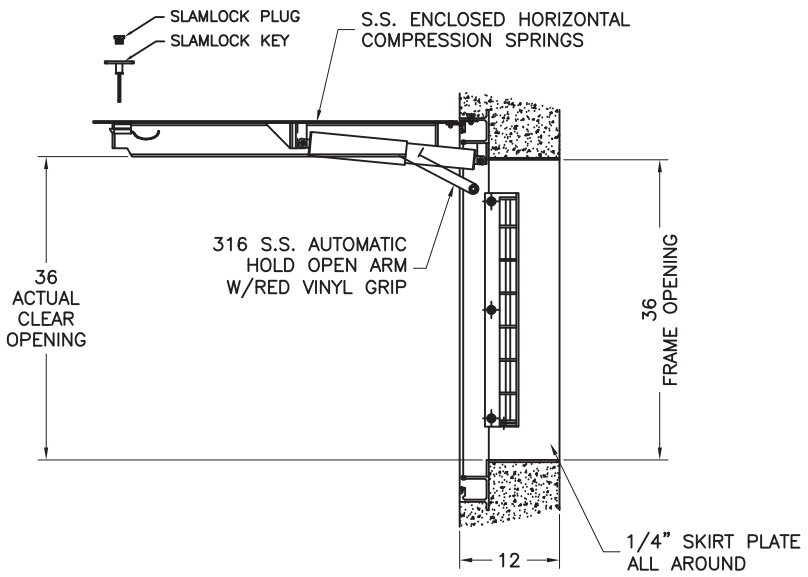
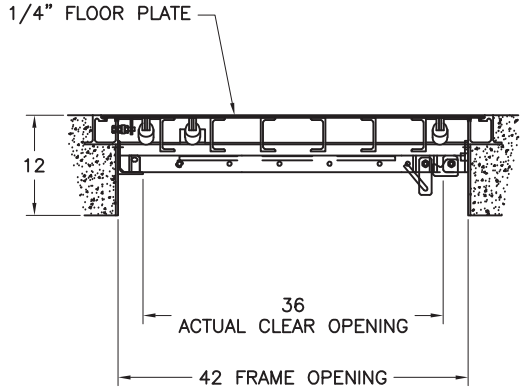
Pump Station No.2 & 3 Valve Vault Access







SELECTED FEATURES
1. DEBRIS FREE FRAME
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3. SLAMLOCK
4. STD. RECESSED PADLOCK
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7. BITUMINOUS COATING
7. 2" STD. INSULATION

NOTES
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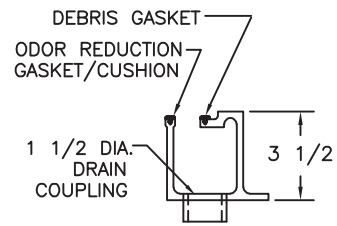
2. FINISH: MILL
3. LOADING: DESIGNED FOR AASHTO H-20 WHEEL LOADS WITH MAX DEFL OF 1/150 OF THE SPAN DESIGNED FOR OCCASIONAL TRAFFIC ONLY.
4. 316 SS NUTS & BOLTS
5. AREA OF FRAME IN CONTACT WITH CONCRETE TO BE PAINTED WITH BITUMINOUS COATING
6. SAFETY GRATING TO BE PAINTED WITH SAFETY ORANGE POWDER COAT
7. APPROX HATCH WT: 254.93 LBS



1/4" EXTRUDED TROUGH SECTION W/INTEGRAL CONT. ANCHOR FLANGE & GROOVE FOR GASKET/CUSHION FRAME MAT'L: ALUMINUM 6063-T5

DEBRIS FREE FRAME DETAIL

INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M

BREAK ALL SHARP CORNERS & EDGES TO 0.01

TOLERANCES UNLESS OTHERWISE SPECIFIED FRACTIONAL

<10' = ± 1/8

>10' = ± 1/4

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HATCH THS 36 X 42 ALUM

DWN. BY:	SCALE:	SHEET:	DATE:
BOB	1:24	1 OF 1	03/13/20
CHK. BY:	DWG #	SHEET SIZE:	REV:
BOB	1000150182	A	0

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Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

8.1 - Ballcentric Plug Valve

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

OPERATION / MAINTENANCE MANUAL

PRATT®

Ballcentric® Plug Valve

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General Information	2
Installation Instructions	2-3
Operation Instructions	4-5
Maintenance	6
Troubleshooting	7
Parts Information	8-9

⚠ WARNING:

1. Read all applicable directions and instructions prior to any maintenance, troubleshooting or installation.

2. Personnel involved in the installation or maintenance of valves should be constantly alert to potential emission of pipeline material and take appropriate safety precautions. Always wear suitable protection when dealing with hazardous pipeline materials.

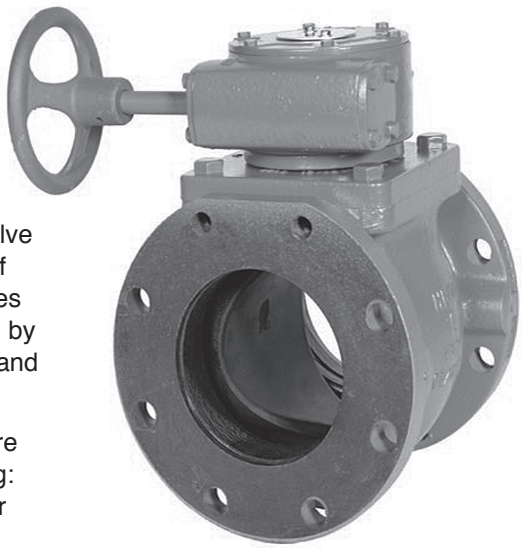
3. Order parts from your local Pratt sales representative or directly from Henry Pratt Company. When ordering parts, please include the serial number located on the valve tag.

NOTE: "WARNING" and "CAUTION" messages (flagged with an exclamation symbol) indicate procedures that must be followed exactly to avoid equipment damage, physical injury, or death.

HENRY PRATT COMPANY
Customer Service
401 South Highland Avenue
Aurora, IL 60506
877.436.7977
www.henrypratt.com
moreinfo@henrypratt.com

FUNCTIONAL DESCRIPTION

Plug valves are designed with eccentric rubber disc seating surfaces. The plug rotates 1/4 turn to provide shutoff in pipes. The eccentric seating action provides for tighter shutoff as the actuator is adjusted to provide for more rotation. The valve can be adjusted to a maximum of 10 degrees over travel. The valves can be used to regulate flow rate by positioning the plug between 15 and 90 degrees open.



Manually operated plug valves are powered with one of the following: 2" direct nut, lever handle or gear actuators, which convert multiple handwheel, chainwheel, or nut input turns into 1/4 turn valve operation. The travel of the valve plug is limited by physical stops in the torque collar for wrench operated valves.

⚠CAUTION: Forcing the handwheel, chainwheel or nut against the stops will not provide tighter shutoff of the valve and may damage the actuator. Only actuator adjustments will affect valve shutoff.

Motor Operated Valve

Motor operated valves are powered with gear actuators, which convert multiple motor input turns into 1/4 turn valve operation. The travel of the valve plug is limited by limit switches in the motor housing and physical stop in the actuator housing. Valve shutoff is affected by limit switch and physical stop settings.

⚠CAUTION: Improperly set limit switches and/or physical stops may damage the motor and/or actuator.

Hydraulically operated valves are powered with a gear box and double acting cylinder. The linear stroke of the cylinder is converted to 1/4 turns operation by the gear box. Auxiliary controls are provided to direct hydraulic power to the cylinder and to control the operating speed of the cylinder.

INSTALLATION

When installing the plug valves, the seat end should be noted. The seat end of the valve is cast in raised letters on the appropriate flange of the valve. Generally, straightway valves should be installed with the highest pressure applied from the opposite end from the seat. This will tend to push the plug into the seat On pump discharge installations the seat end should be towards the pump.

In cases where shut-off is required in both directions, the valve should be installed so that the highest differential pressure at shut-off is opposite the seat end.

When the service is of a clogging type, with suspended solids likely to build up in the valve body, it is recommended that the valve be installed with the media entering the seat end first. In extreme cases, the valve should be installed with the plug horizontal and rotating upward into the top portion of the valve body cavity to open. See Page 6 for recommended installation options.

Class 125 flanged end valves have ANSI B16.1 flat faced 125/150 flanges. Standard ANSI B16.21 flanges and gaskets should be used to install the valves in the pipeline.

Certain size valves utilize tapped holes on the top and bottom of the flange where a backing nut is not possible. Please check specific drawings for detailed information on sizes and quantities of hexagon head screws required on these valves.

Prior to installing valves, they should be cycled open and closed several times to ensure they are in good working order and have not been damaged during shipment or storage.

INSTALLATION OPTIONS

The type of materials carried in the pipeline and the location of the valve determine the correct installation orientation.

Liquids Without Suspended Solids

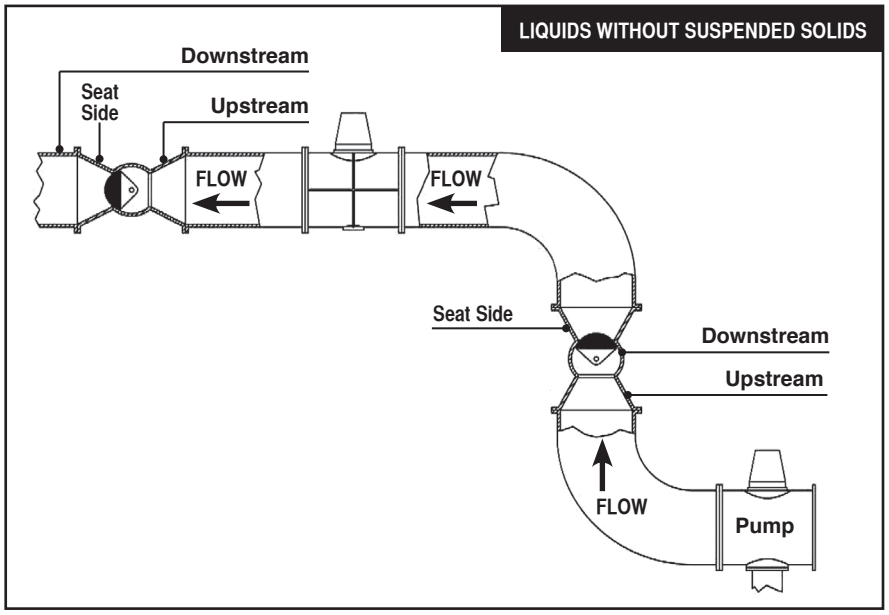
Valve may be installed with plug shaft vertical or horizontal. For vertical pipe installations, install valve with seat facing downstream.

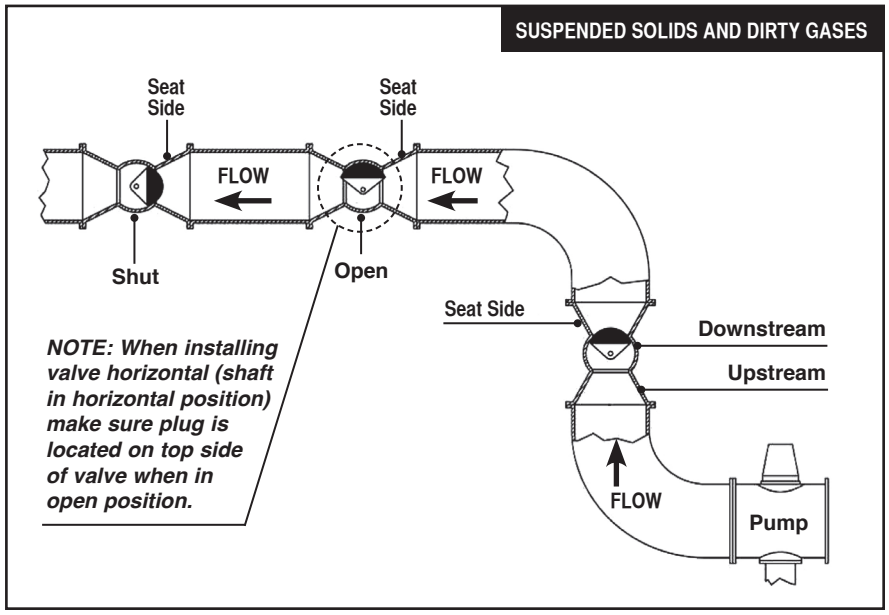
Before installation, blow out pipeline to remove all foreign materials.

Suspended Solids and Dirty Gases

Install valve with plug facing upstream. Ensure plug rotates up to the fully open position thus preventing plug from sweeping through settled debris.

NOTE: For pump isolation service install the discharge valve with the seat downstream from the pump and with the plug rotating to the top of the pipeline in the open position.





WRENCH OPERATED PLUG VALVES

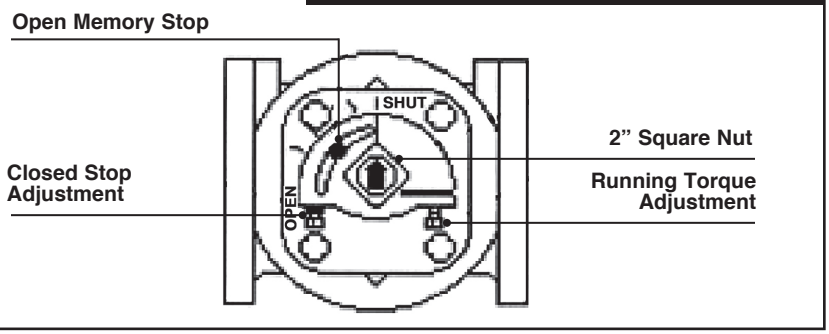
Do not permit use and operation of a Wrench operated eccentric plug valves close by turning the valve 90 degrees clockwise. All wrench operated eccentric valves are equipped with a multifunction device referred to here as a torque collar. This device serves as:

1. Wrench Adapter – 2" Square
2. Position Indicator
3. Open Memory Stop
4. Closed Memory Stop
5. Running Torque Adjustment

Position Indicator: The top of the plug has an indicator plate to show the approximate plug position. Cast onto the torque collar is an indicator mark which corresponds to a graduated scale cast on the bonnet of the valve. This scale is divided into 15 degree lines and indicates the exact valve opening from full open to full closed.

Open Memory Stop: The torque collar also incorporates an open memory stop feature. The plug can be set by tightening the open memory stop adjustment bolt after the correct flow is achieved. The valve can then be closed for maintenance and reopened to the proper position without resetting the flow.

WRENCH OPERATED VALVE WITH TORQUE COLLAR



Closed Memory Stop: The closed memory stop is provided to allow for adjustment to compensate for wear of either the plug coating or the seat. The closed stop is pre-set at the factory and should not require readjustment unless wear occurs.

To adjust the plug for excess plug or seat wear simply rotate the closed stop two turns counter-clockwise then rotate the plug (clockwise) further into the seat and check the flow. Should this movement fail to shut off the flow repeat the above step. Afterward re-set the lock nut to prevent the position from being altered.

Running Torque Adjustment: The nature of eccentric plug valves "camming" action eliminates the majority of the torque prior to seating. To prevent the plug from creeping open or slamming closed, the torque collar maintains a constant drag on the shoulder of the valve bonnet. This component is factory adjusted. However, once the valve has been installed, it is recommended that the torque adjustment nut be further tightened to assure proper friction exists to prevent unwanted closure.

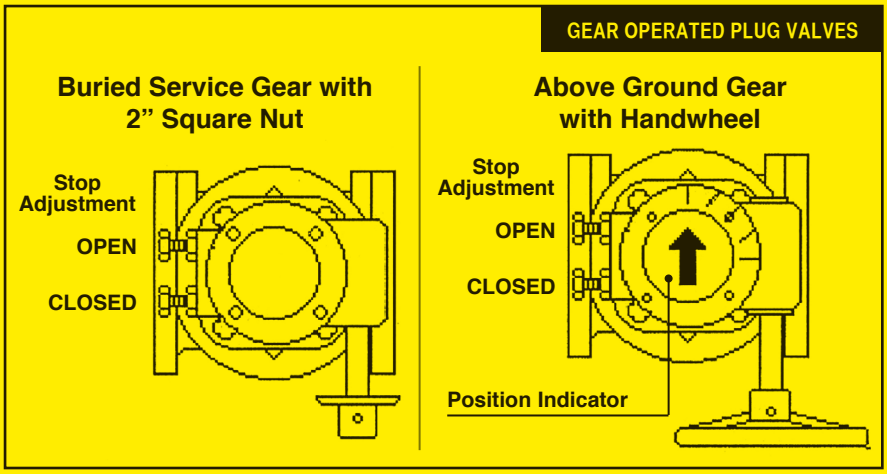
To prevent the plug from unnecessary movement, rotate the hex head bolt clockwise until there is a substantial drag on the plug but not so much as to prevent the movement of the plug with the supplied wrench.

GEAR OPERATED PLUG VALVES

Gear operated eccentric valves close by turning the gear input shaft clockwise until closed.

Position Indicator (above ground units only): The top of the gear operator has an indicator plate to show the plug position. This scale, cast onto the gear housing, is divided into 15 degree lines and indicates the exact valve opening from full open to full closed. Buried service units are totally enclosed and sealed for use below grade.

Open and Closed Memory Stops: The closed memory stop is provided to allow for adjustment to compensate for wear of either the plug coating or the seat. The closed stop is pre-set at the factory and should not require readjustment unless wear occurs.



To adjust the plug for excess plug or seat wear simply rotate the closed stop two turns counterclockwise then rotate the handwheel or nut (clockwise) to move the plug further into the seat and check the flow.

Should movement fail to shut off the flow repeat the above step. Afterward re-set the lock nut to prevent the position from being altered.

~~ACTUATED PLUG VALVES~~

Described below are the operating instructions for an eccentric plug valve equipped with an electric motor actuator. General arrangement drawings are provided in conjunction with this manual to illustrate the fitup and installation of the valve and wiring of the motor. Specific wiring details are contained in the electric motor actuator manual. As with any plug valve, the actuator will cause the valve plug to rotate through 1/4 turn to open or close the valve.

The output motion of the actuator is limited to about 100 degrees of output rotation by mechanical stops in the gearing. These are factory set and should not need adjustment. The actual positioning of the valve plug will be done by limit switches in the motor actuator.

The switches are also set at the factory, but adjustment is sometimes required if the motor unit is installed on a separate mounting base or floor stand. Detailed procedures are given in the motor manual if adjustment is needed for the mechanical stops or the limit switches. The wiring and power requirements are noted on the wiring diagrams included with this instruction manual.

MAINTENANCE

The eccentric valve is designed and manufactured to be a long life valve under normal circumstances. It does not require any routine maintenance. Cycling the valve from full open to full closed on an annual basis will increase the life of the valve and operator components. However, if maintenance is required due to unusual wear or service conditions, the following procedure should be followed:

⚠CAUTION: Valve should be depressurized for all maintenance activities

Disassembly Procedure

Body: The plug valve is a top entry valve; therefore the body can remain in line during this operation.

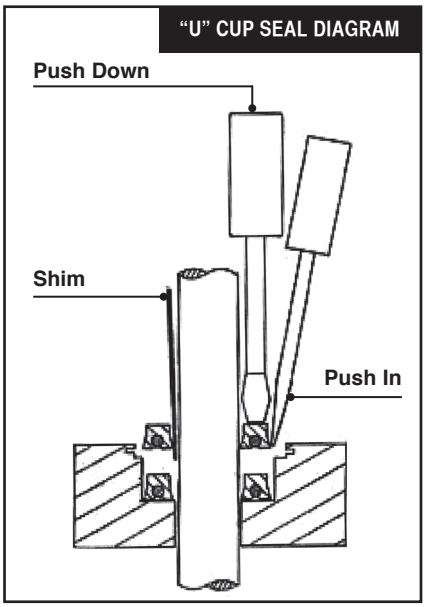
Gear Operated Valves: Remove the bolts holding the gear operator housing cover in place. Remove the housing cover and the internal bolts holding the gear operator to the valve body. Remove the gear operator and set aside.

Wrench Operated Valves: Remove the star washer fastening the torque collar to the plug stem. Remove the torque collar and set aside. With the valve de-pressurized, remove the hexagonal head cap screws that hold the bonnet to the valve body. Remove the bonnet, leaving the plug in the body. At this point, the plug, PTFE thrust washers, journal bearings and bonnet stem seals are accessible and can be removed and replaced.

Reverse the above process for reassembling the valve only. For stem seal replacement follow procedure below.

Stem Seals: With the valve de-pressurized, using internal snap ring pliers, remove the snap ring and thrust washer. The “U” cup seals can now be pried out of the seal cavity. To replace, reverse the above process.

“U” Cup Seals: To replace “U” cup seals on actuated eccentric plug valves, depressurize the valve, remove the actuator, and remove internal bolts fastening the actuator to the valve body. Remove the actuator and set aside. Remove the internal snap ring using snap ring pliers. Remove thrust washer. The “U” cup seals are now visible. Using a screwdriver, pry out the old seals. Apply a small amount of silicone or grease to the new “U” cup seals. This will help them slide in the packing cavity. Put a piece of shim stock into the cavity and put the “U” cup over it. Slide the “U” cup over the stem with shim stock against the stem. This will let any trapped air out of the packing cavity. Now, using two screwdrivers, coax the outer lip of the “U” cup into the cavity while pressing down on the top of the “U” cup with the other screwdriver (see above diagram). Continue to do this all the way around until the “U” cup is at the bottom of the packing cavity.



Repeat the procedure with the second “U” cup, and replace the thrust washer and snap ring. Now you can remount the actuator on the valve.

TROUBLESHOOTING

Wrench Operated Plug Valve

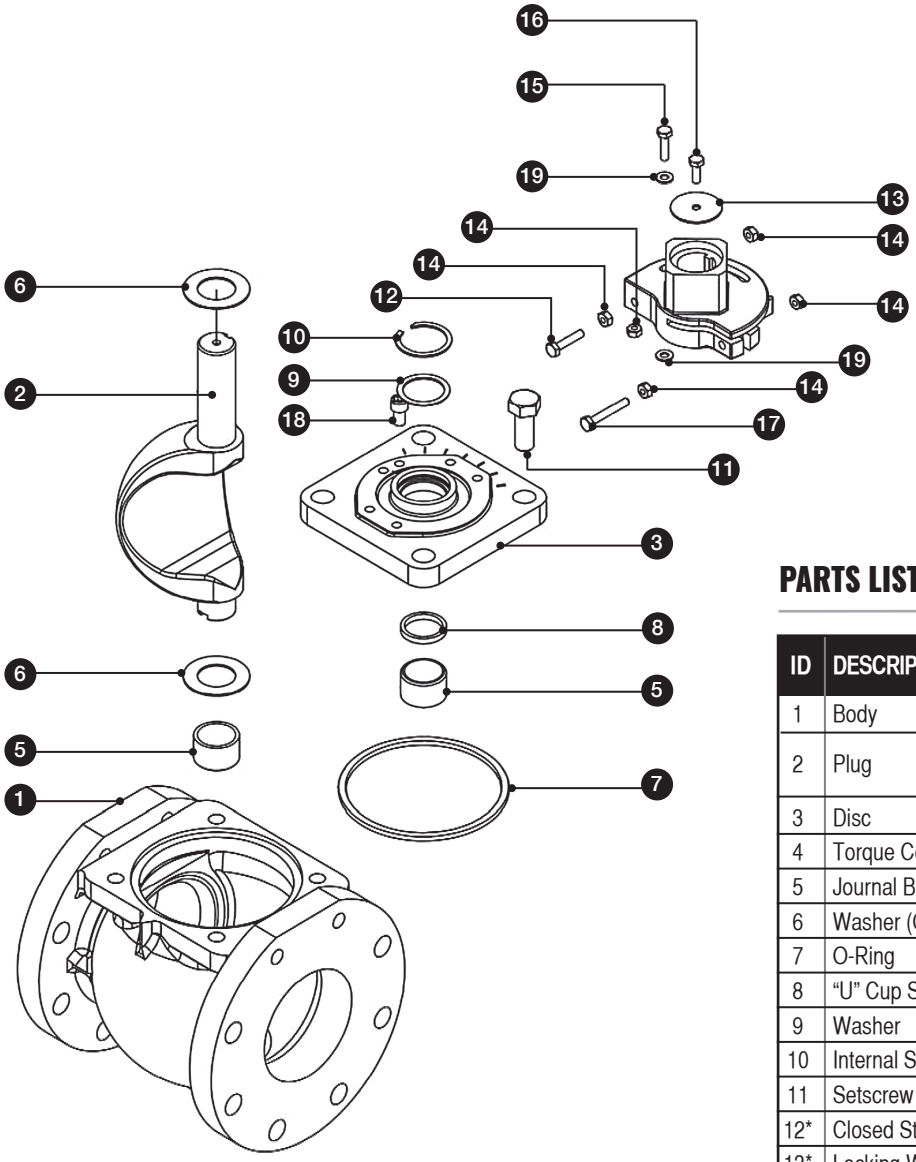
PROBLEM	CAUSE	SOLUTION
Valve will not open	• broken or misadjusted torque collar • obstruction in line • excessive line pressure • elastomer damage	• adjust or replace torque collar • remove obstruction • reduce pressure • replace plug
Valve will not close	• broken or misadjusted torque collar • obstruction in line • excessive line pressure • elastomer damage	• adjust or replace torque collar • remove obstruction • reduce pressure • replace plug
Valve will not shutoff flow	• improper stop adjustment • obstruction in line • excessive line pressure • elastomer damage	• adjust closed stop • remove obstruction • reduce pressure • replace plug
Valve leaks at plug stem	• damaged “U” cup seal	• replace “U” cups

Gear Operated Plug Valve

PROBLEM	CAUSE	SOLUTION
Valve will not open	• bent input shaft • obstruction in line • excessive line pressure • elastomer damage	• replace worn shaft • remove obstruction • reduce pressure • replace plug
Valve will not close	• bent input shaft • obstruction in line • excessive line pressure • elastomer damage	• replace worn shaft • remove obstruction • reduce pressure • replace plug
Valve will not shut off flow	• improper stop adjustment • obstruction in line • excessive line pressure • elastomer damage	• adjust closed stop • remove obstruction • reduce pressure • replace plug
Valve leaks at plug stem	• damaged “U” cup seal	• replace “U” cups

Actuated Plug Valve

PROBLEM	CAUSE	SOLUTION
Valve will not close/open	• no power source • improper signal • burned out or impaired component	• check incoming power source and/or replace fuses • check actuating signal sequence • check and repair or replace motor or relay devices
Valve will not shut off flow	• improper stop adjustment • actuator torques out	• re-set limit switch • check for obstructions in valve



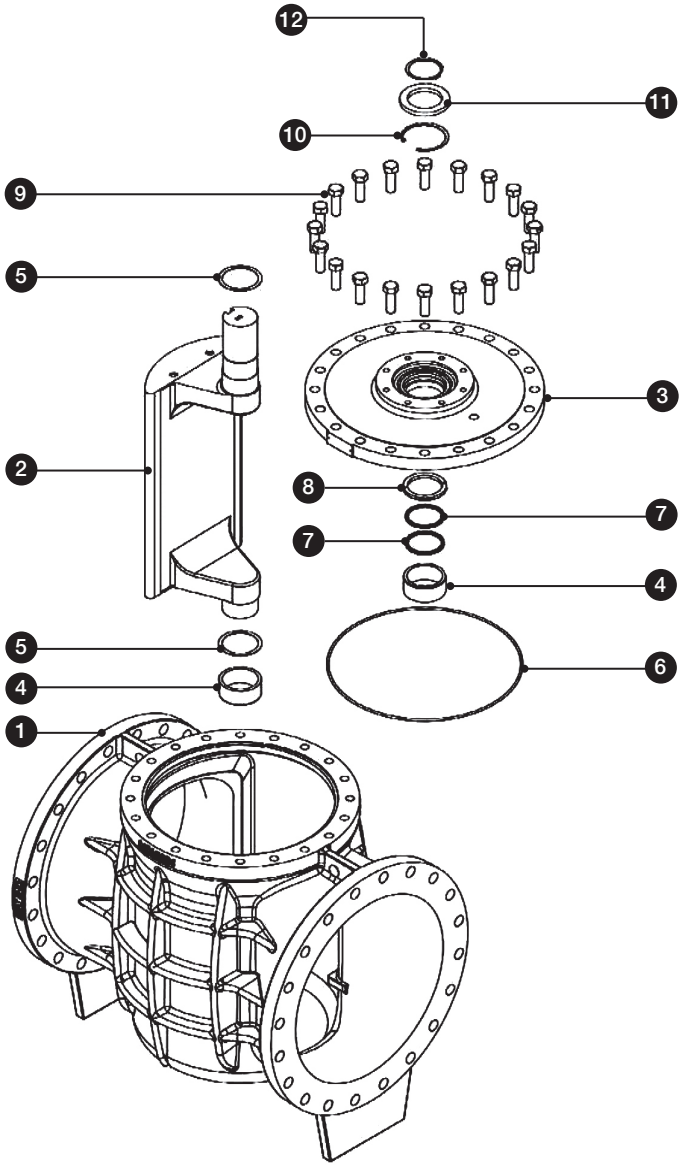
PARTS LIST

ID	DESCRIPTION	MATERIAL
1	Body	Cast Iron ASTM A-126 Class B
2	Plug	Rubber Coated Ductile Iron ASTM A-536
3	Disc	Cast Iron ASTM A-126 Class B
4	Torque Collar	Ductile Iron ASTM A-536
5	Journal Bearing	303 Stainless Steel
6	Washer (Grit Seal)	PTFE
7	O-Ring	Elas. as Spec.
8	“U” Cup Seal	Elas. as Spec
9	Washer	Brass – ASTM B138-675
10	Internal Snap Ring	Spring Steel
11	Setscrew	Steel (Zinc Plated)
12*	Closed Stop	Steel (Zinc Plated)
13*	Locking Washer	Steel
14*	Nut	Steel (Zinc Plated)
15*	Open Stop	Steel (Zinc Plated)
16*	Set Screw	Steel (Zinc Plated)
17*	Torque Bolt	Steel (Zinc Plated)
18*	Travel Stop	Steel
19*	Washer	Steel

*Torque Collar Assembly on 8” and Smaller

TO ORDER: Contact our Parts Department.
Henry Pratt Company
401 South Highland Avenue
Aurora, IL 60506-5563
(630) 844-4000

When ordering parts, please include the serial no. located on the valve tag and the part description.



PARTS LIST

ID	DESCRIPTION	MATERIAL
1	Body	Cast Iron ASTM A-126 Class B
2	Plug	Rubber Coated Ductile Iron ASTM A-536
3	Cap	Cast Iron ASTM A-126 Class B
4	Sleeve Bearing	303 Stainless Steel
5	Washer (Grit Seal)	PTFE
6	Cap O-Ring	Elas. as Spec.
7	"U" Cup Seal	Elas. as Spec.
8	Seal Retaining Ring	(See Note 1)
9	Cap Screw	Steel (Zinc Plated)
10	Internal Snap Ring	Spring Steel
11	Support Collar	Steel
12	Internal Snap Ring	Spring Steel

Notes:
1. Seal Retaining Ring: Brass – ASTM B-138-675 on 14" – 20", Steel on 24" and larger.

TO ORDER: Contact our Parts Department.
Henry Pratt Company
401 South Highland Avenue
Aurora, IL 60506-5563
(630) 844-4000

When ordering parts, please include the serial no. located on the valve tag and the part description.

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

8.2 - Cam-Centric Plug Valve

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

Manual No.
CCPV-OM2-11

Val-Matic® 3” - 72”
Cam-Centric® Plug Valve

Operation, Maintenance and Installation Manual

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VAL-MATIC'S CAM-CENTRIC PLUG VALVE OPERATION, MAINTENANCE AND INSTALLATION

INTRODUCTION

The Cam-Centric® Plug Valve has been designed to give years of trouble-free operation. This manual will provide you with the information to properly install and maintain the valve to ensure a long service life. The valve is an eccentric, resilient seated, quarter-turn plug valve capable of handling many types of fluids including fluids with suspended solids. The Size, Cold Working Pressure (CWP), Actuator Rating, and Model No. are stamped on the nameplate for reference.

CAUTION

Do not use valve for line testing at pressures higher than nameplate rating or leakage and damage to valve may occur.

The "Cold Working Pressure" is the non-shock pressure rating of the valve at 150ºF. The valve is not intended as a block valve for line testing above the valve rating. The “Actuator Rating” is the pressure that was used to size the actuator for operating conditions and may be less than the “Cold Working Pressure”. Because the valve is eccentric, the valve may have a different actuator rating for reverse and direct pressure. If the valve is operated at pressures higher than the actuator ratings, the valve may be difficult to operate or leak.

RECEIVING AND STORAGE

Inspect valves upon receipt for damage in shipment. Unload all valves carefully to the ground without dropping. Do not lift valves with slings or chains around the actuator or through the seat area.

Valves should remain crated, clean and dry until installed to prevent weather-related damage. For long term storage greater than six months, the valve must remain open and the rubber surfaces of the plug coated with a thin film of FDA approved grease such as Dow Corning # 7. Do not expose plug to sunlight or ozone for any extended period.

DESCRIPTION OF OPERATION

As shown in Figure 2, the valve consists of a body and quarter-turn plug that is offset from the seat centerline.

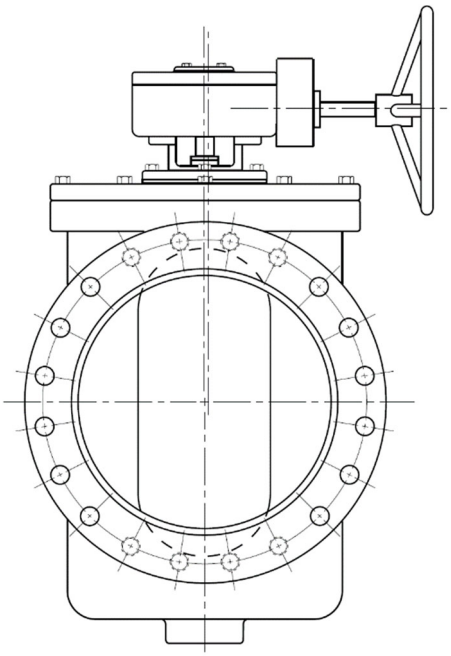

FIGURE 1. PLUG VALVE WITH GEAR ACTUATOR

The eccentric offset causes the plug to lift and rotate off the seat simultaneously to reduce seat friction and wear during operation. Direct Pressure pushes the plug into the seat and Reverse Pressure pushes the plug away from the seat. The valve can be operated with a direct nut, lever, or gear actuator. The gear actuator as shown in Figure 1 requires multi-turn input on a 2” square nut, handwheel, or chainwheel. The valve can also be automated with power actuators such as an electric motor or hydraulic cylinder.

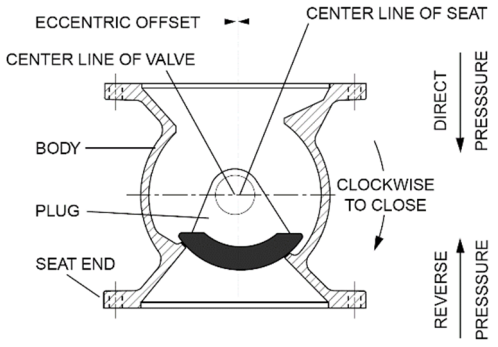

FIGURE 2. PLUG VALVE TERMS

VALVE CONSTRUCTION

The standard Cam-Centric® Plug Valve is constructed of rugged cast iron with a welded nickel seat and permanently lubricated bearings. See the specific Materials List submitted for the order if other than standard cast iron construction. The details of construction are illustrated in Figure 3.

The body (1) is available with flanged or mechanical joint ends for connection to the pipeline. The valve is designed to be serviced in-line by removing the cast cover (2). The quarter-turn plug (3) is guided by sleeve bearings (6) located in the cover and lower boss in the body. Grit-Guard seals (21) are located at the bottom of the bearings (6) to prevent abrasive material from wearing the bearing. Leak-tight closure is made when the rubber-coated plug (3) is rotated into the nickel seat on the "SEAT END" of the body.

Table 1. Standard Plug Valve Parts List

Item	Description	Material
1	Body	Cast Iron with Overlay Welded Nickel Seat
2	Cover	Cast Iron
3	Plug*	Cast Iron with Resilient Facing
4	Key	Carbon Steel
6	Bearings*	316 Stainless Steel
7	V-Type Packing*	Buna-N
8	Cover Seal*	Buna-N
12**	Bottom Cover Seal*	Buna-N
14**	Bottom Cover Bolts	Alloy Steel, Gr. 5
15**	Bottom Cover	Cast Iron
16	Cover Bolt	Alloy Steel, Gr. 5
17	Washer	Carbon Steel
18	Packing Follower	Cast Iron
19	Follower Bolt	Alloy Steel, Gr. 5
21	Grit-Guard*	Buna-N
22	Thrust Bearing*	Teflon
23	Thrust Bearing*	316 Stainless Steel
24	Key	Carbon Steel
29	Shims	304 Stainless Steel
*Items available in spare parts kit		
**42" & Larger		

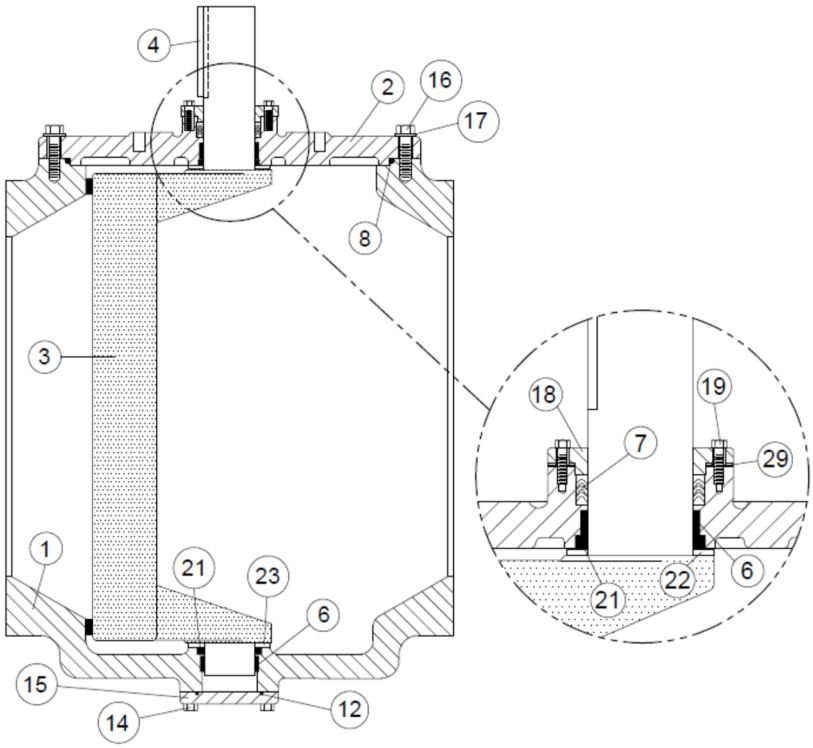

FIGURE 3. STANDARD PLUG VALVE CONSTRUCTION

INSTALLATION

The installation of the valve is important for its proper operation. The valve is capable of flow in either direction but the maximum operating pressure can vary with the location of the seat end (Figure 4). The words “SEAT END” are marked on the valve flange. Actuators are available for pressures up to the full rating in both direct and reverse pressure orientations. Actuator ratings will be indicated on the nameplate. Higher operating pressures may require adjustment of the closed position stop or a larger actuator; consult the factory.

SUSPENDED SOLIDS SERVICE: For fluids containing suspended solids, special orientations are needed to prevent debris from collecting in the valve. For horizontal installations (Figure 5), the valve should be installed with the flow entering the seat end of the valve and the shaft in a horizontal position with the plug up when open. For vertical installations (Figure 6), the valve must be installed with the seat end up regardless of flow direction.

CLEAN SERVICE: For both horizontal and vertical installations, install in the direct pressure orientation (pressure opposite the seat end).

AIR AND GAS SERVICE: Install valve in the direct pressure orientation (pressure opposite the seat end). Lubricate plug face with FDA approved silicone grease such as Dow Corning #7 before installation. Gear actuators are required for gas service applications.

PUMP DISCHARGE SERVICE: On all horizontal pump discharge applications (Figure 7), the seat end should be towards the pump.

BURIED SERVICE: Gear actuators are recommended for buried valves to hold the valve in position and provide multi-turn closure to prevent water hammer. The valve should be installed with the shaft horizontal and the actuator nut directed upwards. The valve box or extension pipe should be installed so that the actuator nut and extension stem turn freely.

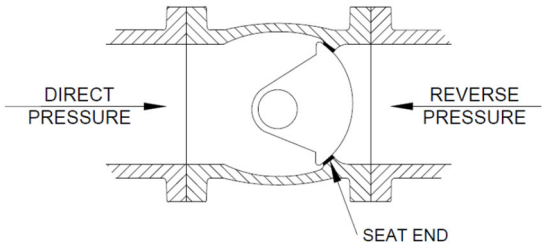

FIGURE 4. INSTALLATION ORIENTATION

NOTE: Adjust and test valve prior to backfill.

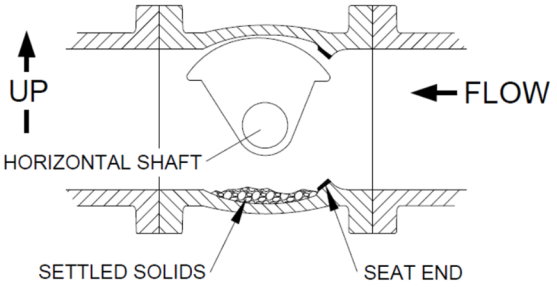

FIGURE 5. HORIZONTAL PIPE WITH SOLIDS

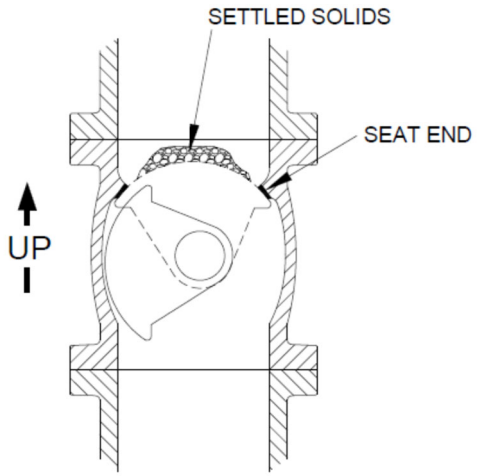

FIGURE 6. VERTICAL PIPE WITH SOLIDS

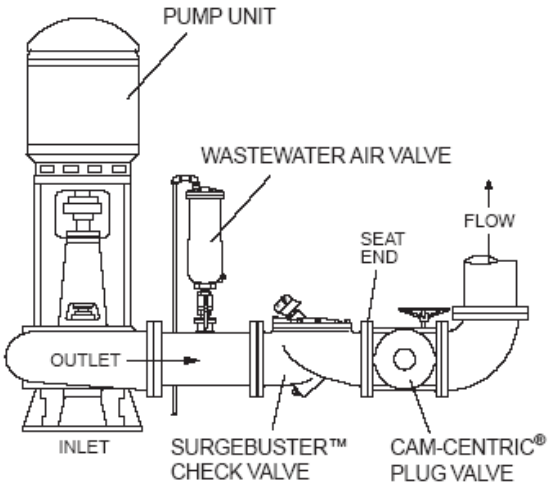

FIGURE 7. PUMP DISCHARGE SERVICE

FLANGED ENDS: Flanged valves should be mated with flat-faced pipe flanges equipped with resilient gaskets. When ring gaskets are used, the bolt material should be ASTM A307 Grade B of SAE Grade 2 Carbon Steel. Higher strength bolts may only be used with full-face gaskets.

The valve and adjacent piping must be supported and aligned to prevent cantilevered stress on the valve. Lower valve into line using slings or chains around the valve body. Lubricate the flange bolts or studs and insert them around the flange. Lightly turn bolts until gaps are eliminated.

The torquing of the bolts should then be done in graduated steps using the cross-over tightening method. Recommended lubricated torques for use with resilient gaskets (75 durometer) are given in Table 2. If leakage occurs, allow gaskets to absorb fluid and check torque and leakage after 24 hours. Do not exceed bolt rating or crush gasket more than 50 percent of its thickness.

Table 2. Flange Bolt Torques

Valve Size (in)	Bolt Dia (in)	Recom Torque (ft-lbs)	Max Torque (ft-lbs)
3	5/8	25	100
4	5/8	25	100
6	3/4	30	150
8	3/4	40	150
10	7/8	45	200
12	7/8	65	200
14	1	80	300
16	1	90	300
18	1 1/8	100	425
20	1 1/8	120	425
24	1 ¼	150	600
30	1 ¼	175	600
36	1 ½	175	1000
42	1 ½	200	1000
48	1 ½	250	1000
54	1 ¾	300	1500
60	1 ¾	350	1500
66	1 ¾	400	1500
72	1 ¾	400	1500

CAUTION
The use of raised-face flanges or excessive bolt torque may damage valve flanges.

MECHANICAL JOINT ENDS: Clean ends of mating pipe and valve sockets with soapy water (Figure 8). Place lubricated gasket and retainer gland over pipe end prior to installing valve. Install valve socket over pipe. Press gland and gasket toward valve until gasket is evenly set into valve socket.

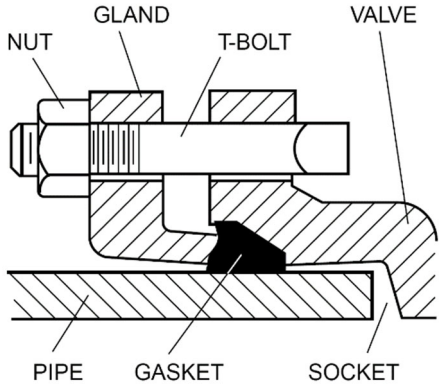

FIGURE 8. MECHANICAL JOINT INSTALLATION

Insert T-bolts in valve flange and hand tighten nuts. Torque nuts in four graduated steps using the cross-over tightening method without exceeding the torque listed in Table 3. Maintain an equal gap between the gland and the face of the valve at all points around the socket.

If a tight connection is not achieved, then the joint should be disassembled, thoroughly cleaned, and reassembled. Over-tightening may cause damage to the valve or gland.

Table 3. Mechanical Joint Nut Torques

Valve Size (in)	T-Bolt Dia (in)	Recom Torque (ft-lbs)	Max Torque (ft-lbs)
3	5/8	45	60
4	3/4	75	90
6	3/4	75	90
8	3/4	75	90
10	3/4	75	90
12	3/4	75	90
14	3/4	75	90
16	3/4	75	90
18	3/4	75	90
20	3/4	75	90
24	3/4	75	90
30	1	75	120
36	1	75	120
42	1 ¼	75	150
48	1 ¼	75	150

DIRECT NUT OPERATED VALVES: 8” and smaller valves may be equipped with a top-mounted nut for direct quarter-turn operation. The nut is 2” square to fit most valve wrenches and is mounted directly to the valve plug. To open the valve, slowly rotate the nut 90 degrees in the counter-clockwise (CCW) direction. The closed position is adjusted with a set screw and lock nut, see Figure 9. The open position can be adjusted by moving the bolt along the curved slot.

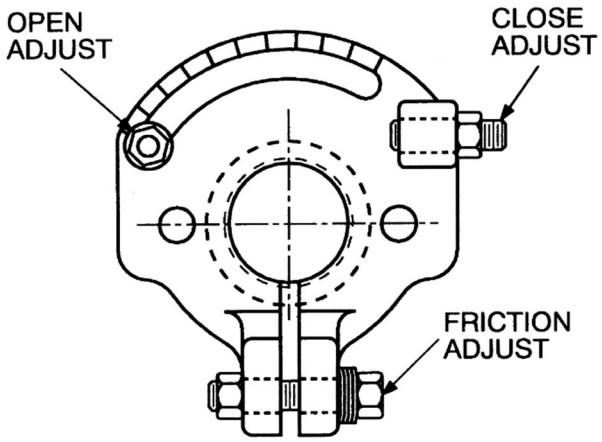

FIGURE 9. DIRECT NUT ADJUSTMENTS

DIRECT NUT FRICTION ADJUSTMENT: As shown in Figure 10, valves with direct nut actuators have a flanged packing follower (18) above the packing (7) to hold the valve in the open or closed position. If the valve is difficult to operate or does not maintain its set position, adjust the clamp bolt (17) to provide sufficient friction to hold the valve in position. If the valve is equipped with a hand lever, the setting should allow the valve to be operated with about 80 pounds of force on the end of the pipe handle.

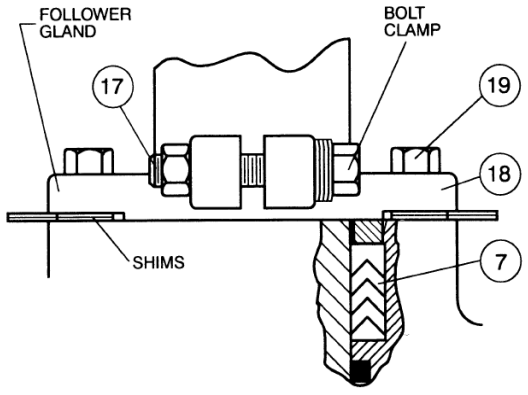

FIGURE 10. FRICTION ADJUSTMENT

LEVER OPERATED VALVES: A wrench head and lever (Figure 11) are available for use over the 2” nut for direct quarter-turn operation. Various lever lengths are available for specific direct and reverse pressure conditions as shown in Table 4.

Table 4. Application of Levers

Wrench Length, (Inches)				
Valve Size	Direct Pressure		Reverse Pressure	
	100 psi	175 psi	50 psi	175 psi
2 ½	22	22	22	22
3	22	22	22	22
4	22	22	22	22
6	44	*	44	*
8	44	*	44	*
* Worm gear recommended due to operating torque				

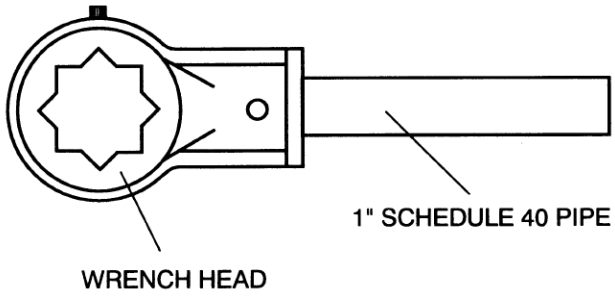

FIGURE 11. HANDLEVER

The wrench head is placed over the nut and can be secured with the set screw provided. To open the valve, rotate the lever 90 degrees in the CCW direction. The closed position is adjustable with a set screw and lock nut mounted below the nut, see Figure 9.

CAUTION
Open and close the valve slowly to prevent water hammer.

GEAR OPERATED VALVES: 4” and larger plug valves are available with a multi-turn manual gear actuator. The gear unit has a self-locking worm gear which multiplies the turning force on the handwheel or nut so that the valve can be operated with ease. A clamp-on chainwheel kit can also be used for installations high above the floor. An indicator on the top of the actuator housing indicates the position of the valve plug. The handwheel or nut must be rotated through 12-80 turns (depending on model) to open or close the plug valve. The direction of rotation to open the valve is indicated on the 2” square actuator nut.

GEAR ACTUATOR ADJUSTMENT: The standard gear actuator is provided with factory-set open and closed position stops. If the valve does not shut off tight, the stop bolt can be adjusted allowing the plug to rotate further into the seat. Loosen the locknut and turn the closed stop bolt CCW 1 turn at a time (Figure 12). If the valve continues to leak after all the adjustment is taken verify the orientation of the valve during installation. If a tight shut-off cannot be achieved, a larger gear actuator may be required for the system operating pressure; consult the factory.

CAUTION

Adjust closed stop bolt for tight shut-off only. Over adjustment may cause high operating torques and damage to the plug.

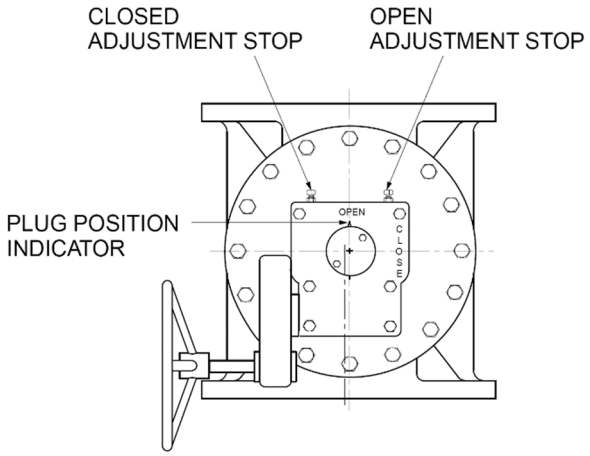

FIGURE 12. GEAR ACTUATOR ADJUSTMENT

MAINTENANCE

The Cam Centric® Plug Valve requires no scheduled lubrication or maintenance other than regular exercising and occasional inspection of the plug. The exercising is achieved by fully opening and closing the valve to verify smooth operation. If operation is difficult, it may be necessary to flush sediment from the valve by opening and closing the valve several times under flowing conditions.

CAUTION

Open and close the valve slowly to prevent water hammer.

The recommended interval for exercising is every six months or annually if the valve is regularly operated. Over the life of the valve, inspection and some regular adjustments may be needed as given below.

For valves in air service, apply a thin film of FDA silicone grease such as Dow Corning #7 to the exposed rubber surface once per year.

CLOSED POSITION ADJUSTMENT: The standard valve is factory-set to seal at the “Actuator Pressure Ratings” shown on the nameplate for direct and reverse pressure directions (see Figure 2). Higher pressure applications may require adjustment of the closed position stop or a larger actuator; consult the factory.

If the valve is found to leak in the closed position due to wear, the plug can be adjusted by loosening the closed position stop on the actuator and rotating the plug further into the seat. Because of the eccentric action of the valve, further rotation will provide additional interference between the rubber plug surface and the body seat. Valves that have been in service for several years may require inspection of the plug for damage or wear. See the Disassembly Instructions of this manual.

PACKING ADJUSTMENT: V-type packing is pressure sensitive and therefore self-adjusting in nature. Over tightening will destroy both the pressure sensitive nature of the packing as well as its sealing capabilities. The packing configuration used in Cam-Centric Plug Valves follows the guidelines and recommendations of V-packing manufacturers.

Additional adjustment can be achieved by removing one or more shims found under the packing follower (18). If a leak develops, remove one shim (29) from the underside of the follower (18). An equal number of shims must be removed from both the left- and right-hand sides. Re-tighten the follower bolts (19) and check for leakage. If the leakage continues, remove additional shims or replace the packing.

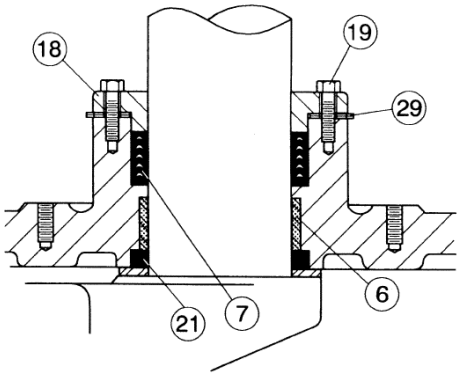

FIGURE 13. PACKING ASSEMBLY

PACKING REPLACEMENT: To replace the packing (7), it is recommended that the line be drained and the actuator removed. The valve can remain in the line. To replace the packing, first open the valve and drain the line. Close the valve to hold it in position. For power actuators, turn off and lock out electrical and hydraulic supplies before proceeding.

CAUTION

Drain line and close valve before removing actuator or valve may rotate suddenly. Take precautions against exposure to toxic or hazardous fluids in the line.

Remove the small round cover on actuator to expose shaft and key. Remove actuator mounting bolts and lift actuator from valve taking care not to lose square key. See Figure 13 and remove gland bolts (19) and lift follower (18) from the valve shaft. Remove old packing (7) with packing hook. Lubricate new packing with FDA grease and set in place one ring at a time taking care not to bend over the lips of the packing rings. Reinstall follower with 2 shims (29) per bolt (3 shims for 12" and larger valves). With valve in the closed position, place the actuator over valve and reinsert key (24). Finally, reinstall cover on actuator indicating "Closed".

CAUTION

If packing assembly contains clamp style follower as shown in Figure 9 do not lubricate shaft or sleeve.

PACKING REPLACEMENT WITH ACTUATOR: The above procedure with removal of the actuator will result in the most reliable shaft seal. But if the actuator cannot be removed, the following alternate procedure can be followed. To prevent the possibility of leakage during this procedure, open valve and drain the line.

CAUTION

Take precautions against exposure to toxic or hazardous fluids in the line.

Referring to Figure 13, remove follower bolts (19) and side follower (18) up to actuator. Remove packing adapters and rings (7) with packing hook. Cut rings with knife to remove. New packing rings should be cut at a 45-degree slope to allow insertion around the shaft and provide some overlap. Install rings one at a time with the tips down toward the valve. Stagger all joints 180 degrees around the shaft. Pull down follower (18) and reinsert bolts (19) with 2 shims (29) under follower (18). V-packing is pressure assisted and only requires light compression.

GEAR ACTUATOR MAINTENANCE: A typical gear actuator is shown in Figure 14 and consists of a worm (3) mounted on an input shaft (9). The worm engages a worm wheel (2). When the worm is turned, it drives the wheel through 90° of rotation. The rotation of the valve plug is displayed by the top indicator (5). The open and closed positions of the segment gear are controlled by an end position stop bolts (20). The stops can be adjusted by loosening the lock nut (21) and rotating the bolts. The gears are lubricated with EP2 grease in a cast iron housing (1). Other parts are listed in Table 5.

The gear box is factory lubricated and sealed. No regular maintenance is required. If difficult operation is observed, the cover (4) can be removed and the unit inspected for wear. All moving parts should be coated with grease. The grease should have an even and smooth consistency. If needed, coat all moving parts with a lithium-based EP-2 grease such as Shell Alvania #2 or equal. Buried units should be packed 90% with grease.

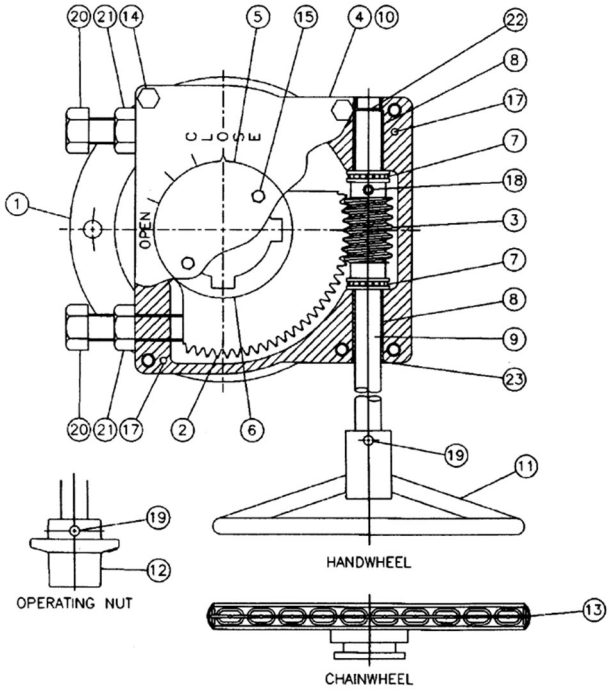

FIGURE 14. GEAR ACTUATOR CONSTRUCTION

Table 5. Gear Actuator Parts List		
Item	**Description**	**Material**
1	Housing	Cast Iron
2	Wormwheel	Ductile Iron
3	Worm	Steel
4	Cover	Cast Iron
5	Indicator	Cast Iron
6	O-Ring	Buna-N
7	Roller Bearing	Steel
8	Shaft Bearing	Bronze
9	Shaft	Steel
10	Gasket	Fiber
11	Handwheel	Steel or Iron
12	Operating Nut	Iron
13	Chainwheel	Iron
14	Cover Bolt	Steel
15	Indicator Bolt	Steel
16	Pipe Plug	Steel
17	Pin	Steel
18	Spirol Pin	Steel
19	Spring Pin	Steel
20	Screw	Steel
21	Jam Nut	Steel
22	Plug	Steel
23	U-Cup Seal	Buna-N

TROUBLESHOOTING

Several problems and solutions are presented below to assist you in troubleshooting the valve assembly in an efficient manner.

- Leakage at Valve Shaft: Adjust or replace packing.
- Leakage at Flanges: Tighten flange bolts, replace gasket.
- Valve Leaks when Closed: Pressure should be in the direction of pushing the plug into the seat. Adjust plug position by rotating the handwheel. Inspect plug for damage and replace.
- Hard to Open: Flush debris from valve. Check interior of valve for grit buildup or debris. On buried valves, check alignment of operating stem.
- Leaking Oil: Tighten actuator cover bolts. If leak persists, remove actuator cover, inspect grease, and replace actuator gasket.
- Noisy Operation: Flow noise is normal. Loud flow noise similar to hammering may be cavitation from dropping high pressures across valve, review application of valve. For gear actuator noise, inspect grease; add new grease if there are uncoated moving parts or grease has broken down into oil.

DISASSEMBLY

Disassembly may be required to inspect the plug for wear or remove debris and deposits from the valve. Work on the valve should be performed by a skilled mechanic with proper tools and a power hoist for large valves. The valve can be disassembled without removing the valve from the pipeline. Refer to Figure 15 for valve construction and parts.

WARNING

Open valve and drain line before removing cover bolts or pressure may be released causing injury. Place plug in lowest position before removing actuator or plug may rotate suddenly and jam or damage plug surface.

1. Open valve and drain the pipeline. Close valve until plug just touches the seat. Remove the small cover on the actuator to expose the shaft key (4).
2. Remove the actuator mounting bolts and lift actuator from valve taking care not to lose key (4).
3. Remove cover bolts (16). Matchmark cover (2) and body (1). Screw eyebolts into actuators mounting holes and use hoist to lift cover (2) and plug assembly (3) from valve. Use caution to prevent plug from dropping while lifting cover. To remove plug from valve, use sling around top portion of plug.
4. Remove bottom cover bolts (14). Remove bottom cover (15) and seal (12) (42” and larger).
5. Inspection of the bearings (6) is done by measuring diameter of shaft and inside diameter of bearing. Check for a normal running clearance of .005". Bearings are permanently lubricated.
6. Remove packing gland hex bolts (19). Remove packing set (7) and packing gland (18).

REASSEMBLY

All parts must be cleaned and gasket surfaces should be cleaned with a stiff wire brush in the direction of the serrations or machine marks. Worn parts, gaskets and seals should be replaced during reassembly. Parts 12, 14, and 15 only appear on valves 42” and larger.

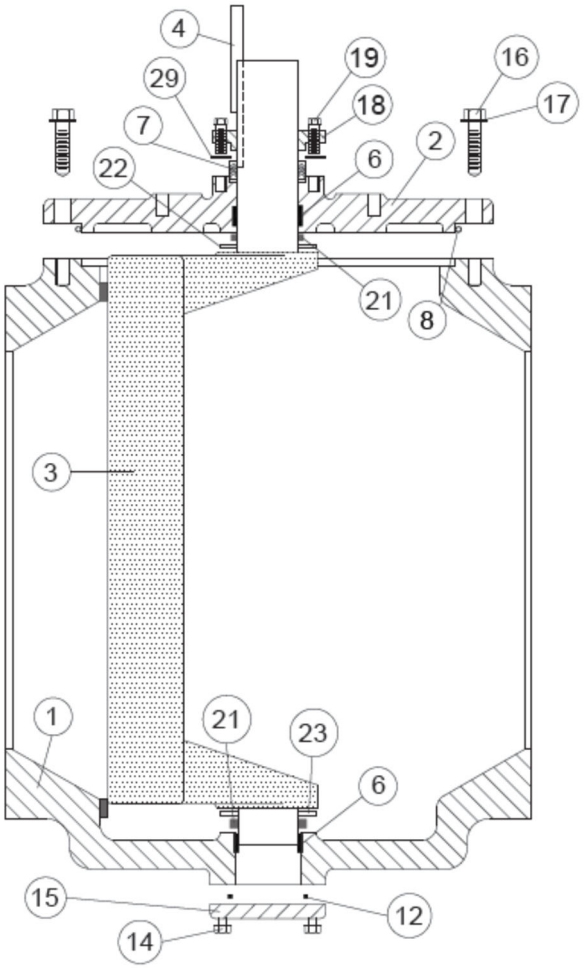

FIGURE 15. PLUG VALVE PARTS

1. Press new bearings (6) into cover and body with round, flat bar 1/4" below inside surfaces of body (1) and cover (2).

2. Install new cover seal (8) over cover lip (42” and larger) and new bottom cover seal (12) in bottom cover (15) groove.

3. Apply thin film of FDA silicone grease such as Dow Corning #7 to plug rubber surface. Place stainless steel thrust bearing (23) over lower shaft of plug, Teflon bearing (22) over the upper shaft. Install grit seals (21) over the shafts of the plug.

4. Carefully place plug into the body (1) and insert lower plug shaft into bottom bearing (6). Plug (3) should be in the open position. Install cover (2) over plug shaft and into recess in body. Align match marks between body and cover (2). Torque cover bolts (14 & 16) per Table 6 in 3-4 increments using the cross-over tightening method. Repeat for bottom cover.

Table 6. Tightening Torques	
Size	**Torque (ft-lbs)**
½” - 13	45-75
5/8” - 11	100-150
¾” – 10	150-250
7/8” – 9	200-350
1” – 8	300-500
1 1/8” - 7	450-700
1 ¼” - 7	650-1000
1 ½” - 6	750-1100
1 ¾” – 5	1650-2350
2”-4-1/2	2350-3350

5. Lubricate ID and OD of new packing set (7) with FDA grease and install in packing bore one ring at a time taking care to keep lips pointing down toward plug. Reinstall follower (18), gland bolts (19), and 2 shims per bolt (29).

   NOTE: If valve has friction assembly with direct nut actuator, follow “Friction Adjustment” procedure on page 6.

6. Insert key (4) into shaft and place actuator over valve. Reinstall actuator mounting bolts and torque per Table 6. Install cover on actuator.

7. Apply power to actuator and cycle valve. Apply pressure to valve and check for cover and shaft leakage. Tighten bolts as necessary. Adjust packing if necessary.

8. If valve does not shut off tight, adjust the closed position stop as described on page 6 under “Closed Position Adjustment.”

PARTS AND SERVICE

Parts and service are available from your local representative or the factory. Make note of the valve Size, Series No, and Serial No. located on the valve nameplate and contact:

Val-Matic Valve and Mfg. Corp.
905 Riverside Drive
Elmhurst, IL 60126
Phone: (630) 941-7600
Fax: (630) 941-8042
www.valmatic.com

A sales representative will quote prices for parts or arrange for service as needed.

LIMITED WARRANTY

All products are warranted to be free of defects in material and workmanship for a period of one year from the date of shipment, subject to the limitations below.

If the purchaser believes a product is defective, the purchaser shall: (a) Notify the manufacturer, state the alleged defect and request permission to return the product; (b) if permission is given, return the product with transportation prepaid. If the product is accepted for return and found to be defective, the manufacturer will, at his discretion, either repair or replace the product, f.o.b. factory, within 60 days of receipt, or refund the purchase price. Other than to repair, replace or refund as described above, purchaser agrees that manufacturer shall not be liable for any loss, costs, expenses or damages of any kind arising out of the product, its use, installation or replacement, labeling, instructions, information or technical data of any kind, description of product use, sample or model, warnings or lack of any of the foregoing. NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF FACT, PROMISE, DESCRIPTION OF PRODUCT OF USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF THE MANUFACTURER. These products are not manufactured, sold or intended for personal, family or household purposes.

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

8.3 - Swing Flex Check Valve

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

Manual No.
SFCV-OM1-14

Swing-Flex® Check Valve

Operation, Maintenance and Installation Manual

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VAL-MATIC® VALVE AND MANUFACTURING CORP.

905 Riverside Dr. • Elmhurst, IL 60126
Phone (630) 941-7600 • Fax (630) 941-8042
www.valmatic.com

VAL-MATIC'S SWING-FLEX® CHECK VALVE OPERATION, MAINTENANCE AND INSTALLATION

INTRODUCTION

The Swing-Flex® Check Valve has been designed to give years of trouble-free operation. This manual will provide you with the information needed to properly install and maintain the valve and to ensure a long service life. The valve is opened by the fluid flow in one direction and closes automatically to prevent flow in the reverse direction.

An optional backflow actuator may be mounted on the bottom of the valve to allow manual backflow through the valve in the reverse direction.

Optional Mechanical Indicators and Limit Switches may be mounted on the valve cover to provide local and remote position indication.

An oil dashpot may be mounted on the bottom of 6" and larger valves to provide slow closure over the last 10% of travel.

The valve is of the swing check type utilizing an angled seat and fully encapsulated, resilient disc. It is capable of handling a wide range of fluids including flows containing suspended solids. The Size, Flow Direction, Maximum Working Pressure, and Series No. are stamped on the nameplate for reference.

CAUTION

Do not use valve for line testing at pressures higher than nameplate rating or damage to valve may occur

The "Maximum Working Pressure" is the non-shock pressure rating of the valve at 150°F. The valve is not intended as an isolation valve for line testing above the valve rating.

RECEIVING AND STORAGE

Inspect valves upon receipt for damage in shipment. Unload all valves carefully to the ground without dropping. Do not allow lifting slings or chains to come in contact with the seat area; use eyebolts or rods through the flange holes on large valves.

WARNING

Do not use threaded holes in cover for lifting the valve. Serious injury may result.

Valves should remain crated, clean and dry until installed to prevent weather related damage. For long term storage greater than six months, the rubber surfaces of the disc should be coated with a thin film of FDA approved grease. Do not expose disc to sunlight or ozone for any extended period.

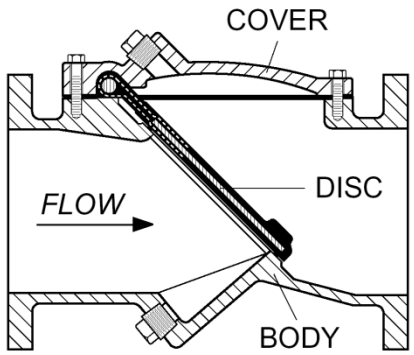


FIGURE 1. SWING FLEX® CHECK VALVE

DESCRIPTION OF VALVE OPERATION

The valve is designed to prevent reverse flow automatically. During system flow conditions, the movement of the fluid forces the disc to the open position allowing 100% un-restricted flow area through the valve. Under reverse flow conditions, the disc automatically returns to the closed position to prevent reverse flow.

Several optional features are a backflow actuator, mechanical indicator, limit switch and bottom oil dashpot. All of these options ship loose of the valve and require field installation.

INSTALLATION

Correct installation of the Swing-Flex® is important for proper operation. It may be installed in either horizontal or vertical flow-up applications. However, when horizontal, the valve must be installed with the nameplate facing up and the cover level. In all installations, the flow arrow cast in the valve cover must be pointed in the direction of flow during normal system operation.

WARNING

Do not use threaded holes in cover for lifting the valve. Serious injury may result.

FLANGED ENDS: Flanged valves should only be mated with flat-faced pipe flanges equipped with full-face resilient gaskets. The valve and adjacent piping must be supported and aligned to prevent cantilevered stress on the valve. Once the flange bolts or studs are lubricated and inserted around the flange, tighten them uniformly hand tight. The tightening of the bolts should then be done in graduated steps using the **crossover tightening** method. Recommended lubricated torque values for use with resilient gaskets (75 durometer) are given in Table 1. If leakage occurs, allow gaskets to absorb fluid and check torque and leakage after 24 hours. Do not exceed bolt rating or extrude gasket.

CAUTION

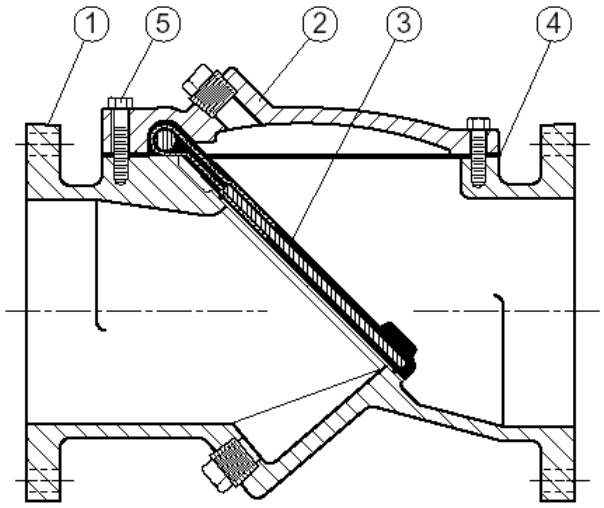
The use of ring gaskets or excessive bolt torque may damage valve flanges.

Table 1. Flange Bolts Torques

Valve Size (in)	Bolt Dia (in)	Recom. Torque (ft-lbs)	Max Torque (ft-lbs)
3	5/8	25	90
4	5/8	25	90
6	3/4	30	150
8	3/4	40	150
10	7/8	45	205
12	7/8	65	205
14	1	80	300
16	1	80	300
18	1 1/8	100	425
20	1 1/8	100	425
24	1 1/4	150	600
30	1 1/4	160	600
36	1 1/2	300	900
42	1 1/2	300	900
48	1 1/2	300	1000

VALVE CONSTRUCTION

The standard Swing-Flex® Check Valve is constructed of rugged cast iron with a rubber encapsulated disc. See the specific Materials List submitted for the order if other than standard cast iron construction. The disc is the only moving part assuring long life with minimal maintenance. The general details of construction are illustrated in Figure 2. The body (1) is flanged for connection to the pipeline with an open top sealed with a cast cover (2). The disc (3) is retained by the cover.



Item	Description	Material
1	Body	Ductile Iron – 250 psi Cast Iron – 150 psi
2	Cover	Ductile Iron – 250 psi Cast Iron – 150 psi
3	Disc*	Steel with Buna-N Facing
4	Cover Seal*	Buna-N or Non-Asbestos
5	Cover Bolt	Alloy Steel
*Recommended Spare Part		

FIGURE 2. CHECK VALVE CONSTRUCTION

MAINTENANCE

The Swing Flex® Check Valve requires no scheduled lubrication or maintenance. For service or inspection, the valve can be serviced without removal from the line.

VALVE INSPECTION: If inspection of the valve is required, follow the Disassembly Instructions given on page 3.

TROUBLESHOOTING

Several problems and solutions are presented below to assist you in troubleshooting the valve assembly in an efficient manner.

- Leakage at Bottom Actuator: Remove line pressure and exercise actuator. If leak persists, replace seals in actuator; see the Backflow Actuator Seal Replacement Procedure on page 4.

- Leakage at Cover or Flanges: Tighten bolts, replace cover seal.

- Valve Leaks when Closed: Inspect disc for damage and replace. Inspect metal seating surface and clean if necessary.

- Valve Does not Open: Check for obstruction in valve or pipeline; see Disassembly procedure on page 4. Operating pressure may be less than cracking pressure. If less than 0.5 psig, review application with factory.

DISASSEMBLY

The valve can be disassembled without removing it from the pipeline. Or for convenience, the valve can be removed from the line. All work on the valve should be performed by a skilled mechanic with proper tools and a power hoist for larger valves. Disassembly may be required to inspect the disc for wear or the valve for deposits.

WARNING

The line must be drained before removing the cover or pressure may be released causing bodily harm.

1. Relieve pressure and drain the pipeline. Refer to Figure 2 on page 2. Remove the cover bolts (5) on the top cover.

2. Pry cover (2) loose and lift off valve body. 12" and larger valves have tapped holes in cover for lifting eyes.

3. Remove disc (3) and inspect for cracks, tears or damage in rubber sealing surface.

4. Clean and inspect parts. Replace worn parts as necessary and lubricate parts with FDA grease.

RE-ASSEMBLY

All parts must be cleaned. Gasket surfaces should be cleaned with a stiff wire brush in the direction of the serrations or machine marks. Worn parts, gaskets and seals should be replaced during reassembly.

1. Wipe clean and dry the seating surface on the body (1). Apply a coating of compatible (food grade) grease to the sealing bead on the disc (3). Lay disc (3) over seat with beaded seating surface directed down.

2. Lay cover gasket (4) and cover (2) over bolt holes and disc hinge. Where o-ring seal is provided, place o-ring into body groove. O-ring may be held in place with compatible grease for re-assembly. Food grade grease should be used for standard Buna-N o-rings. For EPDM o-rings, silicone grease should be used.

3. Insert lubricated bolts (5) noting that the bolts in the hinge area are longer than the other cover bolts.

4. Cover bolts should be tightened to the following specifications during assembly.

Table 2. Valve Cover Bolt Torque

Valve	Size	Torque (ft-lbs)
2"-2.5"	1/2"	75
3"	7/16"	50
4"	1/2"	75
6"	5/8"	150
8"	5/8"	150
10"	7/8"	400
12-20"	7/8"	400
24"	1"	500
30"	1 1/8"	600
36"	1 1/4"	900
42"	1 1/2"	1400
48"	1 1/2"	1400

BACKFLOW ACTUATOR FIELD INSTALLATION AND MAINTENANCE (OPTIONAL)

BACKFLOW ACTUATOR OPERATION:
An optional **backflow actuator** assembly is available which can be easily installed in the field. The actuator is not designed to operate at the valve's Maximum Working Pressure rating. Therefore, prior to using the actuator, close the pump isolation valve and bleed off line pressure. To operate, turn the handle clockwise. This will open the valve disc allowing backflow through the valve. The handle should turn easily. When the actuator is fully extended into the valve, the disc will be partially open. Upon completion of the back flushing operation, turn the handle counter-clockwise and the valve will automatically return to the closed position. Lock the actuator in the closed position with the jam nut provided. The system is again ready for normal operation.

WARNING
Relive line pressure before using backflow actuator or damage may occur.

BACKFLOW ACTUATOR FIELD INSTALLATION:
The backflow actuator is supplied as an optional assembly from the factory, which is shipped loose with the valve.

1. Depressurize and drain the pipeline.

WARNING
Remove of the bottom plug while under pressure may cause bodily harm.

2. Score the coating around and remove the pipe plug in the bottom boss of the valve. Valve must be restrained. Removal torque requires a 2-ft long socket wrench or ½"-sq. drive impact wrench at minimum. Pipe plugs on 8" and larger valves may require the use of a cheater bar in order to remove. Heating the pipe plug can loosen thread sealant and reduce torque. Valves can be provided with corrosion resistant plugs for lower removal torques on request.

3. Inspect the backflow rod and place in the non-extended position. (The rod should extend about 1" past the end of the brass bushing.) Apply Teflon thread sealant to brass threads.

4. Insert the threaded end of the assembly into the valve boss. Slowly turn the assembly into the boss taking care not to cross-thread the bushing. Continue turning the assembly into the valve for a tight fit.

BACKFLOW ACTUATOR SEAL REPLACEMENT:
There are two parts (8 & 9) on the backflow actuator that are subject to wear. To replace the seals, the pipeline must first be depressurized and drained. Next, remove the backflow assembly from the valve by turning the brass bushing (6) counter-clockwise. Disassemble the actuator as follows:

1. Remove one of the vinyl caps (12).
2. Remove the T-Handle (10) and jam nut (11) from the rod (7).
3. Remove the rod (7) from the bushing (6) by screwing in the rod fully clockwise and pull the rod through the valve end of the bushing (6).
4. Lubricate new seals with FDA approved grease and install in the bushing end grooves.
5. Clean, lubricate, and reinstall rod in bushing.
6. Re-install jam nut (11) and T-Handle (10).
7. Place vinyl cap (12) on handle (10).
8. Apply Teflon thread sealant to bushing and carefully thread into valve taking care not to cross-thread the bushing.

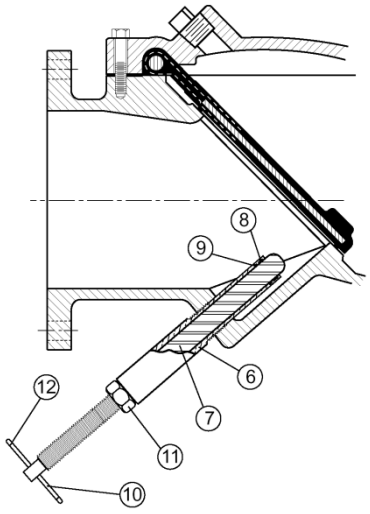


FIGURE 3. BACKFLOW ACTUATOR ASSEMBLY

Backflow Actuator Parts List		
Item	**Description**	**Material**
6	Bushing	Lead-Free Brass
7	Rod	Stainless Steel
8	Rod Wiper*	Molythane
9	O-Ring	Buna-N
10	Handle	Stainless Steel
11	Jam Nut	Brass
12	Cap*	Vinyl
*Recommended Spare Part		

MECHANICAL INDICATOR (OPTIONAL)

The mechanical indicator is an option that fits into the cover and can easily be installed in the field by going through the following steps. The mechanical indicator is used to visually indicate when the valve is opened or closed.

1. Remove line pressure and drain valve.

> **WARNING**
> **Removal of the pipe plug while under pressure may cause bodily harm.**

2. Score the coating around and remove the pipe plug from the cover. Valve must be restrained. Removal torque requires a 2-ft long socket wrench or ½"-sq. drive impact wrench at minimum. Valves can be provided with corrosion resistant plugs for lower removal torques on request.
3. Apply pipe joint compound to indicator body (21) threads.
4. Insert the indicator body (21), without the indicator plate (27), into the valve cover and tighten. Make sure that two of the tapped holes in the indicator body (21) are aligned with the valve and pipeline. This will ensure proper orientation of the indicator plate.
5. Remove the two socket head screws (31) from the indicator body (21).
6. Slide the indicator plate (27) over the indicator rod (23) and spring (28).
7. Align the indicator plate (27) as shown on the back of this card and secure with the 5mm socket head screws (31).
8. Connect the spring (28) to the indicator plate (27) notch.

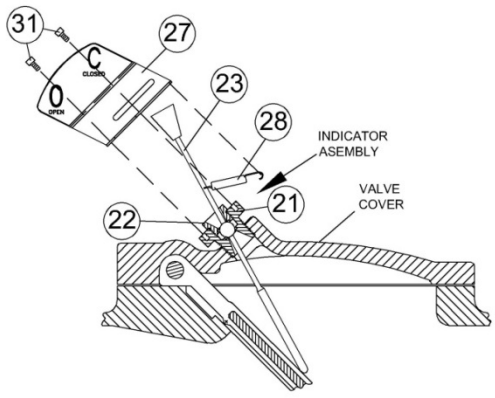


FIG. 4. MECHANICAL INDICATOR ASSEMBLY

Mechanical Indicator Parts List		
Item	**Description**	**Material**
21	Body	Brass
22	Bushing	Brass
23	Rod	Stainless Steel T316
27	Plate	Stainless Steel T316
28	Spring	Stainless Steel T302
32	Screws	Stainless Steel T316

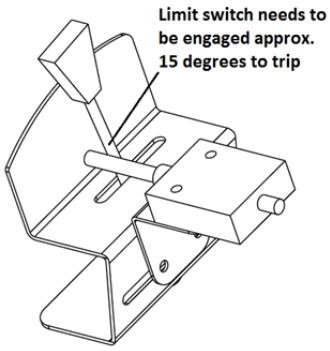
LIMIT SWITCH (OPTIONAL)

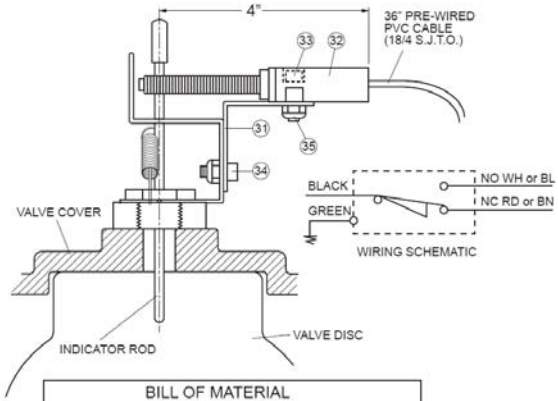
The limit switch is used in conjunction with the Mechanical Indicator. The standard limit switch is Allen Bradley #802B-CSACXSXC3. The limit switch is SCADA (Supervisory Control and Data Acquisition) compatible for applications requiring open/close indication.

NEMA Ratings: 1, 2, 4, 6, 6P, 12, 13
UL Ratings: 5 AMPS, 1/10 HP, 125 or 250 VAC, SPDT

Installation:

1. Attach limit switch assembly to indicator using the supplied screws (34) and bracket (32).
2. Position the assembly so that the switch trips when the valve is closed. The switch needs to be engaged approx. 15 degrees to trip.
3. Connect wiring to either the normally open or normally closed contact as shown in the schematic diagram.





BILL OF MATERIAL		
PART NO.	DESCRIPTION	QTY.
31	MOUNTING BRACKET	1
32	LIMIT SWITCH (SPDT) HONEYWELL 914CE20-3 ALLEN BRADLEY 802B-CSACXSXCE	1
33	SCREW	2
34	SCREW	2
35	NUT	4

FIGURE 5. LIMIT SWITCH ASSEMBLY

BOTTOM MOUNTED OIL DASHPOT FIELD INSTALLATION AND MAINTENANCE (OPTIONAL)

DASHPOT FIELD INSTALLATION: The bottom dashpot is supplied as an optional assembly from the factory. This unit provides control of the disc's final 10% travel to the closed position to reduce valve slam and water hammer. The 10% travel time is adjustable between 1 and 5 seconds.

1. Depressurize and drain the valve and pipeline.

> **WARNING**
> **Removal of the bottom plug in the valve while under pressure may cause bodily harm.**

2. Score the coating around and remove the pipe plug in the bottom boss of the valve. Valve must be restrained. Removal torque requires a 2-ft long socket wrench or ½"-sq. drive impact wrench at minimum. Pipe plugs on 8" and larger valves may require the use of a cheater bar in order to remove. Heating the pipe plug can loosen thread sealant and reduce torque. Valves can be provided with corrosion resistant plugs for lower removal torques on request.
3. Apply Teflon thread sealant or tape to brass threads on the dashpot.Insert the threaded end of the assembly into the valve boss. Slowly turn the assembly into the boss taking care not to cross-thread the bushing. Continue turning the assembly into the valve for a tight fit and so that the tank is upright.
4. Adjust the air pressure in the tank to be a minimum of 50 psi over the line pressure. Set the flow control valve in the mid position (i.e. 1 turn open). The dashpot rod should be extended and hold the disc open about 1 inch. The water line pressure will close the disc.

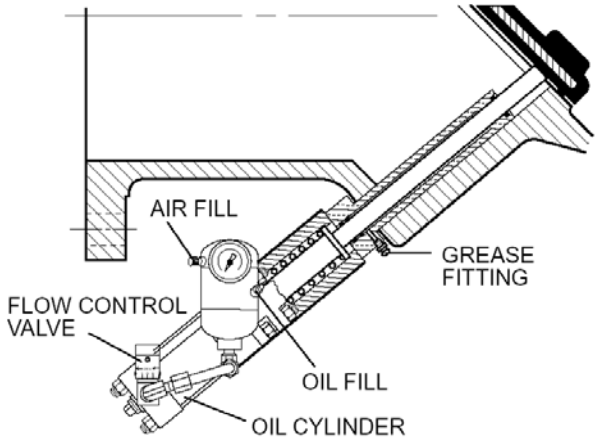


FIGURE 6. BOTTOM MOUNTED OIL DASHPOT

CHECKING OIL AND GREASE LEVELS:

1. The check valve should be closed.
2. The air in the oil reservoir must be bled from the reservoir, using the air fill valve mounted on the reservoir.
3. Remove the pipe plug from the oil reservoir fill port.
4. Add hydraulic fluid equal to Mobil #DTE 24 until fluid is up to level indicated on the reservoir. Replace pipe plug.
5. Recharge the reservoir with air pressure to a minimum of 10 psi over the water line pressure.
6. The grease level cannot be checked but it is recommended that the grease fitting be charged with grease twice a year. Use a cartridge grease gun and pump grease into the fitting using two full strokes. An FDA approved grease should be used.

DASHPOT SEAL REPLACEMENT: There are several seals in the unit that may require replacement.

1. Depressurize and drain the valve and pipeline.
2. Unscrew the dashpot from the valve and remove the 4 bolts holding the dashpot spacer.
3. Replace the (2) rod wipers and o-ring seal.
4. If the oil cylinder is leaking oil, tighten the tie rod nuts. The cylinder should be returned to the factory for rebuilding.
5. Reinstall the unit as listed above for a new unit.

PARTS AND SERVICE

Parts and service are available from your local representative or the factory. Make note of the valve Model No and Working Pressure located on the valve nameplate and contact:

Val-Matic Valve and Mfg. Corp.
905 Riverside Drive
Elmhurst, IL 60126
Phone: (630) 941-7600
Fax: (630) 941-8042
www.valmatic.com

A sales representative will quote prices for parts or arrange for service as needed.

LIMITED WARRANTY

All products are warranted to be free of defects in material and workmanship for a period of one year from the date of shipment, subject to the limitations below.

If the purchaser believes a product is defective, the purchaser shall: (a) Notify the manufacturer, state the alleged defect and request permission to return the product; (b) if permission is given, return the product with transportation prepaid. If the product is accepted for return and found to be defective, the manufacturer will, at his discretion, either repair or replace the product, f.o.b. factory, within 60 days of receipt, or refund the purchase price. Other than to repair, replace or refund as described above, purchaser agrees that manufacturer shall not be liable for any loss, costs, expenses or damages of any kind arising out of the product, its use, installation or replacement, labeling, instructions, information or technical data of any kind, description of product use, sample or model, warnings or lack of any of the foregoing. NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF FACT, PROMISE, DESCRIPTION OF PRODUCT OF USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF THE MANUFACTURER. These products are not manufactured, sold or intended for personal, family or household purposes.

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

8.4 - Tyler Union Warranty

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

1. ENTIRE AGREEMENT.

(A) Each party agrees that all sales of goods ("Goods") by Tyler Union, a division of McWane, Inc. ("Seller") to Buyer are governed by these Terms and Conditions of Sale ("Terms and Conditions of Sale") which supersede any other terms of Buyer or Seller. Each party agrees that the Terms and Conditions of Sale will also govern all sales of Goods to Buyer by any McWane, Inc. subsidiary, affiliate, or division, in which case such subsidiary, affiliate, or division will be the "Seller" under this Agreement (unless otherwise agreed in writing by such subsidiary, affiliate, or division). Buyer acknowledges that these Terms and Conditions of Sale are subject to change from time to time and the parties agree that each sale of Goods will be governed by the version of Terms and Conditions of Sale available online at www.tylerunion.com at the time of acceptance by Seller of an order for such Goods. The Terms and Conditions of Sale and the order for Goods from Buyer and agreed by Seller ("Order) or other contract documents to which they apply constitute the entire agreement between the parties with respect to Goods ("Agreement"). All references by Seller to Buyer's specifications and similar requirements are only to describe Goods and work covered hereby and no warranties or other terms will have any force or effect. No other terms of Buyer, no modification, amendment, or waiver to this Agreement, and no cancellation, change, or return of any Order under this Agreement will be binding on either party until agreed in writing by such party's authorized representative. Buyer may not rely on any representation, promise, or term not set forth herein and Seller expressly objects to and rejects all terms not contained in this Agreement. Seller's acceptance of Orders, whether oral or written, and/or its delivery of Goods to Buyer is based on the express condition that Buyer agrees to all these Terms and Conditions of Sale.

(B) In addition to but not in lieu of the foregoing, Seller expressly rejects any provision that requires compliance with Presidential Executive Order 14042 or any related guidance regarding COVID safety protocols for federal contractors (the "Vaccination Mandate"). Seller makes no representation, certification, or warranty as to the vaccination status of its employees or Seller's or its employees' compliance with the Vaccination Mandate. Buyer understands and agrees that no provision related to the Vaccination Mandate may become a part of this Agreement or any other contract between Seller and Buyer except pursuant to a writing signed by the President of McWane, Inc. No other employee or officer of Seller has any authority, express, implied, or apparent, to agree to a provision related to the Vaccination Mandate on behalf of Seller.

2. QUOTATIONS. Where this Agreement is used by Seller to place a bid or provide a quote, Seller's quotation is for prompt acceptance and Seller may change and/or withdraw without notice. Buyer's prompt acceptance of the quotation is a material term of the bid and any subsequent agreement. In cases where freight allowance is included in the quotation, Buyer is liable for any rate increase and/or additional expense over the calculated allowance resulting from compliance with Buyer's shipping instructions.

3. DELIVERY. Delivery terms (per Incoterms® 2020) are stated on each Order. All Orders must include Buyer's or forwarder's address and are assumed to authorize immediate release upon ready-to-ship status unless otherwise specified in writing. All shipping dates are approximate; production will not begin until receipt by Seller of complete manufacturing, shipping, and credit information. Tender of delivery is deemed to occur at the earliest of (A) acceptance of shipment by designated shipper, (B) allocation of Goods to Buyer at location other than Seller's location, (C) delivery to Buyer's representative or designee, or (D) mailing of an invoice to Buyer. Buyer agrees to provide Seller with defined shipping instructions within seven (7) business days following receipt of packing list provided by Seller. Title to Goods will pass to Buyer on tender of delivery, subject to Seller's right to stop Goods in transit and to any interest of Seller reserved to secure Buyer's payment or performance to Seller, even if freight is included or prepaid. If Seller holds Goods at Buyer's instruction or because Buyer has failed to supply shipping instructions or because Seller, in its sole discretion, determines that any part of Goods should be held for Buyer's account, Seller may invoice Buyer for the Goods, as well as for storage. Storage fees will be at Seller's standard rates. Goods invoiced and held at any location for whatever reason will be at Buyer's risk and Seller may charge for (but is not obligated to carry) insurance. If Buyer fails to provide shipping instructions, Seller may, at its option, ship the Goods to Buyer at the address specified in the applicable Order and invoice Buyer for the Goods. Buyer agrees to make payment of such invoice when due under this Agreement. Buyer will accept and pay for partial deliveries at the Agreement prices and terms. If Buyer declares or indicates an intention to not accept delivery, Seller may, at its option, give written notice to Buyer that Seller is ready and willing to deliver, and such notice will constitute a valid tender of delivery. Buyer must report any shortages in shipments within three (3) calendar days of receipt of the initial shipment. Buyer may not make any deduction from any payment due because of loss or damage to Goods in transit. If Buyer makes a written request, Seller, in its sole discretion, may agree as a service to Buyer to process Buyer's claim against the freight vendor for any loss or damage in transit, so long as Seller receives the claim within five (5) calendar days of delivery of the Goods. All claims will be waived unless accompanied by a delivery receipt, signed by freight vendor's agent at time of delivery, on which receipt the loss or damage has been noted.

4. PRICES; PAYMENT. Prices and payment terms are stated on the Order or invoice document. Seller may make partial shipments and payment for that portion will be due as indicated on the Order or invoice document based on time of shipment. Seller's prices do not include sales, use, excise, or other similar taxes and Buyer agrees to pay the amount of any present or future such tax in addition to the price specified in each Order, unless Buyer, at the time of sale, provides Seller with all tax-exemption certificates required by taxing authorities. If Seller has any cause to question Buyer's ability to perform, Seller may demand such assurances of Buyer's performance as Seller deems necessary in its discretion, including payment in advance for all shipments. If (A) Buyer fails to provide Seller with such assurance within ten (10) calendar days of Seller's demand, or (B) Buyer is declared bankrupt or insolvent or any

proceeding is brought against Buyer, voluntarily or involuntarily, under any bankruptcy or insolvency laws, or (C) Buyer fails to make payment for Goods when due, Seller may suspend its performance, cancel any Order then outstanding, receive reimbursement for its reasonable and proper cancellation charges and collect any sums due and owing, its reasonable cancellation charges and all damages resulting from Buyer's default. Additionally, if Buyer fails to make payment for Goods when due, Buyer's account will be deemed delinquent and Buyer will be liable to Seller for a service charge of eighteen percent (18%) per annum or the maximum allowed by law, whichever is greater, on any unpaid amount. Buyer will be liable to Seller for all costs and expenses of collection, including court costs and reasonable attorneys' fees.

5. CANCELLATION, CHANGES AND RETURNS. If Buyer properly requests a cancellation, change, or return, Seller may, at its option: (A) charge Buyer for any costs Seller incurred prior to or because of such cancellation, change, or return; (B) revise its prices and delivery dates to reflect such change; and/or (C) accept returned Goods for credit if, in Seller's sole discretion, it finds such Goods to be standard stock and in good condition. The credit will be, in Seller's sole discretion, either the invoice price less a percentage to be determined by Seller or the scrap value of the Goods, along with shipping and handling charges to be determined by Seller. All returned Goods must be securely packed by Buyer to ensure that returned material is not damaged during shipment.

6. FORCE MAJEURE; DEFERRED DELIVERY. Seller will not be liable for any expense, loss, or damage resulting from delay in delivery or prevention of performance caused by any event beyond Seller's reasonable control ("Force Majeure"), including but not limited to: fire; flood; storm; act of God; strike, labor dispute or labor shortage; lack of or inability to obtain materials, fuels, supplies, or equipment; civil unrest or riot; pandemic; accident; transportation delay or shortage; act or failure to act of Buyer or any government; or any other cause whatsoever, provided that such cause is beyond Seller's reasonable control. Seller will have such additional time for performance as reasonably necessary under the circumstances and may adjust the price to reflect increases caused by Force Majeure. Buyer's acceptance of any Goods will constitute Buyer's waiver of any claim for damages for delay in delivery of such Goods. If delivery is delayed or interrupted by Force Majeure, Seller may store the Goods at Buyer's expense and risk and charge Buyer a reasonable storage rate. If Seller is delayed because it is awaiting Buyer's approval or acceptance of designs, drawings, prints, or engineering or technical data, or is awaiting Buyer's approval or acceptance of Goods, Seller will be entitled to a price adjustment equal to increase in Seller's production costs and all other losses and expenses incurred by Seller because of such delays. If Buyer requests and Seller approves in writing a deferred delivery on any Order, Seller may charge Buyer for the completed portion of the Order and warehouse all completed Goods at Buyer's expense and risk of loss. As to any uncompleted portion of the Order, Seller may, at its option, cancel the uncompleted portion under Section 5 above or revise its prices and delivery schedules on the uncompleted portion to reflect its increased costs and expenses attributable to the delay.

7. WARRANTY; PATENTS.

(A) Seller warrants that Goods will be of the kind described in this Agreement and free from defects in material and workmanship under conditions of normal use. Seller reserves the right to make any modifications required by production conditions to information set forth in Seller's catalogues and advertising literature. Seller will not be liable or responsible for (A) any defects attributed to normal wear and tear, erosion or corrosion, improper storage, use, or maintenance, or use of Goods with incompatible products, or (B) defects in any part of Goods manufactured by others. If (B) above is applicable, Seller will, as an accommodation to Buyer, assign to Buyer any warranties given to it by any such other manufacturers; provided, however, that the foregoing will not extend Seller's warranty to any accessory products unless Seller specifically agrees in writing. All warranties are void if Goods are modified or used in conjunction with products or accessories not manufactured or approved by Seller or which are incompatible with Goods. This warranty does not cover failure of any part manufactured by others, failure of any part from external forces, including but not limited to corrosive soils, earthquake, installation, vandalism, vehicular or other impact, application of excessive torque to the operating mechanism, frost heave, or other Force Majeure. Any claim by Buyer with reference to Goods for any cause will be deemed waived by Buyer unless submitted to Seller in writing within ten (10) calendar days from the date Buyer discovered, or should have discovered, any claimed breach. Buyer will give Seller an opportunity to investigate. If Buyer furnishes prompt notice to Seller of any defect and an opportunity to inspect the alleged defect as provided above, Seller will, in its sole discretion, either: (i) repair the defective or nonconforming Goods; (ii) replace nonconforming Goods, or part thereof, which are sent to Seller by Buyer within sixty (60) calendar days after receipt of the Goods at Buyer's plant or storage facilities; or (iii) if Seller is unable or chooses not to repair or replace, return the purchase price paid and cancel any obligation to pay unpaid portions of the purchase price of nonconforming Goods. In no event will any obligation to pay or refund exceed the purchase price paid. Repair and/or replacement as provided above will be shipped EXW (Ex-Works) Seller's facility (Incoterms® 2020) unless otherwise agreed in writing by Seller. Buyer will prepay all transportation charges for return of all or part of Goods to Seller, unless otherwise agreed in writing by Seller. Seller will not be responsible for any labor, removal, or installation charges that may result from repair and/or replacement of any Goods.

(B) Specifically for RieberLok gaskets only, the warranty and remedies stated above are modified as follows: if the RieberLok gasket is properly installed in PVC pipe or fittings manufactured to AWWA C900 specifications and originally fitted with a Rieber gasket, the RieberLok gasket is warranted against failure from either leaking or joint separation up to the rated pressure of the pipe or fitting provided. If a RiberLok gasket fails to meet the above-stated performance criteria, Seller will provide a replacement RieberLok gasket and pay the reasonable cost of the PVC pipe directly attached to the defective gasket. The warranty period for RieberLok gaskets is twelve (12) months from the date of delivery.

(C) Buyer's exclusive remedy and Seller's sole liability for any loss, damage, injury, or expense of any kind arising from manufacture, delivery, sale, installation, use, or shipment of Goods will be, at Seller's option, the remedies described above, whether based on contract, warranty, tort, or any other basis of recovery.

(D) If any claim is made against Buyer based on a claim that any Goods constitute an infringement of any U.S. Letter Patent, Buyer will notify Seller immediately. Seller may, with Buyer's assistance, if required, but at Seller's expense, conduct settlement negotiations or defense of any litigation. If any Goods are held to infringe any U.S. Letter Patent, and their use is enjoined, or, if as a result of a settlement, Seller deems their continued use unadvisable and provided that Buyer has given Seller the immediate notice required above and has used Goods only in accordance with the provisions of this Agreement and has not altered or changed them in any material way, Seller will, at its option and expense, procure for Buyer the right to continue using Goods, modify Goods so that they become non-infringing, replace Goods with non-infringing Goods of substantially equal quality, or replace Goods and refund the purchase price, less reasonable depreciation. The above is intended as a complete allocation of risks between the parties, including without limitation liability for patent infringement. Buyer understands that it will not be able to recover consequential damages even though it may suffer such damages in substantial amounts. Because this Agreement and the price paid reflect such allocation, this limitation will not have failed of its essential purpose even if it operates to bar recovery for such consequential damages.

8. LIMITATION OF LIABILITY. THE WARRANTIES IN SECTION 7 ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED BY LAW OR STATUTE OR ARISING FROM TRADE USAGE OR COURSE OF DEALING. THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT, WHETHER AS A RESULT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE), OR STRICT LIABILITY, WILL SELLER BE LIABLE FOR ANY PUNITIVE, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF USE OF GOODS OR OTHER PROPERTY OR EQUIPMENT, DAMAGE TO OTHER PROPERTY, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, DOWNTIME, OR CLAIMS OF BUYER'S CUSTOMERS FOR ANY OF THE AFORESAID DAMAGES, EVEN IF BUYER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. SELLER WILL NOT BE LIABLE, AND BUYER AGREES TO INDEMNIFY SELLER, FOR ALL PERSONAL INJURY, PROPERTY DAMAGE, AND OTHER LIABILITY RESULTING IN WHOLE OR PART FROM BUYER'S NEGLIGENCE OR WILLFUL MISCONDUCT. NO CLAIMS OF ANY KIND, WHETHER BASED ON CONTRACT, TORT, STRICT LIABILITY, OR OTHERWISE, MAY BE BROUGHT AGAINST SELLER MORE THAN TWENTY-FOUR (24) MONTHS AFTER DELIVERY OF GOODS TO BUYER. In any contract by Buyer for resale of Goods, Buyer will effectively disclaim, as against Seller, any implied warranty of merchantability and all liability for property damage or personal injury resulting from handling, possession, or use of Goods, and will exclude, as against Seller, any liability for special or consequential damages.

9. CONTROLLING LAW; CONSENT TO VENUE; DISPUTE RESOLUTION. This Agreement and all rights and obligations hereunder will be governed by, and construed in accordance with, the laws of the State of Delaware, without regard to its conflicts of law provisions. The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement. All disputes, claims, and controversies ("Dispute") between the parties arising out of or relating to this Agreement, including but not limited to Disputes based on or arising from an alleged tort, will be resolved by binding arbitration in accordance with the Delaware Rapid Arbitration Act ("DRAA"). Disputes will be arbitrated in Wilmington, Delaware. The parties will select arbitrators in accordance with the DRAA. The parties may mutually agree on the rules governing such arbitration, provided that such rules, and any additional or different rules, are consistent with the DRAA. Defenses based on statutes of limitation and similar doctrines will be applicable in any such proceeding, and commencement of an arbitration proceeding under this Agreement will be deemed commencement of an action for such purposes. No Dispute will be arbitrated as a class action, representative or general public action, collective action, private attorney-general action, or otherwise be joined with claims of any other person ("Collective Proceedings"). If (A) this limitation on Collective Proceedings is held by an arbitrator or court of competent jurisdiction to be unenforceable or interpreted to not prevent a Collective Proceeding, and/or (B) any arbitrator or court renders a decision regarding the question of arbitrability under the DRAA such that the Dispute is not arbitrated in accordance with the DRAA, then such Dispute will proceed in a court of law as provided below and not arbitration. Notwithstanding the foregoing, Seller reserves the right to resolve or bring any Dispute in a court of competent jurisdiction in the state or federal courts of Delaware and the parties agree that, except when the Dispute is arbitrated, the exclusive venue for all Disputes between the parties will be the state and federal courts of Delaware, to which jurisdiction each party hereby irrevocably submits. Each party waives any objection or defense that it is not personally subject to jurisdiction of the state and federal courts of Delaware; that venue of the action is improper; and that the action, suit, or proceeding is brought in an inconvenient forum. In

addition to any other mode of service of process authorized by law, each party consents to service of process by registered or certified mail. EACH PARTY EXPRESSLY WAIVES ALL RIGHTS IT MAY HAVE TO A TRIAL BY JURY.

10. COMPLIANCE WITH LAWS. Each party represents and warrants, in connection with transactions contemplated by this Agreement, and any other agreement contemplated by or entered into pursuant to this Agreement, that it will comply with all applicable federal, state and local laws, codes, regulations, orders, and ordinances, including but not limited to all applicable: (A) laws and regulations regarding export controls, economic sanctions, trade embargoes, anti-boycott restrictions, and anti-corruption laws, including but not limited to the U.S. Foreign Corrupt Practices Act (as amended), and the United Kingdom Bribery Act ("Applicable International Trade and Anti-Corruption Laws"); (B) equal employment opportunity laws, regulations, and requirements, and laws and regulations prohibiting discrimination against any person because of veteran status, disability, race, creed, color, national origin, religion, age, or sex in any term or condition of employment; and (C) laws and regulations addressing human trafficking and slavery. Each party acknowledges and confirms that it and its officers, directors, employees, agents, contractors, designees, and/or any other party acting on its behalf ("Related Parties") are familiar with the provisions of Applicable International Trade and Anti-Corruption Laws. Each party agrees to indemnify, defend, and hold harmless the other party and its employees from and against all claims, demands, costs, penalties, and fines arising in connection with any alleged breach by the indemnifying party or any of its Related Parties of this Section. Seller may terminate this Agreement entirely, without liability to Buyer, if Seller believes in good faith that Buyer or any of its Related Parties has violated or intends to violate this Section.

11. MISCELLANEOUS.

(A) No waiver of any provision, right or remedy contained in this Agreement, including the terms of this Section 11(A), is binding on or effective against a party unless expressly stated in writing and signed by such party's authorized representative. Each party agrees that no right or remedy provided for in this Agreement can be waived through course of dealing, course of performance or trade usage and that reliance on any waiver without the other party's written consent is unreasonable. Waiver of any breach will be limited to the specific breach so waived and will not be construed as a waiver of any subsequent breach. A party's approval or consent to any action proposed by the other will not be considered an agreement to the propriety, fitness, or usefulness of the proposed action, and will not affect the proposing party's obligation to strictly comply with this Agreement and all related Orders.

(B) Buyer may not assign this Agreement or any rights or obligations hereunder without Seller's prior written consent. Any attempted assignment in violation of this Section is void; however, this Agreement and the Terms and Conditions of Sale contained herein are enforceable against Buyer's successors and permitted assigns.

(C) Seller's remedies in this Agreement are cumulative and in addition to any other remedies available to Seller, whether at law, equity, or otherwise.

(D) If any provision or part of a provision contained in this Agreement is held by a court of competent jurisdiction to be contrary to law or public policy, the remaining provisions of the Agreement will remain in full force and effect.

(E) Each party is an independent contractor with respect to this Agreement and not an agent or employee of the other party.

(F) Any notice, request, demand, or other communication from one party to the other required or permitted to be given under this Agreement will be sent to the address for each party indicated on the applicable Order and (i) delivered in person; (ii) sent by overnight service (signature required); or (iii) sent via email with confirmation of delivery. All notices will be effect on the date of receipt. Parties may change such notice addresses upon written notice to the other party. In the case of notice to Seller, please also send a copy to:

McWane, Inc.
2900 Hwy 280 S Suite 250
Birmingham, AL 35223
Attn: General Counsel
Email: jim.proctor@mcwane.com

(G) No provision of this Agreement may be construed against either party as the drafting party. The English language version of this Agreement will govern over any translations.

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

8.5 - Couplings & Adapters

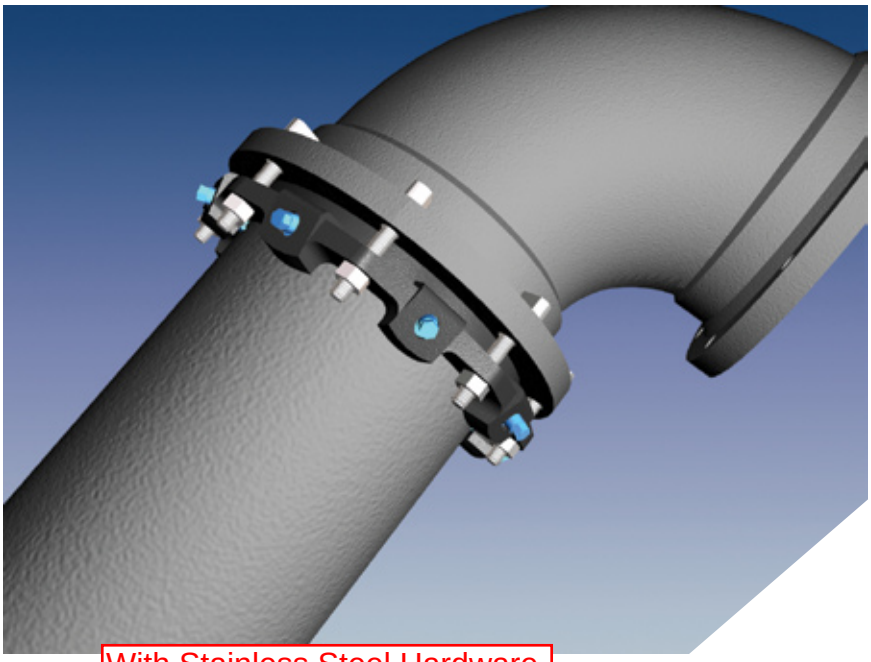
United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

EBAA IRON INC
Your Connection to the Future™

MEGALUG®
Series 1100

Mechanical Joint Restraint for Ductile Iron Pipe



With Stainless Steel Hardware

Nominal Pipe Size	Series Number	Shipping Weights	Post Assembly Deflection	Pressure Rating (PSI)
3	1103	6.1	3°	350
4	1104	7.7	3°	350
6	1106	11.9	3°	350
8	1108	14.8	3°	350
10	1110	23.9	3°	350
12	1112	31.2	3°	350
14	1114	48.5	2°	350
16	1116	56.4	2°	350
18	1118	63.1	1½°	250
20	1120	72.3	1½°	250
24	1124	133.1	1½°	250
30	1130	194.6	1°	250
36	1136	234.0	1°	250
42	1142	536.0	1°	250
48	1148	653.0	1°	250

NOTE: For applications or pressures other than those shown please contact EBAA for assistance.

Features and Applications:

- Sizes 3 inch through 48 inch
- Constructed of ASTM A536 Ductile Iron
- Torque Limiting Twist-Off Nuts
- MEGA-BOND®
  Restraint Coating System
  For more information on MEGA-BOND, refer to www.ebaa.com
- The Mechanical Joint Follower Gland is incorporated into the restraint
- Heavy Duty thick wall design
- Support Products Available:
  Split repair style available 3 inch through 48 inch.
  EBAA Series 1100SD

  Solid restraint harness available for push-on pipe bells.
  EBAA Series 1700

  Split restraint harness available for existing push-on bells.
  EBAA Series 1100HD
- All MEGALUG and related restraint products can be furnished as packaged accessories complete with appropriate restraint, gasket, lubrication, and bolting hardware
- For use on water or wastewater pipelines subject to hydrostatic pressure and tested in accordance with either AWWA C600 or ASTM D2774

Made In The USA

U.S. Patent Nos.
4092036, 4627774, 4779900, 4896903, 5544922

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Mechanical Joint Restraint Sample Specifications

(The text of the specifications below can be copied pasted from www.ebaa.com/download/1100Spec.DOC)

Restraint devices for mechanical joint fittings and appurtenances conforming to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53, shall conform to the following:

Design
Restraint devices for nominal pipe sizes 3 inch through 48 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.

The devices shall have a working pressure rating of 350 psi for 3-16 inch and 250 psi for 18-48 inch. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

Material
Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.

For applications requiring restraint 30 inch and greater, an alternate grade of iron meeting the material requirements of ASTM A536 is acceptable, providing the device meets all end product performance requirements.

Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.

Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) Specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.

Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.

Traceability
An identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number), shall be cast into each gland body.

All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. These Material Traceability Records (MTR's) are to be made available, in hard copy, to the purchaser that requests such documentation and submits his gland body identification number.

Production pieces that are too small to accommodate individual numbering, such as fasteners and wedges, shall be controlled in segregate inventory until such time as all quality control tests are passed. These component parts may then be released to a general inventory for final assembly and packaging.

All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.

Installation
Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly.

Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

Approvals
Restraint devices shall be Listed by Underwriters Laboratories (3" through 24" inch size) and Approved by Factory Mutual (3" through 12" inch size).

Mechanical joint restraint for ductile Iron pipe shall be Megalug Series 1100 produced by EBAA Iron Inc. or approved equal.

MEGA-BOND® Restraint Coating System
All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat.

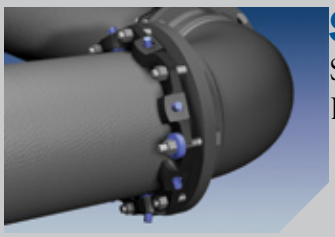
All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.

The coating system shall be MEGA-BOND by EBAA Iron, Inc. or approved equal. Requests for approved equal must submit coating material and process details for review prior to bid.

For more information regarding MEGA-BOND, refer to the MEGA-BOND brochure or visit www.ebaa.com.

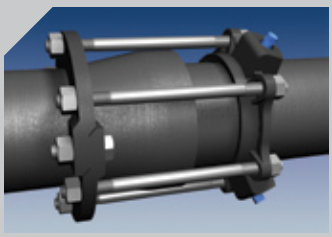
Support Products

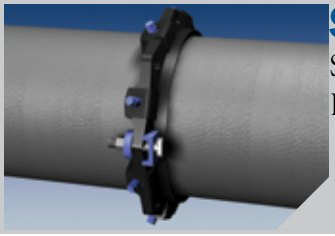
for more information concerning these products please consult the catalog or www.ebaa.com



Series 1100SD
Split MEGALUG Restraint
For Existing Mechanical Joints

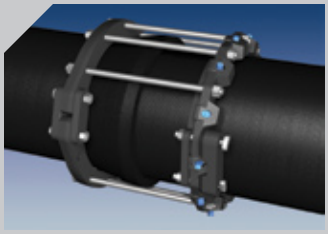
Series 1700
MEGALUG Restraint Harness
For Push-On Bell Joints





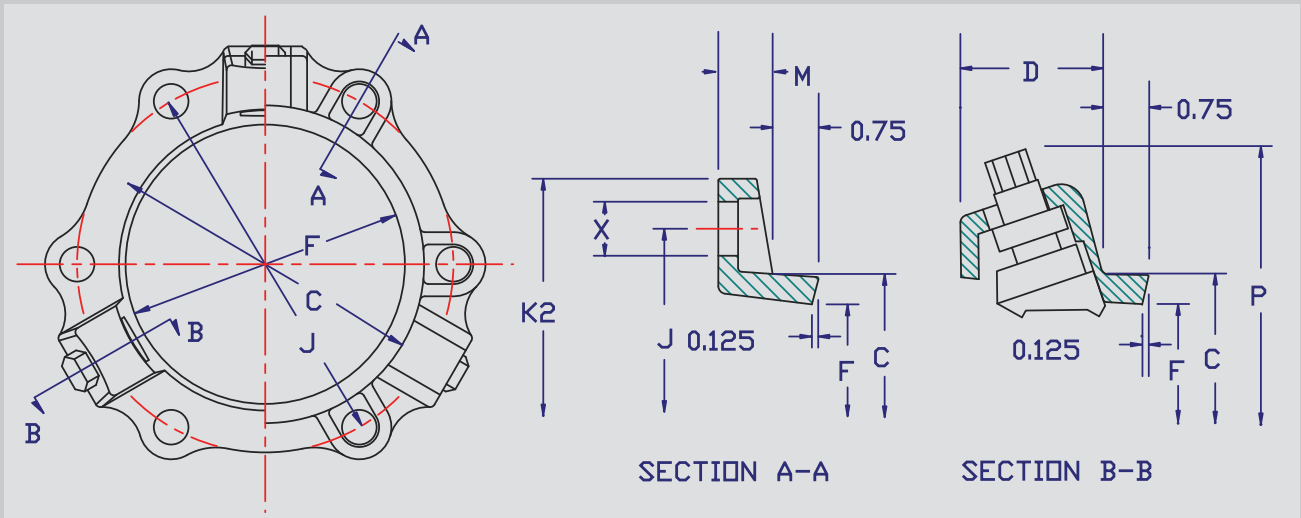
Series 1100SDB
Split MEGALUG Restraint
For Mid-Span Applications

Series 1100HD
Split MEGALUG Restraint
Harness for Existing Push-On Bells



Series 1100 Submittal Reference Drawing

EBAA IRON



MADE IN USA

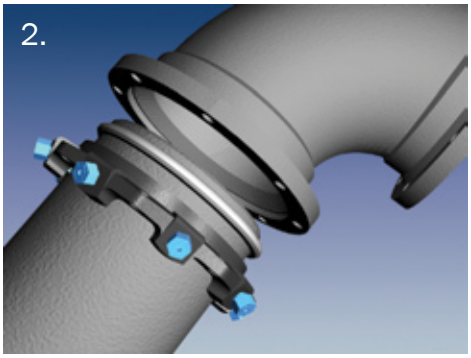
Nominal Pipe Size	Series Number	C	D	F	M	P*	X	J	K2	Wedge QTY.	Bolt QTY.	Weight (LBS.)	Pressure Rating (PSI)
3	1103	4.48	2.27	4.06	0.62	9.06	0.750	6.19	7.69	2	4	6.1	350
4	1104	5.92	2.27	4.90	0.75	9.90	0.875	7.50	9.12	2	4	7.6	350
6	1106	8.02	2.27	7.00	0.88	12.00	0.875	9.50	11.12	3	6	11.8	350
8	1108	10.17	2.31	9.15	1.00	14.15	0.875	11.75	13.37	4	6	14.9	350
10	1110	12.22	2.37	11.20	1.00	16.20	0.875	14.00	15.62	6	8	23.9	350
12	1112	14.32	2.37	13.30	1.25	18.30	0.875	16.25	17.88	8	8	31.2	350
14	1114	16.40	2.69	15.44	1.50	20.94	0.875	18.75	20.25	10	10	49.7	350
16	1116	18.50	2.69	17.54	1.56	22.90	0.875	21.00	22.50	12	12	56.4	350
18	1118	20.60	2.69	19.64	1.63	25.00	0.875	23.25	24.75	12	12	63.6	250
20	1120	22.70	2.69	21.74	1.69	27.10	0.875	25.50	27.00	14	14	71.0	250
24	1124	26.90	3.20	25.94	1.81	32.64	0.875	30.00	31.50	16	16	128.7	250
30	1130	33.29	3.20	32.17	2.25	38.87	1.125	36.88	39.12	20	20	190.7	250
36	1136	39.59	3.20	38.47	2.25	45.17	1.125	43.75	46.00	24	24	226.5	250
42	1142	45.79	4.56	44.67	3.88	55.57	1.375	50.62	53.48	28	28	518.9	250
48	1148	52.09	4.56	50.97	3.88	61.87	1.375	57.50	60.36	32	32	608.3	250

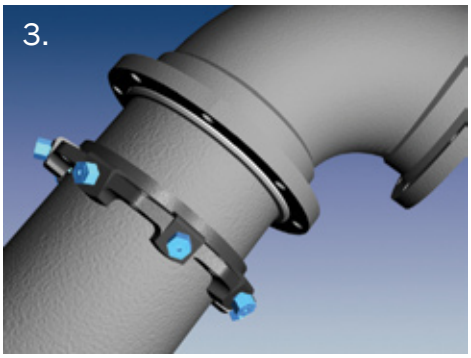
* With Twist-Off Nuts twisted off.

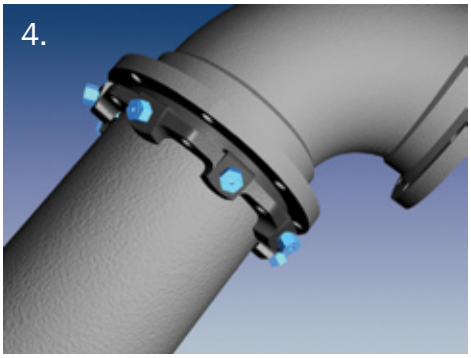
NOTE: Dimensions are in inches and are subject to change without notice.

Important Notes

- The Series 1100 MEGALUG should not be used on plain end fittings.
- If encased in concrete, polyethylene wrap must be used to prevent concrete intrusion into the wedge pocket.
- For test pressures above the rated pressures shown, contact EBAA for recommendations, such as tandem restraint for high pressure applications.
- If you experience the need to install the Series 1100 MEGALUG in an unconventional manner please consult our engineering department.
- EBAA-Seal™ Mechanical Joint Gaskets are provided with 30 inch through 48 inch MEGALUG restraints. These are required on the above referenced sizes to accommodate the pressure ratings and safety factors shown.
- Extra length T-bolts are provided with the 42 inch and 48 inch sizes to facilitate easier assembly of the mechanical joint.
- All Series 1100 MEGALUG components are made of ductile iron conforming to ASTM A536. The wedges are heat treated to a hardness range of 370 to 470 BHN.
- LISTINGS AND APPROVALS: Sizes 3 inch through 24 inch are listed by Underwriters Laboratories, Inc. Category HJKF "Fittings, Retainer Type" with a deflection angle of 5 degrees (3 inch through 12 inch) and 2½ degrees (14 inch through 24 inch). The listing file number is EX2836, Sizes 3 inch through 12 inch are Factory Mutual approved.
- The Series 1100 MEGALUG is intended for use on ductile iron pipe. The restraint can be used on grey iron pipe if the pipe is not severely corroded and is in sound condition and has an outside diameter that can be accommodated. For more information on the use of the MEGALUG restraint on grey iron pipe ask for Connections Bulletin DI-1.







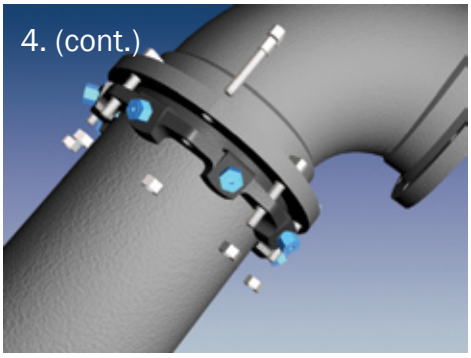
1. The Series 1100 MEGALUG joint restraint is designed for use on ductile iron pipe conforming to ANSI/AWWA C151/A21.51 (all thickness classes) when restraining mechanical joint pipe fittings.

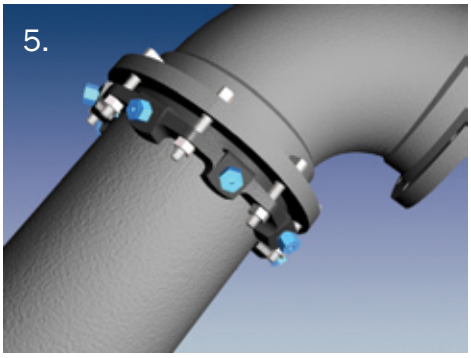
2.* Clean the socket and the plain end. Lubrication and additional cleaning should be provided by brushing both the gasket and the plain end with soapy water or an approved pipe lubrication meeting the requirement of ANSI/AWWA C111/A21.11, just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with lip extension toward the plain end, followed by the gasket.

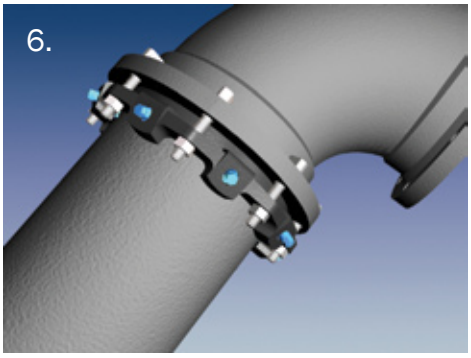
NOTE: In cold weather it is preferable to warm the gasket to facilitate assembly of the joint.

3.* Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.

4.* Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make deflection after joint assembly but before tightening bolts.





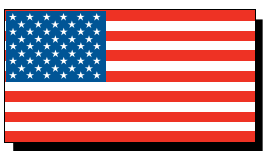


5.* Tighten the bolts to the normal range of torque as indicated [3 inch 45-60 ft-lbs., 4-24 inch 75-90 ft-lbs., 30-36 inch 100-120 ft-lbs., and 42-48 inch 120-150 ft-lbs.] While at all times maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This can be accomplished by partially tightening the bottom bolt first, then top bolt, next the bolts at either side, finally the remaining bolts. Repeat the process until all bolts are within the appropriate range of torque. In large sizes (30-48 inch), five or more repetitions may be required. The use of a torque-indicating wrench will facilitate this procedure.

6. Tighten the torque limiting twist-off nuts in a clockwise direction (direction indicated by arrow on top of nut) until all wedges are in firm contact with the pipe surface. Continue tightening in an alternating manner until all of the nuts have been twisted off.

7. If removal is necessary, utilize the ⅝ inch hex heads provided. If reassembly is required, assemble the joint in the same manner as above, by tightening the wedge bolts to 90 ft-lbs. If the series 1100 restraint is removed from the pipe, be sure that all the collar bolts and wedges are in place before the restraint is reassembled.

* These steps are requirements of AWWA. AWWA Standard C600



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For More Information

For more information about MEGALUG restraints call EBAA today and request "EBAA Connections Bulletin DI-1" concerning use of the MEGALUG restraint on grey iron pipe, or "EBAA Connections Bulletin DI-2" covering the background and operation of the MEGALUG system of restraint.

"Restraint Length Calculation" Software is available for PC/Windows applications. Support documentation about the software can be found in "EBAA Connections Bulletin PD-1 through PD-5".

RFCA
RESTRAINED FLANGE COUPLING ADAPTER FOR STEEL AND DI PIPE 3 – 12 INCH

SUBMITTAL INFORMATION

USE

The Restrained Flanged Coupling Adapter is used to connect plain end IPS sizes steel pipe (minimum thickness STD weight class pipe) or ductile iron pipe to a flanged pipe or fitting. It provides flexibility before and after installation, and a RomaGrip wedge style restrainer provides restraint for the plain end pipe. Not for use on plain end mechanical joint fittings. The RomaGrip may be used on cast iron pipe as long as it has the same OD as ductile iron pipe.

NOTE: Some initial axial movement may occur in lug style restraints as the lugs seat. Movement is directly related to the size of the piping system and the system pressure. In general terms movement of approximately 0.25 can be expected in restraints under 16". For larger sizes, movement of approximately 0.40 may be seen. If this is critical to your application please contact Romac Engineering for additional information.

MATERIALS

GLAND AND FLANGE BODY
Ductile (nodular) iron, meeting or exceeding ASTM A 536, Grade 65-45-12.

GASKETS
Gasket is made from virgin Styrene Butadiene Rubber (SBR) compounded for water and sewer service in accordance with ASTM D 2000 MBA 710. Flange gasket is O ring style and is made of Nitrile Butadiene Rubber (NBR) in accordance with ASTM D 2000. Other compounds available for petroleum, chemical, or high temperature service on request.

RESTRAINING BOLT
7/8 –9 roll thread, Ductile (nodular) iron, meeting or exceeding ASTM A 536.

RESTRAINING LUGS
Ductile (nodular) iron, meeting or exceeding ASTM A 536. Heat treated using a proprietary process.

LUG LOCATORS
Polyurethane, a thermal plastic.

T-BOLTS AND NUTS
High strength low alloy steel T-head bolt. National coarse rolled thread and heavy hex nut. Steel meets AWWA C111 composition specifications. Stainless steel bolts and nuts available on request.

COATINGS
Shop coat applied to cast parts for corrosion protection in transit. Fusion bonded epoxy, RomaGrip Romabond polyester available on request.

FLANGE
Compatible with ANSI Class 125 and 150 bolt circles.

STANDARD

Romac couplings meet the specifications set forth in the AWWA Standard C219 coupling spec.

FM APPROVED

FM approved for cast iron and ductile iron pipe.

SIZES & RANGES

See Catalog.

PERFORMANCE

NOM. PIPE SIZE (INCHES)	PRESSURE RATING (PSI) WORKING	TEST	MAX. JOINT DEFLECTION (°)	PIPE INSERTION (INCHES) MINIMUM	MAXIMUM	Δ
3	275	412	2.0	2.0	4.5	2.5
4	275	412	3.5	2.0	5.0	3.0
6	275	412	3.5	2.0	5.5	3.5
8	275	412	3.3	2.0	5.5	3.5
10	275	412	3.0	2.0	6.3	4.3
12	275	412	3.0	2.0	6.3	4.3

This information is based on the best data available at the date printed above. Please check with Romac for any updates or changes.

Document 10-8-0018 1/17

ROMAC INDUSTRIES, INC.
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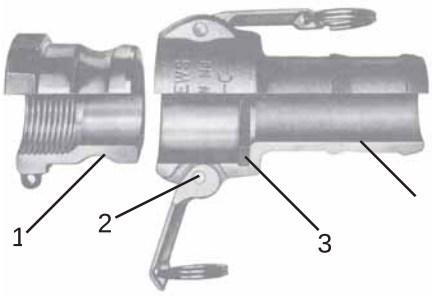
2 Cam and Groove Information

"ANDREWS"



1. Precision machined to rigid tolerances.
2. Durable stainless steel cam arm pins will not rust or bind, for greater strength and safety.
3. Recess holds gasket firmly in place - assures proper placement.
4. Long shank design allows proper banding thus eliminating the major cause of hose damage.

ANDREWS ORDERING SYSTEM

200 - A - AL - *

- Gasket
- Material Code
- Style Code
- Size of coupler or adapter and hose or pipe end; i.e. = 2 inch size.

If coupling is a reducing size, the coupler or adapter is the first size (i.e. 4030-C is 4 inch coupler to 3 inch hose shank.)

Operation of Cam and Groove

1. To make connection, simply slide the adapter into the coupler and with normal hand pressure, press the cam levers down.
2. Uncoupling is as quick and simple as coupling. Just lift the cam arms and remove the adapter.

"BOSS-LOCK"

"Boss-Lock" Cam & Groove provides a unique patented safety feature.

The Cast-in lugs allow safety clips to be attached once the lugs are passed through slots in the special cam lever arms. These clips prevent the coupler from being unlocked until they are removed, providing a positive locking action.

Pull Ring Safety Clips

Dixon has developed the Pull Ring Safety Clip to simplify the locking action on "Boss-Lock" couplers. No more inserting clips or dangling lanyards, just a twist and it's locked, giving you a low profile positive locking action.
The Pull Ring Safety Clip will be phased into stock on all "Boss-Lock" couplers as inventory is replaced.

Buy with Confidence
"Boss-Lock" Investment Stainless Steel Cam Arms are Guaranteed!!!
Should you ever break a "Boss-Lock" Investment Stainless Steel Cam Arm, simply return it to the nearest warehouse for a free replacement.

SPECIFICATIONS ON OUR CAM AND GROOVE

Specifications: "Andrews", "Boss-Lock" and "EZ Boss-Lock" Cam and Groove couplers and adapters are produced to interchange with all product produced to *MIl-C-27487F*.
No standard exists for the 1/2" and 8" fittings, and generally these sizes do not interchange with other manufacturers.
Dust Caps and Dust Plugs are NOT to be used in Pressure Applications for safety and environmental reasons.

Pressure Ratings: Designed for use with Liquids, consult Dixon for specific recommendations.

SAFETY ALERT

Recommendations based on the use of mating Dixon fittings at ambient temperature (70° F) with standard Buna-N Seal installed. For use at elevated temperature or other unusual operating conditions, consult the factory.

"Andrews", "Boss-Lock" and "EZ Boss-Lock" Couplers and Adapters Maximum Working Pressure						
Sizes	1/2"	3/4"-2"	2 1/2"	3"	4"	5" & 6"
PSI	150	250	150	125	100	75

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Cam and Groove Information

"EZ BOSS-LOCK"

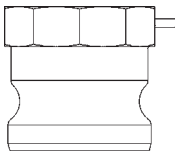
No more fumbling with clamps, wire, clips or pins . . .
Just close the handles and the locking mechanism is engaged.

Unlike other safety couplings . . .

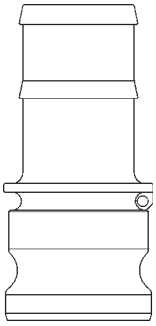
- The EZ Boss-Lock is extremely EASY TO OPEN!!! *The release lever is under your thumb when you want to open the fitting.* ERGONOMIC.
- The EZ Boss-Lock is resistant to accidental disconnection when being dragged. *The release lever opens in the direction opposite to the cam arm, so movements that tend to open the release lever also tend to close the cam arm!!!*
- The EZ Boss-Lock alerts you if it is not properly engaged. *If the rotating lever is not flush with the handle, it is not properly engaged.*
- The EZ Boss-Lock has no sliding pins to jam. *The EZ Boss-Lock's rotating action helps keep the locking device free of debris.*
- The EZ Boss-Lock has no sliding pins to pop open. *The EZ Boss-Lock is designed to protect critical parts from impact and to withstand rugged use.*
- The EZ Boss-Lock can be supplied with special shanks custom suited to your needs. *The EZ Boss-Lock is available with Swaged and PF shank designs, for hard to couple chemical hoses.*
- The EZ Boss-Lock cam arm assemblies are made of investment cast Stainless Steel with plated Carbon Steel pull rings.
- The EZ Boss-Lock is easier to insert into the hose tubes on Tank Trucks, and easier to use in restricted spaces. *This is due to the smaller maximum O.D. and a more snag free exterior.*
- The EZ Boss-Lock Cam Arm assemblies can be retrofitted onto Undamaged Stainless Steel Boss-Lock. *This allows you to protect your investment in Stainless Steel Boss-Lock couplings while you upgrade.*
- The EZ Boss-Lock is Made in the USA.

All measurements in this brochure are for reference only and are subject to change. Where dimensions are critical, please consult the factory. For products not shown or special application questions, please consult the factory.

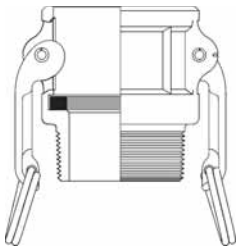
CAM & GROOVE LINE DRAWINGS



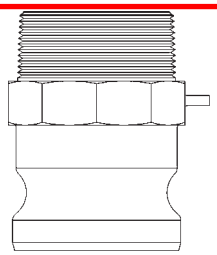
TYPE A
(male adapter x female NPT)



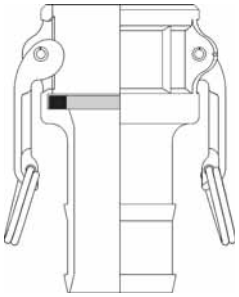
TYPE E
(male adapter x hose shank)



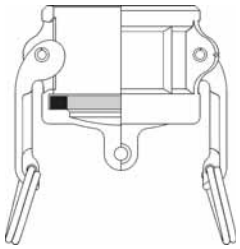
TYPE B
(female coupler x male NPT)



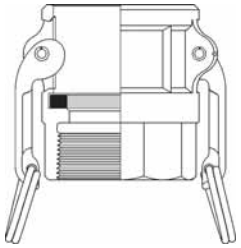
TYPE F
(male adapter x male NPT)



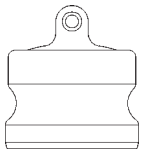
TYPE C
(female coupler x hose shank)



TYPE DC *
(dust cap)



TYPE D
(female coupler x female NPT)



TYPE DP *
(dust plug)

NOTE: Line drawings are representative of the Dixon / "Andrews" line of cam and groove.

** Dust Caps and Dust Plugs are NOT to be used in Pressure Applications for safety and environmental reasons.*

WARNING:
SAFETY ALERT
UNDER NO CIRCUMSTANCES should Cam and Groove couplings be used for compressed air or steam service!

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6 Dixon "Andrews" / "Boss-Lock" Type F Adapters

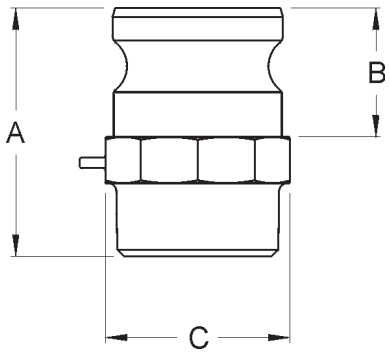
Male Adapter x Male NPT

Size	Aluminum Part #	Aluminum Hard Coat Part #	Brass Part #	Unplated Malleable Iron Part #	Plated Malleable Iron Part #	Stainless Steel Part #
1/2"	50-F-AL	-----	50-F-BR	-----	-----	50-F-SS
3/4" x 1/2"	7550-F-AL	-----	7550-F-BR	-----	-----	7550-F-SS
3/4"	75-F-AL	-----	75-F-BR	-----	75-F-PM	75-F-SS
1"	100-F-AL	-----	100-F-BR	-----	100-F-PM	100-F-SS
1 1/4"	125-F-AL	-----	125-F-BR	-----	-----	125-F-SS
1 1/2"	150-F-AL	150-F-ALH	150-F-BR	150-F-MI	150-F-PM	150-F-SS
2"	200-F-AL	200-F-ALH	200-F-BR	200-F-MI	200-F-PM	200-F-SS
2 1/2"	250-F-AL	-----	250-F-BR	-----	250-F-PM	250-F-SS
3"	300-F-AL	300-F-ALH	300-F-BR	300-F-MI	300-F-PM	300-F-SS
4"	400-F-AL	400-F-ALH	400-F-BR	400-F-MI	400-F-PM	400-F-SS
5"	500-F-AL	-----	-----	-----	-----	-----
6"	600-F-AL	600-F-ALH	600-F-BR	-----	600-F-PM	600-F-SS
8" AND*	800-F-AL	-----	-----	-----	-----	-----
8" BL*	801-F-AL	-----	-----	-----	-----	-----

* "Andrews" and "Boss-Lock" Cam and Groove Couplings DO NOT INTERCHANGE IN THE 8" SIZE.

SAFETY ALERT

- The 8" "Boss-Lock" were designed to interchange with 8" Cam & Groove Couplings manufactured by P.T. Coupling.



ALUMINUM, BRASS and MALLEABLE IRON DIMENSIONS

Size	1/2"	3/4 x 1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8" AND	8" BL
A Overall Length	2 1/8	2 7/16	2 1/16	2 3/8	2 15/16	3 5/32	3 17/32	4 3/8	4 15/32	4 21/32	4 1/2	5 17/32	6 15/16	6 3/8
B Adapter Length	1	1	1	1 5/16	1 9/16	1 5/8	1 7/8	1 15/16	2	2 1/16	2 5/16	2 1/4	3 9/16	3 1/16
C Distance Across Flats	1	1 5/16	1 3/8	1 1/2	1 7/8	2 1/4	2 11/16	3 1/4	3 3/4	5	6 1/2*	8 1/32*	10 5/8*	10 5/8*

STAINLESS STEEL DIMENSIONS

Dixon Type DC Dust Caps

dust cap

Size	356T6 Aluminum		Aluminum Hard Coat		Brass	
	Part #	Price/E	Part #	Price/E	Part #	Price/E
½"	50-DC-AL	$21.40	---	---	50-DC-BR	$32.50
¾"	75-DC-AL	23.70	---	---	75-DC-BR	42.50
1"	100-DC-AL	23.65	---	---	100-DC-BR	51.70
1½"	150-DC-AL	30.55	150-DC-ALH	$47.00	150-DC-BR	73.15
2"	200-DC-AL	29.20	200-DC-ALH	46.90	200-DC-BR	70.95
2½"	250-DC-AL [2]	50.70	---	---	---	---
3"	300-DC-AL	39.50	300-DC-ALH	65.30	300-DC-BR	102.00
4"	400-DC-AL	52.45	400-DC-ALH	96.50	400-DC-BR	146.00
5"	500-DC-AL	86.40	---	---	500-DC-BR	320.90
6"	600-DC-AL	129.00	600-DC-ALH	205.00	---	---
8"	800-DC-AL [1]	534.00	---	---	---	---

SAFETY ALERT

[1] Dixon and Boss-Lock cam and groove couplings *do not interchange in the 8" size*. The 8" Dixon dust cap has 2 cam arms.

[2] Parts are manufactured in Canada.

Dust caps and dust plugs are not to be used in pressure applications for safety and environmental reasons.

Boss-Lock Type H Dust Caps

dust cap

Size	356T6 Aluminum		Brass	
	Part #	Price/E	Part #	Price/E
¾"	---	---	---	---
1"	AH100	$38.25	BH100	$67.10
1¼"	AH125	38.30	BH125	74.25
1½"	AH150	39.90	BH150	78.75
2"	AH200	40.35	BH200	103.40
2½"	AH250	43.95	BH250	120.75
3"	AH300	71.40	BH300	150.60
4"	AH400	76.80	BH400	199.80
6"	AH600	198.20	BH600	480.00
8"	AH800 [1]	438.80	---	---

SAFETY ALERT

[1] Dixon and Boss-Lock cam and groove couplings *do not interchange in the 8" size*. The 8" Boss-Lock design has 2 cam arms.

Dust caps and dust plugs are not to be used in pressure applications for safety and environmental reasons.

EZ Boss-Lock Type H Dust Caps

dust cap

Size	356T6 Aluminum		Brass	
	Part #	Price/E	Part #	Price/E
¾"	---	---	---	---
1"	AH100EZ	$71.30	BH100EZ	$114.00
1¼"	---	---	---	---
1½"	AH150EZ	72.00	BH150EZ	116.30
2"	AH200EZ	72.80	BH200EZ	125.50
2½"	AH250EZ	80.00	---	---
3"	AH300EZ	103.50	BH300EZ	244.00
4"	AH400EZ	122.40	---	---
6"	AH600EZ	240.00	---	---

SAFETY ALERT

Dust caps and dust plugs are not to be used in pressure applications for safety and environmental reasons.

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

8.6 - Exterior Pipe Coating

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

Protective & Marine Coatings

DURA-PLATE® 235
MULTI-PURPOSE EPOXY

PART A	B67-235	SERIES COLORS
PART B	B67V235	HARDENER

Revised 6/11

PRODUCT INFORMATION

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PRODUCT DESCRIPTION

Dura-Plate 235 Multi-Purpose Epoxy is a modified epoxy phenalkamine, formulated specifically for immersion and atmospheric service in marine and industrial environments. Dura-Plate 235 provides exceptional performance in corrosive environment, and can be applied at temperatures as low as 0°F (-18°C).

- Self-priming
- Low temperature application, 0°F (-18°C)
- Surface tolerant - damp surfaces
- Provides salt water and fresh water immersion resistance
- Approved as a primer per MIL-PRF-23236, Type V, Class 7, Grade C
- Outstanding application properties

PRODUCT CHARACTERISTICS

Finish:	Semi-Gloss
Color:	Wide range of colors available
Volume Solids:	68% ± 2%, mixed
Weight Solids:	79% ± 2%, mixed
VOC (EPA Method 24):	Unreduced: <280 g/L; 2.33 lb/gal Reduced 10%: <327 g/L; 2.72 lb/gal
Mix Ratio:	4:1 by volume

Recommended Spreading Rate per coat:

	Minimum	Maximum
Wet mils (microns)	**6.0** (150)	**12.0** (300)
Dry mils (microns)	**4.0*** (100)	**8.0*** (200)
~Coverage sq ft/gal (m^2/L)	**136** (3.3)	**272** (6.6)
Theoretical coverage **sq ft/gal** (m^2/L) @ 1 mil / 25 microns dft	**1088** (26.6)	

*See Performance Tips section

NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.

Drying Schedule @ 6.0 mils wet (150 microns):

	@ 0°F/-18°C	@ 40°F/4.5°C	@ 77°F/25°C *50% RH*	@ 120°F/49°C
To touch:	18 hours	3.5 hours	2 hours	20 minutes
To handle:	36 hours	12 hours	3.5 hours	40 minutes
To recoat:				
minimum:	36 hours	12 hours	3.5 hours	40 minutes
maximum:	6 months	6 months	6 months	6 months
Cure to service:	30 days	14 days	7 days	3 days

If maximum recoat time is exceeded, abrade surface before recoating.

Drying time is temperature, humidity, and film thickness dependent.

Pot Life:	16 hours	8 hours	4 hours	1 hour
Sweat-in-time:	1 hour	30 minutes	15 minutes	5 minutes

Shelf Life:	Part A: 36 months, unopened Part B: 24 months, unopened Store indoors at 40°F (4.5°C) to 100°F (38°C).
Flash Point:	116°F (47°C) PMCC, mixed
Reducer/Clean Up:	Reducer R7K104

RECOMMENDED USES

For use over prepared steel and masonry surfaces.
- Salt water and fresh water immersion resistance
- Ballast tanks, offshore and marine structures
- Bilges and wet void areas
- Above- and below- water hull areas
- Decks and superstructures
- Water and waste water tanks
- Acceptable for use with cathodic protection systems.
- Dura-Plate 235 Black meets or exceeds the performance criteria of C-200; SSPC Paint 16; and Mil-P-23236B(SH) Type I or IV Class 2
- Suitable for use in USDA inspected facilities
- Conforms to MPI # 101

PERFORMANCE CHARACTERISTICS

Substrate*: Steel

Surface Preparation*: SSPC-SP10/NACE 2

System Tested*:

2 cts. Dura-Plate 235 @ 5.0 mils (125 microns) dft/ct

*unless otherwise noted below

Test Name	Test Method	Results
Abrasion Resistance	ASTM D4060 CS17 wheel, 1000 cycles, 1 kg load	65 mg loss
Adhesion	ASTM D4541	850 psi
Direct Impact Resistance	ASTM D2794	10 in lb
Dry Heat Resistance	ASTM D2485	250°F (121°C)
Moisture Condensation Resistance	ASTM D4585, 100°F (38°C), 2000 hours	Rating 10 per ASTM D610 for rusting; Rating 10 per ASTM D714 for blistering
Pencil Hardness	ASTM D3363	H

IMMERSION
(Ambient temperature)
- Salt Water.....Recommended
- Fresh Water.....Recommended
- Ballast Tank Mix .....Recommended

Epoxy coatings may darken or yellow following application and curing.

continued on back

Protective & Marine Coatings

DURA-PLATE® 235
MULTI-PURPOSE EPOXY

PART A	B67-235	SERIES COLORS
PART B	B67V235	HARDENER

PRODUCT INFORMATION

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RECOMMENDED SYSTEMS

		Dry Film Thickness / ct. Mils	(Microns)
Steel, immersion or atmospheric service:			
2 cts.	Dura-Plate 235	4.0-8.0	(100-200)
Steel, immersion service:			
1 ct.	Dura-Plate 235	4.0-8.0	(100-200)
1-2 cts.	Dura-Plate UHS	10.0-12.0	(250-300)
Steel, immersion service:			
1 ct.	Dura-Plate 235	4.0-8.0	(100-200)
1-2 cts.	TarGuard Coal Tar Epoxy	8.0-16.0	(200-400)
Steel, immersion service:			
2 cts.	Dura-Plate 235	4.0-8.0	(100-200)
2 cts.	SeaGuard Anti-Foulant (refer to respective data pages for coverage)		
Steel, atmospheric service:			
1 ct.	Dura-Plate 235	4.0-8.0	(100-200)
1-2 cts.	Macropoxy 646	5.0-10.0	(125-250)
Steel, atmospheric service:			
1 ct.	Zinc-Clad II Plus	3.0-5.0	(75-125)
1-2 cts.	Dura-Plate 235	4.0-8.0	(100-200)
Steel, atmospheric service:			
1 ct.	Zinc-Clad IV	3.0-5.0	(75-125)
1-2 cts.	Dura-Plate 235	4.0-8.0	(100-200)
Steel, atmospheric service:			
1 ct.	Corothane I GalvaPac Zinc Primer	3.0-4.0	(75-100)
1-2 cts.	Dura-Plate 235	4.0-8.0	(100-200)
Steel, atmospheric service:			
1 ct.	Dura-Plate 235	4.0-8.0	(100-200)
1-2 cts.	Acrolon 218 HS	3.0-6.0	(75-150)
or	Hi-Solids Polyurethane	3.0-5.0	(75-125)
Concrete/Masonry, immersion service:			
1 ct.	Kem Cati-Coat HS Epoxy Filler/Sealer as required to fill voids and provide a continuous substrate	10.0-20.0	(250-500)
2 cts.	Dura-Plate 235	4.0-8.0	(100-200)
Galvanized, atmospheric service:			
1 ct.	Dura-Plate 235	4.0-8.0	(100-200)

Steel-Seam FT910 - as required for filling pits, and transitioning sharp edges, weld seams, etc...

The systems listed above are representative of the product's use, other systems may be appropriate.

DISCLAIMER

The information and recommendations set forth in this Product Data Sheet are based upon tests conducted by or on behalf of The Sherwin-Williams Company. Such information and recommendations set forth herein are subject to change and pertain to the product offered at the time of publication. Consult your Sherwin-Williams representative to obtain the most recent Product Data Information and Application Bulletin.

SURFACE PREPARATION

Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.

Refer to product Application Bulletin for detailed surface preparation information.

Minimum recommended surface preparation:
Iron & Steel:
- Atmospheric: SSPC-SP2 or SSPC-SP12/NACE 5 , WJ-4
- Immersion: SSPC-SP10, 2 mil (50 micron) profile or SSPC-SP-12/NACE 5, WJ-2

Concrete & Masonry:
- Atmospheric: SSPC-SP13/NACE 6, or ICRI No. 310.2, CSP 1-3
- Immersion: SSPC-SP13/NACE 6-4.3.1 or 4.3.2, or ICRI No. 310.2, CSP1-3

Galvanized, atmospheric: SSPC-SP1

Surface Preparation Standards

	Condition of Surface	ISO 8501-1 BS7079:A1	Swedish Std. SIS055900	SSPC	NACE
White Metal		Sa 3	Sa 3	SP 5	1
Near White Metal		Sa 2.5	Sa 2.5	SP 10	2
Commercial Blast		Sa 2	Sa 2	SP 6	3
Brush-Off Blast		Sa 1	Sa 1	SP 7	4
Hand Tool Cleaning	Rusted	C St 2	C St 2	SP 2	-
	Pitted & Rusted	D St 2	D St 2	SP 2	-
Power Tool Cleaning	Rusted	C St 3	C St 3	SP 3	-
	Pitted & Rusted	D St 3	D St 3	SP 3	-

TINTING

Tint Part A with Maxitoners only. Mill White tints at 150%. Ultradeep Base tints at 100%. Five minutes minimum mixing on a mechanical shaker is required for complete mixing of color.

APPLICATION CONDITIONS

Temperature: 0°F (-18°C) minimum, 120°F (49°C) maximum (air and surface)
At least 5°F (2.8°C) above dew point
Material should be at least 40°F (4.5°C) for optimal performance.
Relative humidity: 85% maximum

Refer to product Application Bulletin for detailed application information.

ORDERING INFORMATION

Packaging:
- Part A: 1 gallon (3.78L) and 4 gallons (15.1L) in a 5 gallon (18.9L) container
- Part B: 1 quart (0.94L) and 1 gallon (3.78L)

Weight: 11.3 ± 0.2 lb/gal ; 1.35 Kg/L, mixed may vary with color

SAFETY PRECAUTIONS

Refer to the MSDS sheet before use.

Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.

WARRANTY

The Sherwin-Williams Company warrants our products to be free of manufacturing defects in accord with applicable Sherwin-Williams quality control procedures. Liability for products proven defective, if any, is limited to replacement of the defective product or the refund of the purchase price paid for the defective product as determined by Sherwin-Williams. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY SHERWIN-WILLIAMS, EXPRESSED OR IMPLIED, STATUTORY, BY OPERATION OF LAW OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Protective & Marine Coatings

DURA-PLATE® 235
MULTI-PURPOSE EPOXY

PART A	B67-235	SERIES COLORS
PART B	B67V235	HARDENER

Revised 6/11

APPLICATION BULLETIN

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SURFACE PREPARATIONS

Surface must be clean, dry, and in sound condition. Remove all oil, dust, grease, dirt, loose rust, and other foreign material to ensure adequate adhesion.

Iron & Steel, Immersion Service:
Remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1. Minimum surface preparation is Near White Metal Blast Cleaning per SSPC-SP10/NACE 2 or SSPC-SP12/NACE 5. For SSPC-SP10/NACE 2, blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils / 50 microns). For SSPC-SP12/NACE No. 5, all surfaces to be coated shall be cleaned in accordance with WJ-2. Pre-existing profile should be approximately 2 mils (50 microns). Light rust bloom is allowed. Remove all weld spatter and round all sharp edges by grinding. Prime any bare steel the same day as it is cleaned.

Iron & Steel, Atmospheric Service:
Minimum surface preparation is Hand Tool Clean per SSPC-SP2 or SSPC-SP12/NACE 5. For surfaces prepared by SSPC-SP2, first remove all oil and grease from surface by Solvent Cleaning per SSPC-SP1. For better performance, use Commercial Blast Cleaning per SSPC-SP6/NACE 3, blast clean all surfaces using a sharp, angular abrasive for optimum surface profile (2 mils). For surfaces prepared by SSPC-SP12/NACE No. 5, all surfaces shall be cleaned in accordance with WJ-4. Pre-existing profile should be approximately 2 mils (50 microns). Prime any bare steel the same day as it is cleaned.

Galvanized Steel
Allow to weather a minimum of six months prior to coating. Solvent Clean per SSPC-SP1 (recommended solvent is VM&P Naphtha). When weathering is not possible, or the surface has been treated with chromates or silicates, first Solvent Clean per SSPC-SP1 and apply a test patch. Allow paint to dry at least one week before testing adhesion. If adhesion is poor, brush blasting per SSPC-SP7 is necessary to remove these treatments. Rusty galvanizing requires a minimum of Hand Tool Cleaning per SSPC-SP2, prime the area the same day as cleaned.

Concrete and Masonry
For surface preparation, refer to SSPC-SP13/NACE 6, or ICRI No. 310.2, CSP 1-3. Surfaces should be thoroughly clean and dry. Concrete and mortar must be cured at least 28 days @ 75°F (24°C). Remove all loose mortar and foreign material. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement and hardeners. Fill bug holes, air pockets and other voids with Steel-Seam FT910.

Concrete, Immersion Service:
For surface preparation, refer to SSPC-SP13/NACE 6, Section 4.3.1 or 1.3.2 or ICRI No. 310.2, CSP 1-3.

Follow the standard methods listed below when applicable:
ASTM D4258 Standard Practice for Cleaning Concrete.
ASTM D4259 Standard Practice for Abrading Concrete.
ASTM D4260 Standard Practice for Etching Concrete.
ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete.
SSPC-SP 13/Nace 6 Surface Preparation of Concrete.
ICRI No. 310.2 Concrete Surface Preparation.

Surface Preparation Standards

	Condition of Surface	ISO 8501-1 BS7079:A1	Swedish Std. SIS055900	SSPC	NACE
White Metal		Sa 3	Sa 3	SP 5	1
Near White Metal		Sa 2.5	Sa 2.5	SP 10	2
Commercial Blast		Sa 2	Sa 2	SP 6	3
Brush-Off Blast		Sa 1	Sa 1	SP 7	4
Hand Tool Cleaning	Rusted	C St 2	C St 2	SP 2	-
	Pitted & Rusted	D St 2	D St 2	SP 2	-
Power Tool Cleaning	Rusted	C St 3	C St 3	SP 3	-
	Pitted & Rusted	D St 3	D St 3	SP 3	-

APPLICATION CONDITIONS

Temperature: 0°F (-18°C) minimum, 120°F (49°C) maximum (air and surface)
At least 5°F (2.8°C) above dew point

Material should be at least 40°F (4.5°C) for optimal performance.

Relative humidity: 85% maximum

APPLICATION EQUIPMENT

The following is a guide. Changes in pressures and tip sizes may be needed for proper spray characteristics. Always purge spray equipment before use with listed reducer. Any reduction must be compliant with existing VOC regulations and compatible with the existing environmental and application conditions.

Reducer/Clean Up ..... Reducer R7K104

Airless Spray
Unit.....30:1 Pump
Pressure.....2400 - 2800 psi
Hose.....1/4" - 3/8" ID
Tip .....015" - .019"
Filter.....60 mesh
Reduction.....As needed, up to 10% by volume

Conventional Spray
Gun .....DeVilbiss MBC-510
Fluid Tip .....E
Air Nozzle.....704
Atomization Pressure.....60-65 psi
Fluid Pressure.....5-15 psi
Reduction.....As needed, up to 10% by volume

Brush
Brush.....Natural Bristle
Reduction.....Not recommended

Roller
Cover .....3/8" woven with solvent resistant core
Reduction.....Not recommended

If specific application equipment is not listed above, equivalent equipment may be substituted.

continued on back

Protective & Marine Coatings

DURA-PLATE® 235
MULTI-PURPOSE EPOXY

PART A	B67-235	SERIES COLORS
PART B	B67V235	HARDENER

APPLICATION BULLETIN

4.67

APPLICATION PROCEDURES

Surface preparation must be completed as indicated.

Mix contents of each component thoroughly using low speed power agitation. Make certain no pigment remains on the bottom of the can. Then combine 4 parts by volume of Part A with 1 part by volume of Part B. Thoroughly agitate the mixture with power agitation. Allow the material to sweat-in as indicated prior to application. Re-stir before using.

If reducer solvent is used, add only after both components have been thoroughly mixed, after sweat-in.

Apply paint at the recommended film thickness and spreading rate as indicated below:

Recommended Spreading Rate per coat:

	Minimum	Maximum
Wet mils (microns)	**6.0** (150)	**12.0** (300)
Dry mils (microns)	**4.0*** (100)	**8.0*** (200)
~Coverage sq ft/gal (m^2/L)	**136** (3.3)	**272** (6.6)
Theoretical coverage **sq ft/gal** (m^2/L) @ 1 mil / 25 microns dft	**1088** (26.6)	

*See Performance Tips section

NOTE: Brush or roll application may require multiple coats to achieve maximum film thickness and uniformity of appearance.

Drying Schedule @ 6.0 mils wet (150 microns):

	@ 0°F/-18°C	@ 40°F/4.5°C	@ 77°F/25°C *50% RH*	@ 120°F/49°C
To touch:	18 hours	3.5 hours	2 hours	20 minutes
To handle:	36 hours	12 hours	3.5 hours	40 minutes
To recoat:				
minimum:	36 hours	12 hours	3.5 hours	40 minutes
maximum:	6 months	6 months	6 months	6 months
Cure to service:	30 days	14 days	7 days	3 days

If maximum recoat time is exceeded, abrade surface before recoating.

Drying time is temperature, humidity, and film thickness dependent.

Pot Life:	16 hours	8 hours	4 hours	1 hour
Sweat-in-time:	1 hour	30 minutes	15 minutes	5 minutes

Application of coating above maximum or below minimum recommended spreading rate may adversely affect coating performance.

CLEAN UP INSTRUCTIONS

Clean spills and spatters immediately with Reducer R7K104. Clean tools immediately after use with Reducer R7K104. Follow manufacturer's safety recommendations when using any solvent.

DISCLAIMER

The information and recommendations set forth in this Product Data Sheet are based upon tests conducted by or on behalf of The Sherwin-Williams Company. Such information and recommendations set forth herein are subject to change and pertain to the product offered at the time of publication. Consult your Sherwin-Williams representative to obtain the most recent Product Data Information and Application Bulletin.

PERFORMANCE TIPS

Stripe coat crevices, welds, and sharp angles to prevent early failure in these areas.

When using spray application, use a 50% overlap with each pass of the gun to avoid holidays, bare areas, and pinholes. If necessary, cross spray at a right angle

Spreading rates are calculated on volume solids and do not include an application loss factor due to surface profile, roughness or porosity of the surface, skill and technique of the applicator, method of application, various surface irregularities, material lost during mixing, spillage, overthinning, climatic conditions, and excessive film build.

Excessive reduction of material can affect film build, appearance, and adhesion.

Insufficient ventilation, incomplete mixing, miscatalyzation, and external heaters may cause premature yellowing.

Excessive film build, poor ventilation, and cool temperatures may cause solvent entrapment and premature coating failure.

For Immersion Service: (if required) Holiday test in accordance with ASTM D5162 for steel, or ASTM D4787 for concrete.

Do not mix previously catalyzed material with new.

Do not apply the material beyond recommended pot life.

In order to avoid blockage of spray equipment, clean equipment before use or before periods of extended downtime with Reducer R7K104.

Please contact your Sherwin-Williams Representative for recommendations for immersion service of tinted material.

When coating over aluminum and galvanizing, recommended dft is 2-4 mils (50-100 microns).

Refer to Product Information sheet for additional performance characteristics and properties.

SAFETY PRECAUTIONS

Refer to the MSDS sheet before use.

Published technical data and instructions are subject to change without notice. Contact your Sherwin-Williams representative for additional technical data and instructions.

WARRANTY

The Sherwin-Williams Company warrants our products to be free of manufacturing defects in accord with applicable Sherwin-Williams quality control procedures. Liability for products proven defective, if any, is limited to replacement of the defective product or the refund of the purchase price paid for the defective product as determined by Sherwin-Williams. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY SHERWIN-WILLIAMS, EXPRESSED OR IMPLIED, STATUTORY, BY OPERATION OF LAW OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

9.1 - Pumps

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

OPERATION & MAINTENACE MANUAL

Town of Orleans, MA
Downtown Area Collection System & PS Project 2019-02

Submersible Solids Handling Pumps & Appurtenances
Specification Section 11306

Equipment Supplier:
Atlantic Fluid Technology
354 West Boylston Street, Suite 221
West Boylston, MA 01583
(508) 755-0440
Contacts: Riccardo Ricci / Dan Weaver

Equipment List

Three(3) – **Raw Wastewater Pumps PS1.P-1,2,3** - KSB Model KRT F80-252/224XEG1-S submersible pump in cast iron construction fitted with open recessed type impeller in hardened duplex stainless steel CD4MCu material, 30 HP 3/60/460 VAC 1762 RPM motor, and with the following options / accessories. Pumps are rated for 552 GPM @ 86 ft TDH.

-50 Ft. of power cable
-30 Ft. of 1/4" 316 SS lifting chain
-3" base elbow in cast iron construction - See note 2
-316 SS upper guide rail – 2" sch 40 rails by others
-316 SS intermediate guide rail support bracket for 6" riser pipe
-Grip slide lifting device – fig 1 size
-5 year standard pump warranty
-HI certified non-witnessed factory performance tests 14.6 Level 1U
-HI Variable speed tests
-HI certified non-witnessed hydro tests. Test psi = 75 psi
-Spare Parts – None provided at this time
-Pumpsafe A motor protection relay - mounted in local monitoring panel

Two(2) – **Raw Wastewater Pumps PS2.P-1,2** - KSB Model KRT F80-252/224XEG1-S submersible pump in cast iron construction fitted with open recessed type impeller in hardened duplex stainless steel CD4MCu material, 30 HP 3/60/460 VAC 1762 RPM motor, and with the following options / accessories. Pumps are rated for 552 GPM @ 86 ft TDH.

-50 Ft. of power cable
-30 Ft. of 1/4" 316 SS lifting chain
-3" base elbow in cast iron construction - See note 2
-316 SS upper guide rail – 2" sch 40 rails by others
-316 SS intermediate guide rail support bracket for 6" riser pipe
-Grip slide lifting device – fig 1 size
-5 year standard pump warranty
-HI certified non-witnessed factory performance tests 14.6 Level 1U
-HI Variable speed tests
-HI certified non-witnessed hydro tests. Test psi = 75 psi
-Spare Parts – None provided at this time
-Pumpsafe A motor protection relay - mounted in local monitoring panel

Two(2) – **Raw Wastewater Pumps PS3.P-1,2** - KSB Model KRT F80-252/154XEG1-S submersible pump in cast iron construction fitted with open recessed type impeller in hardened duplex stainless steel CD4MCu material, 20 HP 3/60/460 VAC 1763 RPM motor, and with the following options / accessories. Pumps are rated for 305 GPM @ 71 ft TDH.

-50 Ft. of power cable
-30 Ft. of 1/4" 316 SS lifting chain
-3" base elbow in cast iron construction - See note 2
-316 SS upper guide rail – 2" sch 40 rails by others
-316 SS intermediate guide rail support bracket for 6" riser pipe
-Grip slide lifting device – fig 1 size
-5 year standard pump warranty
-HI certified non-witnessed factory performance tests 14.6 Level 1U
-HI Variable speed tests
-HI certified non-witnessed hydro tests. Test psi = 75 psi
-Spare Parts – None provided at this time
-Pumpsafe A motor protection relay - mounted in local monitoring panel

Seven(7) – Local monitoring panel / junction box mounted in wall mount Nema 4X 316 stainless steel outdoor enclosure (12"H x 12"W x 8" D) complete with motor power connection terminals, fault lights, KSB pump motor protection relay Pumpsafe A mounted and wired.

Spare Parts

Description	PN
Five(5) – Oring and gasket kit	TBD
Two(2) – Oring and gasket kit (PS3 pumps)	TBD
One(1) – Propeller removal bolt (special tool - fits all pumps)	11197784

Project	**Orleans MA**
Customer pos.no	
Project ID	**Submersible Raw Sewage Pumps**
Pos.no	
Created by	

Created 7/31/2020
Update 7/31/2020

PS1 and PS2 Pumps

Data sheet

Pump type KRT F 80-252/224XEG1-S

Operating data

Flow	560	US g.p.m.	Fluid			
Head	86.2	ft	Density of fluid	62.3	lb/ft³	
Operating speed	1773	rpm	Viscosity	1.08E-5	ft²/s	
Shaft power	22.3	hp	Temperature	68	°F	
Efficiency	55	%				
Required pump NPSH	22.2	ft				
Head H(Q=0)	122	ft				
Application range	Head		Flow			
From	121	ft	4.86	US g.p.m.		
To	43.2	ft	1100	US g.p.m.		

Design

Make	KSB	Impeller type	Vortex impeller		
Design	Submersible pump		Open		
Series	KRT F	Impeller size	(260)	10 1/4	inch
Frame size	80-252		Max. (265)	10 7/16	inch
Stages	1		Min. (190)	7 1/2	inch
Curve number	K43400s/0	Free passage		3 inch	inch
		Weight			lb

Type of bearings	Antifriction		
Nos. of bearings	1 / 1		
Lubrication	Grease lubrication. lubricated for lifetime		
Suction port	Pressure rating		--
	Flange size	DN0	---
	Flange size	DN1	4"
	Norm		--
Discharge port	Pressure rating		CLASS 125
	Flange size	DN2	3 inch
	Flange size	DN3	3 inch
	Norm		ASME/ANSI B16.1

Suction port: pump (DN1)
Discharge port: discharge elbow (DN3)

Materials

Pump casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Discharge cover	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Impeller	Duplex stainless steel EN-1.4517 (A 890 CD4MCu)
Shaft	Stainless steel EN-1.4021+QT800 (A 276 Type 420)
Bearing bracket	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bolts. nuts	Stainless steel A4 (EN-1.4571) (A 276 Type 316)
Shaft protection sleeve	---
Casing wear ring	
Impeller wear ring	
O-Rings	Nitrile rubber (NBR)

KSB Inc., 4415 Sarellen Road, Richmond, Virginia 23231, Phone: 001-804-222-1818, Fax: 001-804-226-6961
KSB Pumps Inc, 5885 Kennedy Road, Mississauga, Ontario L4Z 2G3 (Canada), Phone: (0905) 568-9200, Fax: (0905) 568-9120
KSB Aktiengesellschaft, Turmstrasse 92, 06110 Halle (Germany), Phone +49 (345) 48260, Fax +49 (345) 4826 4699, www.ksb.com

4.3.12 - 2019/06/25 (Build 259) 10.10.2019 15:25 UTC+2,00 ALL USA

Data sheet

Pump type **KRT F 80-252/224XEG1-S**

Shaft seal

Type of seal	Double mechanical seal
Arrangement:	Tandem
Seal on medium side	with elastomer bellows
Mechanical seal. pump-side	Silicon carbide / Silicon carbide
Mechanical seal. bearing-side	Carbon / Silicon carbide

Monitoring

Thermal winding protection	By temperature sensitive switches
Explosion proof protection	By PTC (Explosion proof models only)
Motor housing monitoring	By conductive moisture sensor electrode
Mechanical seal leakage detection	---
Bearing temperature monitoring	---

Coating

Preparatory treatment	SSPC near white SP 10
Blasting method	Steel grit blasting
Primer	Zinc phosphate or Zinc dust
Dry film thickness primer	> 1 1/2 mils (35 microns)
Top coat	2-component epoxy resin
Solids content	> 82 %
Dry film thickness top coat	> 6 mils (150 microns)
Color	Ultramarine Blue (RAL 5002 to DIN 6174)

Installation

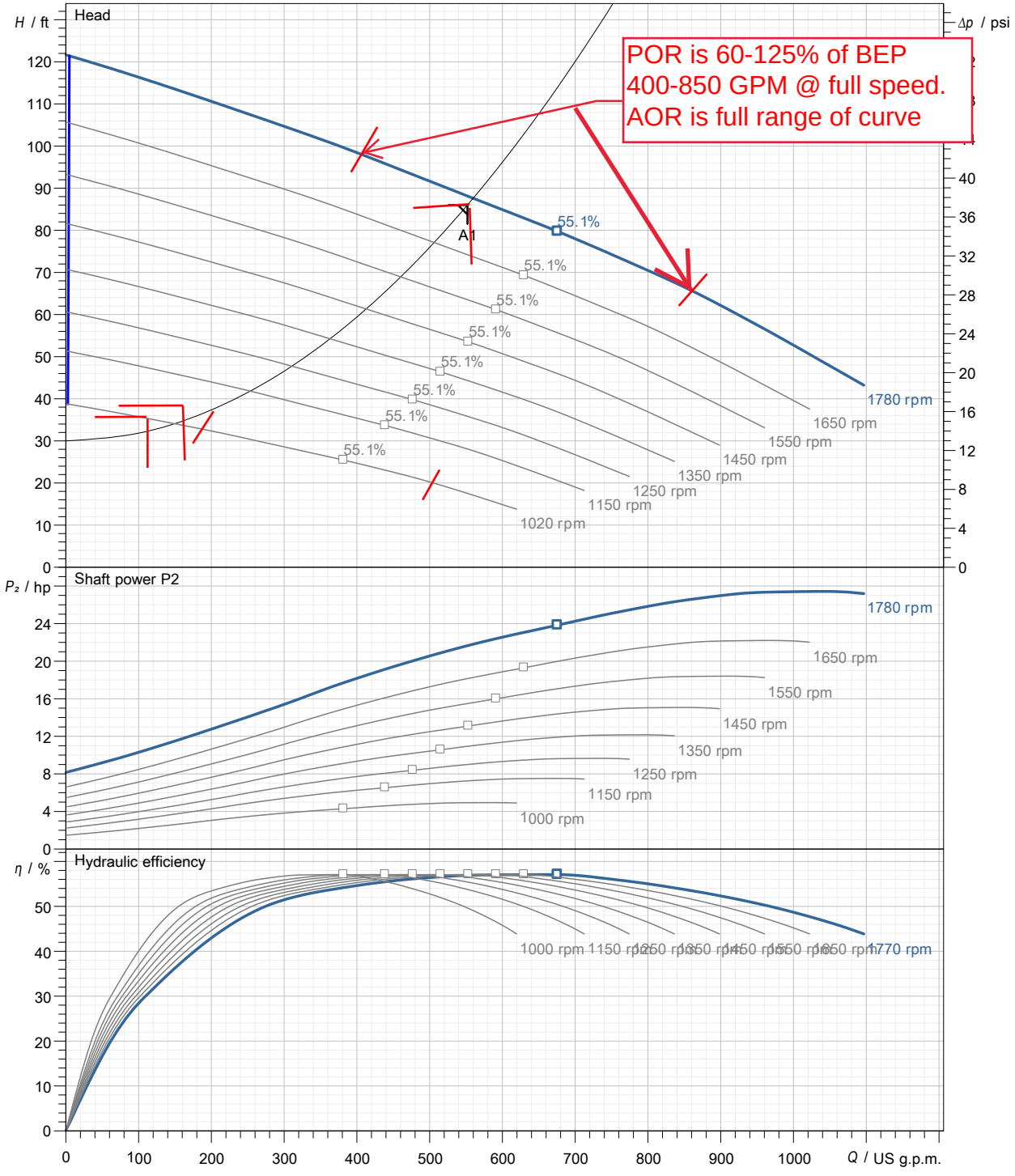
INSTALLATION	
Type of installation: automatic connection to a permanently installed discharge elbow	Wet well installation designed for
Discharge elbow size (DN2/DN3):	3 inch / 4 inch
Flange to suit:	ASME/ANSI B16.1, CLASS 125
Claw:	Bolted to the pump
Guide system:	Double guide bars, by contractor
Guide bar dimension:	2" diameter pipes
Installation depth:	15 ft (4.5 m)
Lifting device:	stainless steel lifting chain
Length of lifting device:	33 ft (10 m)
Lifting loops:	Every 8 ft (2.5 m)
Installation accessories: fasteners, claw, bracket, lifting chain, but without guide bars	Discharge elbow, 3 inch / 4 inch
Materials:	
Discharge elbow:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Claw:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bracket:	Stainless steel EN-1.4571 (A 276 Type 316 Ti)
Lifting device:	Stainless steel EN-1.4404 (A 276 Type 316L)

INSTALLATION

4.3.12 - 2019/06/25 (Build 259) 10.10.2019 15:25 UTC+2.00 ALL USA

Performance curve

Pump type **KRT F 80-252/224XEG1-S**



Impeller type	Vortex impeller , Open			Curve number	K43400s/0
Free passage	3 inch	Density of fluid	62.322 lb/ft³	Frequency	60 Hz
Impeller size	10 1/4inch (260)	Viscosity	1.082E-5 ft²/s	Speed	1780 1/min

KSB Inc., Richmond, VA. / KSB Pumps Inc., Mississauga, Ontario / KSB AG, Halle (Germany)

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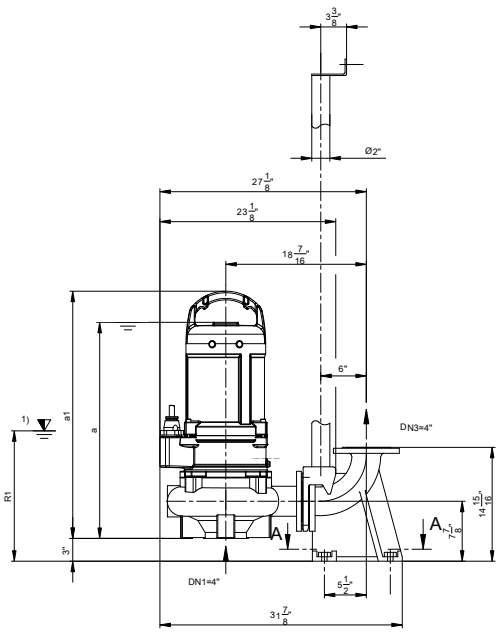
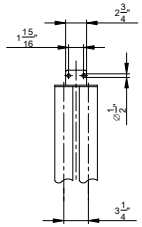
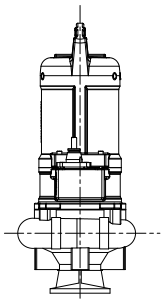
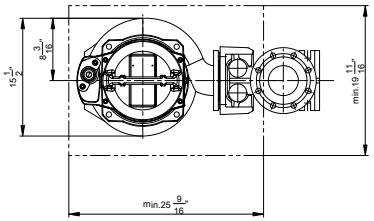






Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	a			a1			Gewicht / Weight / Poids					
		50 Hz	60 Hz		50 Hz	60 Hz		G		H		C1, C2	
		mm	mm	inch	mm	mm	inch	kg	lbs	kg	lbs	kg	lbs
F	154 KA16							190	419	195	430	195	430
	~~184 KA16~~	721	721	28 3/8	825	825	32 1/2	200	441	205	452	205	452
	224 KA16							213	470	218	481	218	481
	156 KA16	--			--			196	432	201	443	201	443
	186 KA16	--			--			212	468	217	479	217	479
	74 KA13	667	667	26 1/4	771	771	30 3/8	162	357	166	366	166	366
	114 KA13							169	373	174	384	174	384
	76 KA13	--			--			161	355	166	366	166	366
	116 KA13	--			--			169	373	174	384	174	384

Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	R1 U...X...Y...W...- Motor/Engine/Moteur		Z...- Motor/Engine/Moteur	
		mm	inch	mm	inch
F	154 KA16	325	12 13/16	420	16 9/16
	184 KA16				
	224 KA16				
	156 KA16				
	186 KA16				
	74 KA13				
	114 KA13				
	76 KA13				
	116 KA13				



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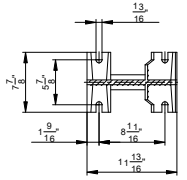


1)Lowest shut-off point for automatic operation

Maßstab/Scale/Echelle 1:10				stationäre Aufstellung stationary installation installation stationnaire
CAD A 2				Baureihe-Größe/Type-Size KRT F 80-252
KSB	0	2018-04-13	emmrpat	KSB Auftraga-Nr./KSB Order No./N° commande KSB ----------
	Änderung/Revision/Modification	Datum/Date	Name/Nom	
KSB SE & Co. KGaA Turmstraße 92-100 D-06110 Halle (Saale)	CAD-BEZEICHNUNG SCHUTZVERMERK DIN 34-1-D			Zeichnungs-Nr./Drawing No./N° Plan

4.3.12 - 2019/06/25 (Build 259)

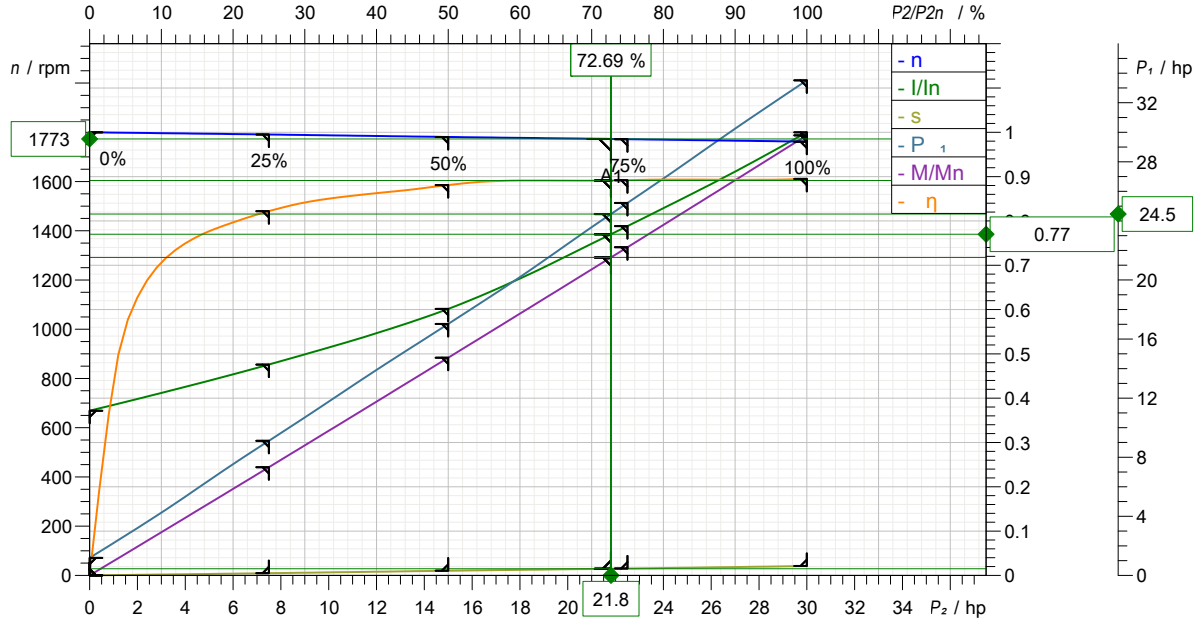
Data sheet: Motor data

Motor type **224XEG**

Motor manufacturer	KSB SE & Co. KGaA	Rated voltage	460	V
Design acc. standard	-	Rated frequency	60	Hz
Service factor	1.15	Rated HP (D.O.L) or VFD	30	hp
Degree of protection	IP68	Rated current	37.4	A
Insulation class		Nominal speed	1762	rpm
Starting mode	Direct starting	NEMA code letter	G	
No. starts / h	10	Starting to rated current	6.3	
Coolant temperature	< / = 104 °F (40 °C)	Starting current	235.6	A
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)			
Explosion protection	Class I, Div. 1, Groups C,D, T3			
Pump type	KRT F 80-252/224XEG1-S			

Load	P1 kW	P2 hp	eta %	cos phi	I A
4/4	24.99	30.0	89.5	0.84	37.4
3/4	18.81	22.5	89.2	0.8	29.5
2/4	12.70	15.0	88.1	0.71	22.5
1/4	6.80	7.5	82.2	0.48	17.8

Main cable	1 x AWG 9-7+15-5	Diameter	0.94 inch...1.06 inch
Control cable	---	Diameter	
Cable. outer sheath	Waterproof synthetic rubber compound		
Cable length	50 ft (15 m)		



KSB Inc., 4415 Sarellen Road, Richmond, Virginia 23231, Phone: 001-804-222-1818, Fax: 001-804-226-6961
KSB Pumps Inc, 5885 Kennedy Road, Mississauga, Ontario L4Z 2G3 (Canada), Phone: (0905) 568-9200, Fax: (0905) 568-9120

KSB Aktiengesellschaft, Turmstrasse 92, 06110 Halle (Germany), Phone +49 (345) 48260, Fax +49 (345) 4826 4699, www.ksb.com

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Project	**Orleans MA**		
Customer pos.no			
Project ID	**Submersible Raw Sewage Pumps**		
Pos.no		Page	1 / 5
Created by	PS3 Pumps	Created	7/31/2020
		Update	7/31/2020

Data sheet

Pump type **KRT F 80-252/154XEG1-S**

Operating data

Flow	350	US g.p.m.	Fluid			
Head	76.0	ft	Density of fluid	62.3	lb/ft³	
Operating speed	1774	rpm	Viscosity	1.08E-5	ft²/s	
Shaft power	13	hp	Temperature	68	°F	
Efficiency	51	%				
Required pump NPSH	18.2	ft				
Head H(Q=0)	102	ft				
Application range	Head		Flow			
From	101	ft	4.86	US g.p.m.		
To	33.2	ft	874	US g.p.m.		

Design

Make	KSB	Impeller type	Vortex impeller		
Design	Submersible pump		Open		
Series	KRT F	Impeller size	(249)	9 13/16	inch
Frame size	80-252		Max. (265)	10 7/16	inch
Stages	1		Min. (190)	7 1/2	inch
Curve number	K43400s/0	Free passage		3 inch	inch
		Weight			lb

Type of bearings	Antifriction		
Nos. of bearings	1 / 1		
Lubrication	Grease lubrication. lubricated for lifetime		
Suction port	Pressure rating		--
	Flange size	DN0	---
	Flange size	DN1	4"
	Norm		--
Discharge port	Pressure rating		CLASS 125
	Flange size	DN2	3 inch
	Flange size	DN3	3 inch
	Norm		ASME/ANSI B16.1

Suction port: pump (DN1)
Discharge port: discharge elbow (DN3)

Materials

Pump casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Discharge cover	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Impeller	Duplex stainless steel EN-1.4517 (A 890 CD4MCu)
Shaft	Stainless steel EN-1.4021+QT800 (A 276 Type 420)
Bearing bracket	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bolts. nuts	Stainless steel A4 (EN-1.4571) (A 276 Type 316)
Shaft protection sleeve	---
Casing wear ring	
Impeller wear ring	
O-Rings	Nitrile rubber (NBR)

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KSB Inc., 4415 Sarellen Road, Richmond, Virginia 23231, Phone: 001-804-222-1818, Fax: 001-804-226-6961
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KSB Aktiengesellschaft, Turmstrasse 92, 06110 Halle (Germany), Phone +49 (345) 48260, Fax +49 (345) 4826 4699, www.ksb.com

Data sheet

Pump type **KRT F 80-252/154XEG1-S**

Shaft seal

Type of seal	Double mechanical seal
Arrangement:	Tandem
Seal on medium side	with elastomer bellows
Mechanical seal. pump-side	Silicon carbide / Silicon carbide
Mechanical seal. bearing-side	Carbon / Silicon carbide

Monitoring

Thermal winding protection	By temperature sensitive switches
Explosion proof protection	By PTC (Explosion proof models only)
Motor housing monitoring	By conductive moisture sensor electrode
Mechanical seal leakage detection	---
Bearing temperature monitoring	---

Coating

Preparatory treatment	SSPC near white SP 10
Blasting method	Steel grit blasting
Primer	Zinc phosphate or Zinc dust
Dry film thickness primer	> 1 1/2 mils (35 microns)
Top coat	2-component epoxy resin
Solids content	> 82 %
Dry film thickness top coat	> 6 mils (150 microns)
Color	Ultramarine Blue (RAL 5002 to DIN 6174)

Installation

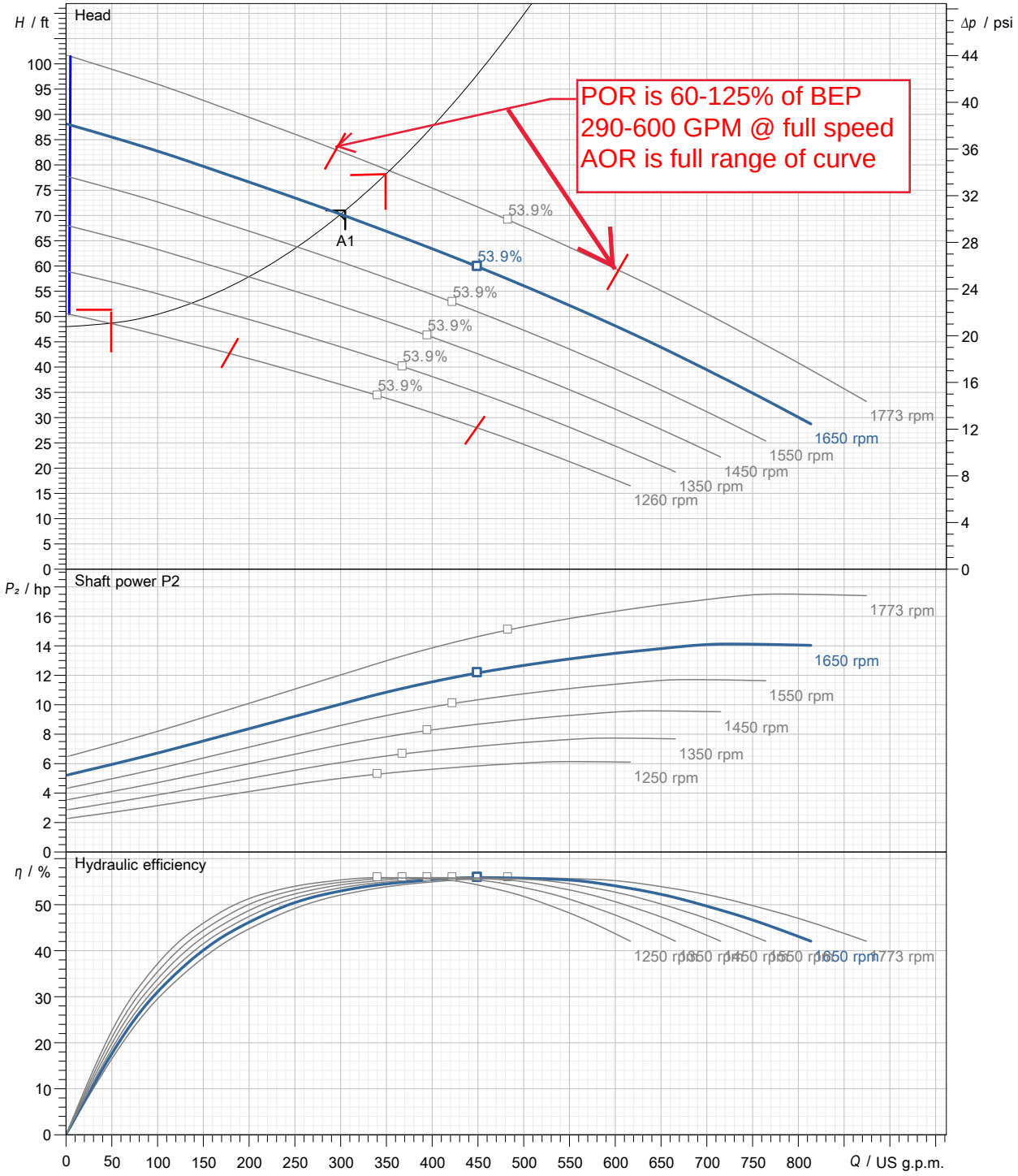
INSTALLATION	
Type of installation: automatic connection to a permanently installed discharge elbow	Wet well installation designed for
Discharge elbow size (DN2/DN3):	3 inch / 4 inch
Flange to suit:	ASME/ANSI B16.1, CLASS 125
Claw:	Bolted to the pump
Guide system:	Double guide bars, by contractor
Guide bar dimension:	2" diameter pipes
Installation depth:	33 ft (10 m)
Lifting device:	stainless steel lifting chain
Length of lifting device:	33 ft (10 m)
Lifting loops:	Every 8 ft (2.5 m)
Installation accessories: fasteners, claw, bracket, lifting chain, but without guide bars	Discharge elbow, 3 inch / 4 inch
Materials:	
Discharge elbow:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Claw:	Grey cast iron EN-GJL-250 (A 48 Class 35B)
Bracket:	Stainless steel EN-1.4571 (A 276 Type 316 Ti)
Lifting device:	Stainless steel EN-1.4404 (A 276 Type 316L)

INSTALLATION

4.3.12 - 2019/06/25 (Build 259) 10.10.2019 15:25 UTC+2.00 ALL USA

Performance curve

Pump type **KRT F 80-252/154XEG1-S**



Impeller type	Vortex impeller , Open			Curve number	K43400s/0
Free passage	3 inch	Density of fluid	62.322 lb/ft³	Frequency	60 Hz
Impeller size	9 13/16inch (249)	Viscosity	1.082E-5 ft²/s	Speed	1773 1/min

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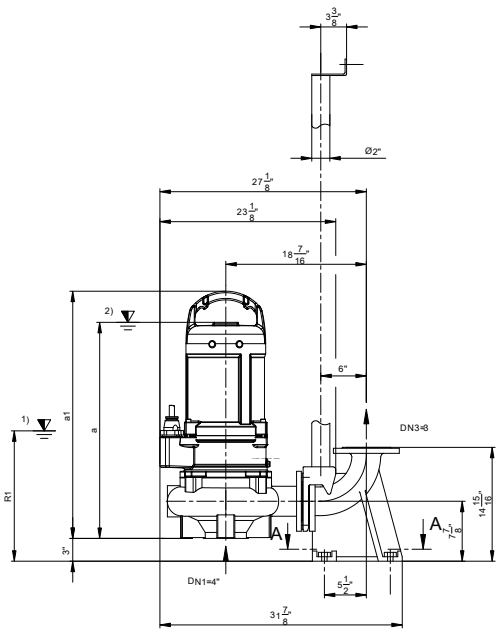

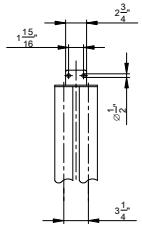

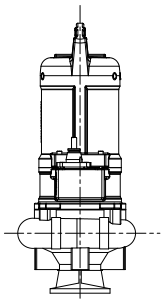

Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	a 50 Hz mm	a 60 Hz mm	a 60 Hz inch	a1 50 Hz mm	a1 60 Hz mm	a1 60 Hz inch	Gewicht / Weight / Poids G kg	G lbs	H kg	H lbs	C1, C2 kg	C1, C2 lbs
F	154 KA16	721	721	28 3/8	825	825	32 1/2	190	419	195	430	195	430
	184 KA16							200	441	205	452	205	452
	[illegible]							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	481
	156 KA16	--			--			196	432	201	443	201	443
	186 KA16	--			--			212	468	217	479	217	479
	74 KA13	667	667	26 1/4	771	771	30 3/8	162	357	166	366	166	366
	114 KA13							169	373	174	384	174	384
	76 KA13	--			--			161	355	166	366	166	366
	116 KA13	--			--			169	373	174	384	174	384

Hydraulik Hydraulics Hydraulique	KSB-Motor KSB-Engine KSB-Moteur	R1 U...X...Y...W...- Motor/Engine/Moteur mm	R1 U...X...Y...W...- Motor/Engine/Moteur inch	R1 Z...- Motor/Engine/Moteur mm	R1 Z...- Motor/Engine/Moteur inch
F	154 KA16	325	12 13/16	420	16 9/16
	184 KA16				
	224 KA16				
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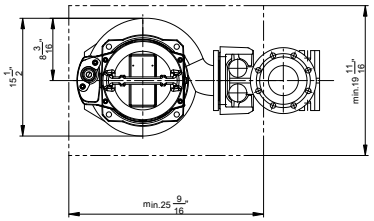
	74 KA13				
	114 KA13				
	76 KA13				
	116 KA13				



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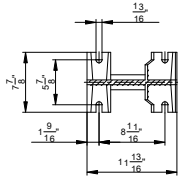


1)Lowest shut-off point for automatic operation

Maßstab/Scale/Echelle 1:10			stationäre Aufstellung stationary installation installation stationnaire
CAD A 2			Baureihe-Größe/Type-Size KRT F 80-252
KSB	0	2018-04-13 emmrpat	KSB Auftraga-Nr./KSB Order No./N° commande KSB ----------
KSB SE & Co. KGaA Tramstraße 92-100 D-06110 Halle (Saale)	Änderung/Revision Modification	Datum/Date Name/Nom	Zeichnunga-Nr./Drawing No./N° Plan
	CAD-BEZEICHNUNG		
	SCHUTZVERMERK DIN 34-1-D		

4.3.12 - 2019/06/25 (Build 259)

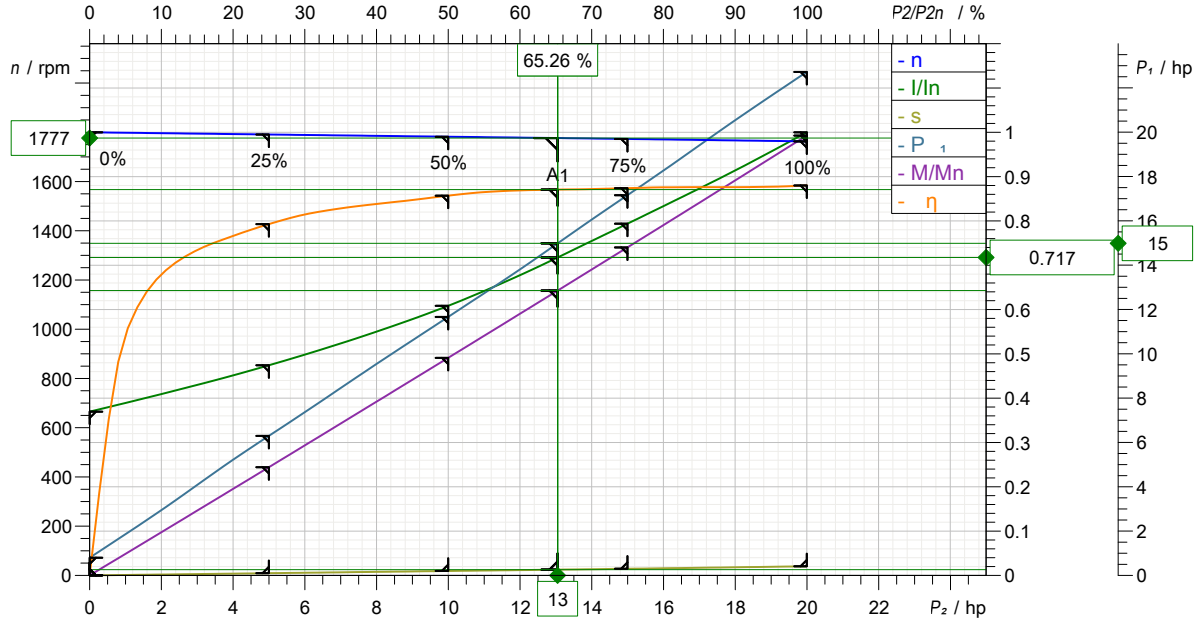
Data sheet: Motor data

Motor type **154XEG**

Motor manufacturer	KSB SE & Co. KGaA	Rated voltage	460	V
Design acc. standard	-	Rated frequency	60	Hz
Service factor	1.15	Rated HP (D.O.L) or VFD	20	hp
Degree of protection	IP68	Rated current	25.3	A
Insulation class		Nominal speed	1763	rpm
Starting mode	Direct starting	NEMA code letter	G	
No. starts / h	10	Starting to rated current	6.1	
Coolant temperature	< / = 104 °F (40 °C)	Starting current	154.3	A
Motor casing	Grey cast iron EN-GJL-250 (A 48 Class 35B)			
Explosion protection	Class I, Div. 1, Groups C,D, T3			
Pump type	KRT F 80-252/154XEG1-S			

Load	P1 kW	P2 hp	eta %	cos phi	I A
4/4	16.94	20.0	88.0	0.84	25.3
3/4	12.80	15.0	87.3	0.8	20.1
2/4	8.70	10.0	85.6	0.71	15.4
1/4	4.70	5.0	79.2	0.49	12.0

Main cable	1 x AWG 13-12	Diameter	0.73 inch...0.77 inch
Control cable	---	Diameter	
Cable. outer sheath	Waterproof synthetic rubber compound		
Cable length	50 ft (15 m)		



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Submersible Motor Pump

Amarex KRT

Sizes DN 40 to DN 300; 60 Hz
Motor sizes
2 Poles: 3 2.E to 75 2.E
4 Poles: 2 4.E to 75 4.E
6 Poles: 7 6.E to 55 6.E
8 Poles: 11 8.E to 45 8.E

Orleans MA Project
KSB Factory Order: 9974530833
PS1: 412739,412740,412741
PS2: 412742, 412743
PS3: 413055, 413056

Installation/Operating Manual

Mat. No.: 01654473

KSB

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Glossary

Back pull-out unit

Pump without pump casing; partly completed machinery

Certificate of decontamination

If a product is to be returned to the manufacturer, the customer declares in a certificate of decontamination that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

Close-coupled design

Motor directly fitted to the pump via a flange or a drive lantern

Discharge line

The pipeline which is connected to the discharge nozzle

Hydraulic system

The part of the pump in which the kinetic energy is converted into pressure energy

Noise characteristics

The noise characteristics are indicated as surface sound pressure level in dB(A).

Pump set

Complete pump set consisting of pump, drive, additional components and accessories

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

1 General

1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover (for details, refer to the table below).

Table 1: Variants covered by this manual

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH	H	C1	C2
40-252	F, K, S	F, K, S	F, K	F, K	F, K	F, K	F, K	F, K
50-215	F	F	F	F	F	F	F	F
50-216	F, S	F, S	F	F	F	F	F	F
65-215	F	F	F	F	F	F	F	F
65-216	E	E	-	-	-	-	-	-
65-217	F	F	F	F	F	-	-	-
80-216	E, F	E, F	F	F	F	F	F	F
80-217	F	F	F	F	F	-	-	-
80-252	F	F	F	F	F	F	F	F
80-253	E, F, K	E, F, K	F, K	F, K	F, K	F, K	F, K	F, K
80-315	D	D	D	-	-	-	-	-
80-317	D	D	D	-	-	-	-	-
100-215	F	F	F	F	F	-	-	-
100-253	D, E, K	D, E, K	D, K	K	K	K	K	K
100-254	F, K	F, K	F, K	F, K	F, K	F, K	F, K	F, K
100-255	E	E	-	-	-	-	-	-
100-315	D	D	D	-	-	-	-	-
100-316	D, F, K	D, F, K	D, F, K	F, K	F, K	F, K	F, K	F, K
100-317	E	E	-	-	-	-	-	-
100-400	K	K	K	-	K	-	K	K
100-401	E, F, K	E, F, K	F, K	-	F, K	F, K	F, K	F, K
150-253	D	D	D	-	-	-	-	-
150-315	D, F, K	D, F, K	D, F, K	F, K	F, K	F, K	F, K	F, K
150-317	E, K	E, K	K	K	K	K	K	K
150-400	D, K	D, K	D, K	K	K	K	K	K
150-401	D, E, F, K	D, E, F, K	D, F, K	K	F, K	F, K	F, K	F, K
150-403	K	K	K	K	K	K	K	K
151-401	K	K	K	-	K	K	K	K
151-403	K	K	K	K	K	K	K	K
200-315	D, K	D, K	D, K	K	K	K	K	K
200-316	K	K	K	K	K	K	K	K
200-317	K	K	K	K	K	-	-	-
200-318	K	K	K	K	K	-	-	-
200-330	K	K	K	K	K	K	K	K
200-400	D	D	D	-	-	-	-	-
200-401	E, K	E, K	K	K	K	K	K	K
200-402	K	K	K	K	K	K	K	K
200-403	K	K	K	K	K	K	K	K
250-400	D, K	D, K	D, K	K	K	K	K	K
250-401	K	K	K	K	K	K	K	K
250-403	K	K	K	K	K	K	K	K

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH	H	C1	C2
300-400	D, K	D, K	D, K	K	K	K	K	K
300-401	K	K	K	K	K	K	K	K
300-403	K	K	K	K	K	K	K	K

The manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series and size, the main operating data, the order number and the order item number. The order number and order item number clearly identify the pump set and serve as identification for all further business processes.

In the event of damage, immediately contact your nearest KSB Service center to maintain the right to claim under warranty.

Observe the noise characteristics, indicated as surface sound pressure level.
(⇨ Section 4.7, Page 22)

1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance.

1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇨ Section 2.4, Page 12)

1.4 Other applicable documents

Table 2: Overview of other applicable documents

Document	Contents
Data sheet	Technical data of the pump set
General arrangement drawing/ outline drawing	Mating dimensions, installation dimensions and weights of the pump set
Hydraulic characteristic curve	Characteristic curves showing head, flow rate, efficiency and power input
General assembly drawing[1)]	Sectional drawing of the pump set with part numbers
Sub-supplier product literature[1)]	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists[1)]	Description of spare parts
Supplementary operating manual[1)]	E.g. for special accessories

For accessories and/or integrated machinery components observe the product literature of the corresponding manufacturer.

1.5 Symbols

Table 3: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action

1) If agreed to be included in the scope of supply

Symbol	Description
⇨	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

2 Safety

DANGER

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

2.1 Key to safety symbols/markings

Table 4: Definition of safety symbols/markings

Symbol	Description
DANGER	**DANGER** This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	General hazard In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	Electrical hazard In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	Machine damage In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

2.2 General

This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.

The safety information in all sections of this manual must be complied with.

The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.

The contents of this operating manual must be available to the specialist personnel at the site at all times.

Information attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:

- Arrow indicating the direction of rotation
- Markings for connections
- Name plate

The operator is responsible for ensuring compliance with all local regulations which are not taken into account.

2.3 Intended use

- The pump (set) must only be operated within the operating limits which are described in the other applicable documents.
- Only operate pump sets which are in perfect technical condition.
- Do not operate partially assembled pump sets.
- Only use the pump (set) to handle the fluids described in the data sheet or product literature of the pump variant.
- Never operate the pump set without the fluid to be handled.

- Observe the limits for continuous duty specified in the data sheet or product literature (Q_{min} and Q_{max}) (to prevent damage such as shaft fracture, bearing failure, mechanical seal damage, etc).
- When untreated waste water is handled, the duty points in continuous operation lie within 0.7 to 1.2 × $Q_{opt}$to minimize the risk of clogging/hardening.
- Avoid duty points for continuous operation at very low speeds and small flow rates (< 0.7 x Q_{opt}).
- Observe the minimum flow rates and maximum flow rates indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the pump set (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.
- Only use the respective impeller types in combination with the fluids described below.

	Impeller with cutter (impeller type S/S-max)
	Free-flow impeller (impeller type F/F-max)
	Closed single-channel impeller (impeller type E/E-max)
	Open, diagonal single-vane impeller (impeller type D)
	Closed multi-channel impeller (impeller type K/K-max)

- Use in the Amajet system
  See Amajet installation/operating manual for installation types.
  The following sizes are approved for use in the Amajet system:
  - F 100-254
  - D 100-253
  - F 150-315
  - D 100-316
  - D 150-253
  - D 150-315

Prevention of foreseeable misuse

- Observe the minimum flow velocities required to fully open the swing check valves to prevent the reduction of pressure and risk of clogging.
  (Contact the manufacturer for the required minimum flow velocities/loss coefficients.)
- Never exceed the permissible operating limits (pressure, temperature, etc.) specified in the data sheet or product literature.
- Observe all safety information and instructions in this manual.

2.4 Personnel qualification and personnel training

All personnel involved must be fully qualified to transport, install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by sufficiently trained specialist personnel training and instructing the personnel who will carry out the respective tasks. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

2.5 Consequences and risks caused by non-compliance with these operating instructions

- Non-compliance with these operating instructions will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices
  - Hazard to the environment due to leakage of hazardous substances

2.6 Safety awareness

In addition to the safety information contained in this manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

2.7 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If shutting down the pump does not increase potential risk, fit an emergency stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.8 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorized by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation is performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energized).
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇨ Section 6.3, Page 56)
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇨ Section 6.1, Page 50)

2.9 Unauthorized modes of operation

Never operate the pump (set) outside the limits stated in the data sheet and in this manual.

The warranty relating to the operating reliability and safety of the pump (set) supplied is only valid if the equipment is used in accordance with its intended use.

2.10 Explosion protection

Special conditions apply to the operation of explosion-proof pumps.

- The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its intended use.
- The limits stated in the data sheet and on the name plate must not be exceeded under any circumstances.
- Correct monitoring of the motor temperature is imperative to ensure explosion protection.
- Observe the wiring diagrams.
- Never operate an explosion-proof pump set without temperature monitoring.
- Modifications or alteration of the pump set could affect explosion protection and are only permitted after consultation with the manufacturer.
- Only original spare parts and accessories authorized by the manufacturer must be used for explosion-proof pumps.

3 Transport/Temporary Storage/Disposal

3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the distributor and the insurance company about the damage in writing immediately.

3.2 Transport

DANGER

Improper transport

Danger to life from falling parts!

Damage to the pump set!

- Use the attachment point provided for attaching the lifting accessory.
- Never suspend the pump set by its power cable.
- Use the lifting chain/rope included in the scope of supply exclusively for lowering or lifting the pump set into/out of the pump sump.
- Securely attach the lifting chain/rope to the pump and crane.
- Use tested, marked and approved lifting accessories only.
- Observe the regional transport regulations.
- Observe the documentation of the lifting accessory manufacturer.
- The load-carrying capacity of the lifting accessories must exceed the weight indicated on the name plate of the pump set to be lifted. Take into account any additional system components to be lifted.

To transport the pump set suspend it from the lifting tackle as shown.

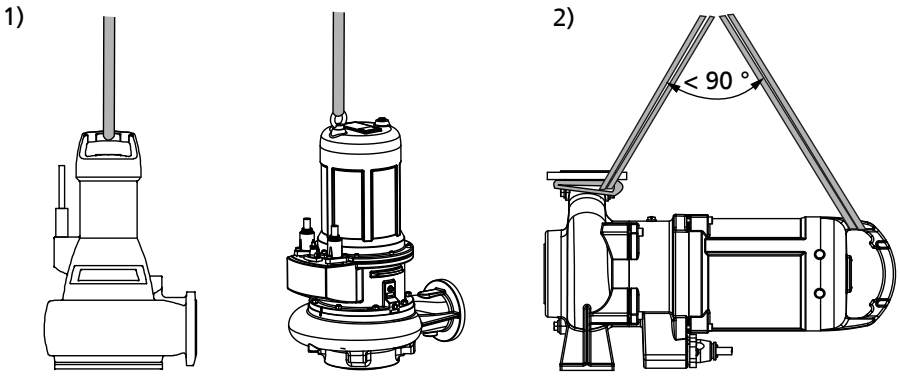


Fig. 1: Transporting the pump set 1) vertical installation 2) horizontal installation

Placing down the pump set

WARNING

Incorrect positioning/placing down

Personal injury and damage to property!

- Position the pump set vertically with the motor on top.
- Use appropriate means to secure the pump set against tilting and tipping over.
- Refer to the weights given in the data sheet/on the name plate.

⚠ WARNING

Improper placing of pump sets in a vertical/horizontal position

Personal injury and damage to property!

- Use appropriate means to secure the pump set against tilting or tipping over.
- Use two sets of lifting equipment when handling large pump sets if possible (using the attachment point provided on the motor and the discharge nozzle).
- Secure power cables against falling down.
- Use additional supports for the transport holder to secure it against tilting.
- Maintain adequate safety distance during lifting operations.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

⚠ WARNING

Placing the pump set on unsecured and uneven surfaces

Personal injury and damage to property!

- Always place the pump set on a solid and level surface with the pump set in a vertical position and the motor on top.
- Only place the pump set on a surface of sufficient load-carrying capacity.
- Use appropriate means to secure the pump set against tilting or tipping over.

It may be necessary to place the pump set down in a horizontal position during maintenance or installation.

3.3 Storage/Preservation

If commissioning is to take place some time after delivery, we recommend that the following measures be taken:

CAUTION

Improper storage

Damage to the power cables!

- Support the power cables at the cable entry to prevent permanent deformation.
- Only remove the protective caps from the power cables at the time of installation.

CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of the pump (set)!

- For outdoor storage cover the pump (set) or the packaged pump (set) and accessories with waterproof material.

CAUTION

Wet, contaminated or damaged openings and connections

Leakage or damage to the pump!

▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.

Table 5: Ambient conditions for storage

Ambient conditions	Value
Relative humidity	5 % to 85 % (non-condensing)
Ambient temperature	-4 °F to 158 °F [- 20 °C to + 70 °C]

- Store the pump set under dry and vibration-free conditions, if possible in its original packaging.

1. Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative.
2. Spray the preservative through the suction and discharge nozzles.
   It is advisable to then close the pump nozzles (e.g. with plastic caps or similar).

NOTE

Observe the manufacturer's instructions for application/removal of the preservative.

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇨ Section 7.3, Page 68)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump must also be neutralized, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.
   Always indicate any safety measures and decontamination measures taken.
   (⇨ Section 10, Page 118)

NOTE

If required, a blank certificate of decontamination can be downloaded from the KSB web site at: www.ksb.com/certificate_of_decontamination

3.5 Disposal

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Dismantle the pump (set).
   Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
   - Metals
   - Plastics
   - Electronic waste
   - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

4 Description of the Pump (Set)

4.1 General description

Pump for handling untreated waste water containing long fibers and solid substances, liquids containing air/gas, and raw sludge, activated sludge and digested sludge.

4.2 Designation

F80-252/224XEG1-S
F80-252/154XEG1-S (PS3)

Example: Amarex KRT F 50 - 215 / 32XEC1 - S IE3

Table 6: Designation key

Code	Description	
Amarex KRT	Type series	
F	Impeller type	
50	Nominal discharge nozzle diameter [mm]	
215	Maximum nominal impeller diameter [mm]	
3	Motor size	
2	Number of motor poles	
XE	Motor version	
	UE	Not explosion-proof, for fluid temperatures of up to 104 °F [40 °C]
	WE	Not explosion-proof, for fluid temperatures of up to 140 °F [60 °C]
	XE	Explosion-proof, for fluid temperatures of up to 104 °F [40 °C]
	ZE	Explosion-proof, for fluid temperatures of up to 140 °F [60 °C]
C1	Material variant	
	G	Standard design, gray cast iron
	G1	Like G with impeller made of duplex stainless steel
	G2	Like G with impeller made of white cast iron
	GH	Like G with impeller and discharge cover made of white cast iron
	H	Like G with impeller, discharge cover and pump casing made of white cast iron
	C1	Wetted components made of duplex stainless steel, mechanical seal with elastomer bellows, screws/bolts made of A4
	C2	Wetted components made of duplex stainless steel, mechanical seal with covered spring, screws/bolts made of 1.4462
S	Type of installation	
IE3	Motor efficiency classification[2)]	
	[3)]	No efficiency classification
	IE3	Premium Efficiency

2) IEC 60034-30 standard not binding for submersible motor pumps. Efficiencies calculated/determined according to the measurement method specified in IEC 60034-2. The marking is used for submersible motors that achieve efficiency levels similar to those of standardized motors acc. to the IEC 60034-30 standard.

3) Blank

4.3 Name plate

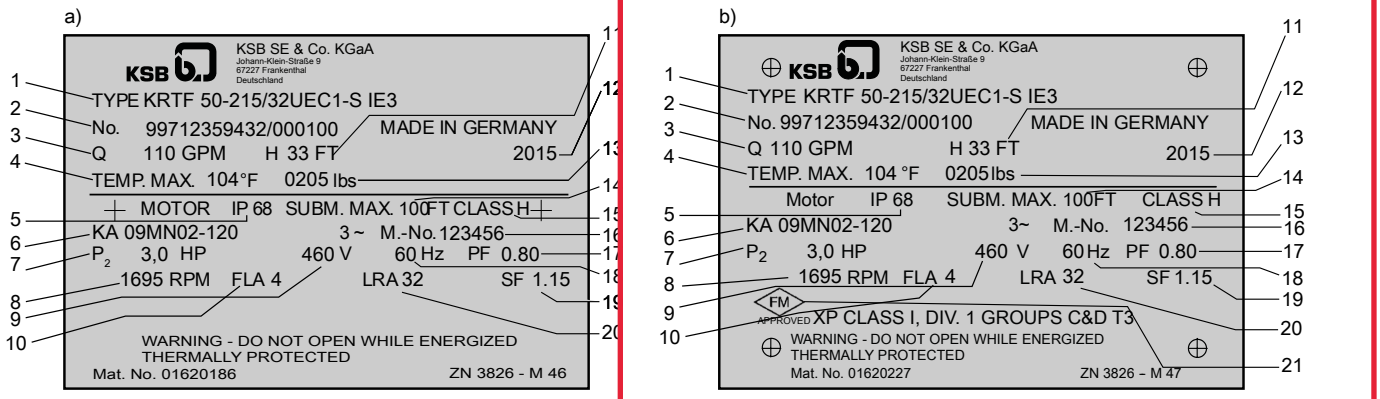


Fig. 2: Name plate (example) a) for non-explosionproof model, b) for explosion-proof model

1	Designation	2	KSB order number
3	Flow rate	4	Maximum fluid temperature and ambient temperature
5	Enclosure	6	Motor type
7	Rated power	8	Rated speed
9	Rated voltage	10	Rated current
11	Head	12	Year of construction
13	Total weight	14	Maximum submergence
15	Thermal class of winding insulation	16	Motor number
17	Power factor at rated operating point	18	Rated frequency
19	Service factor	20	Starting current
21	Explosion protection marking		

4.4 Design details

Design

- Fully floodable submersible motor pump
- Not self-priming
- Close-coupled design

Impeller type

- Various application-oriented impeller types

Shaft seal

Standard bearings:

- Two bi-directional mechanical seals in tandem arrangement, with leakage chamber

Reinforced bearings: (⇨ Section 9.2.7, Page 94)

- Two bi-directional mechanical seals in tandem arrangement, with leakage chamber

Bearings

Standard bearings:

- Grease-packed bearings sealed for life
- Maintenance-free

Reinforced bearings: (⇨ Section 9.2.7, Page 94)

Drive end:

- Grease-packed bearings sealed for life
- Maintenance-free

Pump end:

- Grease-packed bearings
- Can be re-lubricated

Drive

- Three-phase asynchronous squirrel-cage motor
- Motors integrated in explosion-proof pump sets are supplied in Explosionproof Class I Division 1, Groups C&D, T3.

4.5 Installation types

Fig. 3: Installation types

1	Installation type D: stationary dry installation, vertical (S1 duty)
2	Installation type H: stationary dry installation, horizontal (S1 duty)
3	Installation type K: wet installation (S1 duty with motor outside of the fluid possible) with guide rail arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide rail arrangement
4	~~Installation type K: stationary wet installation (S1 duty with motor outside of the fluid possible) with guide~~ cable arrangement Installation type S: stationary wet installation (S1 duty with submerged motor) with guide cable arrangement
5	Installation type P: wet installation of transportable model (S1 duty with submerged motor)

Pump sets of installation types D, H and K
are suitable for continuous operation with the motor outside the fluid. Cooling is effected by means of air convection.
Versions with a cooling jacket have an additional internal cooling circuit.

Pump sets of installation types P and S
are designed for continuously submerged operation. The motor is cooled by the fluid handled on the motor surface. Operation with the motor outside the fluid handled is possible for short periods.

4.6 Configuration and function

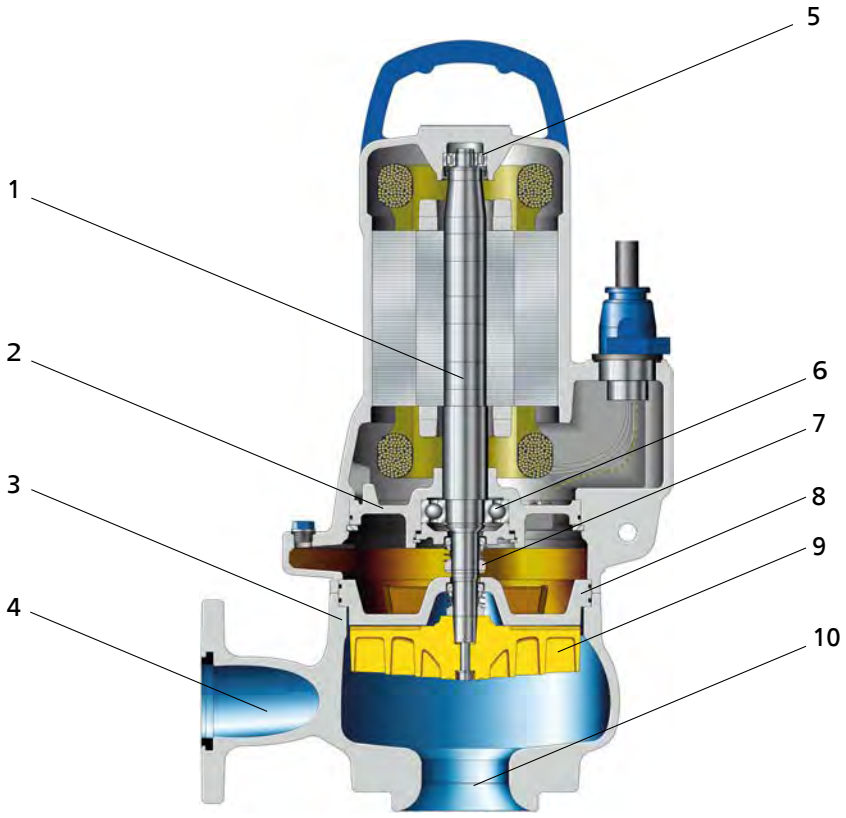


Fig. 4: Sectional drawing

1	Shaft	2	Bearing housing
3	Pump casing	4	Discharge nozzle
5	Bearing, motor end	6	Bearing, pump end
7	Shaft seal	8	Discharge cover
9	Impeller	10	Suction nozzle

Design The pump is designed with an axial fluid inlet and a radial outlet. The hydraulic system sits on the extended motor shaft. The shaft runs in common bearings.

Function The fluid enters the pump axially via a suction nozzle (10) and is accelerated outward in a cylindrical flow by the rotating impeller (9). In the flow passage of the pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the discharge nozzle (4), where it leaves the pump. At the rear side of the impeller, the shaft (1) enters the hydraulic system via the discharge cover (8). The shaft passage through the discharge cover is sealed with a shaft seal (7). The shaft runs in rolling element bearings (5 and 6) which are supported by a bearing housing (2).

Sealing The pump is sealed by two bi-directional mechanical seals in tandem arrangement. A lubricant chamber in-between the seals ensures cooling and lubrication of the mechanical seals.

4.7 Noise characteristics

Table 7: Surface sound pressure level (L_{pA} [4) 5)]) depending on speed (n) and rated power (P_2)

P_2		L_{pA}		
		n = 3500 rpm	n = 1750 rpm	n = 1160 rpm
[kW]	[hp]	[dB]	[dB]	[dB]
2,2	3,0	-	58,5	57,5
3,7	5,0	68.5	62	59
5,5	7,4	70	63,5	63
6,5	8,7	71	-	63,5
7,5	10,0	71,5	65	-
8,5	11,4	72	66	-
10,0	13,4	72,5	67	-

4.8 Scope of supply

Depending on the model, the following items are included in the scope of supply:

Stationary model for wet installation (installation types S and K)

- Pump set complete with connection cables
- Claw with sealing and mounting elements
- Lifting rope / lifting chain
- Mounting bracket with mounting elements
- Base elbow and mounting elements
- Guide cable / guide rail
  (guide rails are not included in KSB's scope of supply)

A separate name plate is included in KSB's scope of supply. Attach this name plate in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

Transportable model for wet installation (installation type P)

- Pump set complete with connection cables
- Foot plate or pump stool with mounting elements
- Lifting rope / lifting chain

A separate name plate is included in KSB's scope of supply. Attach this name plate in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

Stationary model for dry installation (installation types D and H)

Depending on the model, the following items are included in the scope of supply:

- Pump set complete with connection cables
- Foundation rails (for horizontal installation)
- Suction-side flanged spacer with inspection hole[6)] (optional)
- Suction elbow (for vertical installation)

A separate name plate is included in KSB's scope of supply. Attach this name plate in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

4) Measured at a distance of 1 m from the pump outline (as per DIN 45635 Parts 1 and 24)
5) For installation types D and H only
6) For nominal discharge nozzle diameter ≥ DN100

4.9 Dimensions and weights

For dimensions and weights refer to the general arrangement drawing/outline drawing or data sheet of the pump set.

5 Installation at Site

5.1 Safety regulations

DANGER

Improper installation

Damage to the pump set!

- Observe the information given in the data sheet and on the name plate of the pump set.

DANGER

Risk of falling when working at great heights

Danger to life by falling from great heights!

- Do not step onto the pump (set) during installation work or dismantling work.
- Pay attention to safety equipment, such as railings, covers, barriers, etc.
- Observe the applicable local occupational safety regulations and accident prevention regulations.

DANGER

Persons in the tank during pump operation

Electric shock!

Risk of personal injury!

Danger of death from drowning!

- Never start up the pump set when there are persons in the tank.

WARNING

Hands, other body parts or foreign objects in the impeller or intake area

Risk of personal injury! Damage to the submersible motor pump!

- Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area.
- Check that the impeller can rotate freely.

WARNING

Impermissible solid objects (tools, screws/bolts or similar) in the pump sump/inlet tank during pump start-up

Personal injury and damage to property!

- Check the pump sump/inlet tank for impermissible solid objects before flooding, and remove, if necessary.

5.2 Checks to be carried out prior to installation

5.2.1 Checking the operating data

Before installing the pump set, verify that the name plate data matches the data given in the purchase order and the system data.

5.2.2 Preparing the place of installation

Place of installation for stationary models

	⚠ WARNING **Installation on mounting surfaces which are unsecured and cannot support the load** Personal injury and damage to property! ▷ Observe the required compressive strength class C25/30 of the concrete in exposure class XC1 as per EN 206-1. ▷ The mounting surface must have set and must be completely horizontal and even. ▷ Observe the weights indicated.

Resonances

Any resonances at the usual excitation frequencies (1x and 2x rotational frequency, rotational noise) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

Place of installation for transportable models

	⚠ WARNING **Incorrect positioning/placing down** Personal injury and damage to property! ▷ Position the pump set vertically with the motor on top. ▷ Use appropriate means to secure the pump set against tilting and tipping over. ▷ Refer to the weights given in the data sheet/on the name plate.

Resonances

Any resonances at the usual excitation frequencies (1x and 2x rotational frequency, rotational noise) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

5.2.3 Checking the lubricant level

The lubricant chambers have been filled with an environmentally-friendly, non-toxic lubricant at the factory.

Visual inspection for signs of oil leakage

1. If no oil leakage is visible in the area of the pump casing, impeller and transport holder, the lubricant chamber is filled properly.
2. If oil leakage is visible in the area of the pump casing, impeller and transport holder, top up the lubricant chamber.

Filling in the lubricant

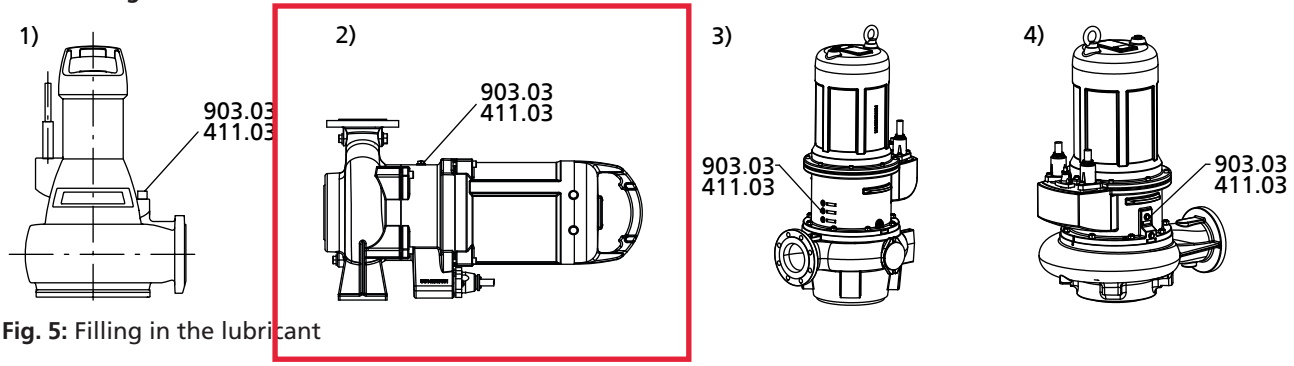


Fig. 5: Filling in the lubricant

Table 8: Filling in the lubricant

Motor	Impeller type	Variant			
		1	2	3	4
3 2.E - 7 2.E	E, F, K, S	✗	-	-	-
11 2.E - 26 2.E	E, F, K, S	-	✗	-	-
55 2.E - 75 2.E	D	-	-	✗	-
2 4.E - 5 4.E	E, F, K, S	✗	-	-	-
7 4.E - 37 4.E	D, E, F, K, S	-	✗	-	-
45 4.E - 75 4.E	D	-	-	✗	-
45 4.E - 75 4.E	E, F, K	-	-	-	✗
7 6.E - 30 6.E	D, E, F, K, S	-	✗	-	-
31 6.E - 55 6.E	D	-	-	✗	-
31 6.E - 55 6.E	E, F, K	-	-	-	✗
11 8.E - 22 8.E	D, E, F, K	-	✗	-	-
30 8.E - 45 8.E	D	-	-	✗	-
30 8.E - 45 8.E	E, F, K	-	-	-	✗

1. Position the pump set as shown.
2. Undo and remove screw plug 903.03 and joint ring 411.03.
3. Fill lubricant through the lubricant filler opening until the lubricant level reaches the opening.
4. Fit screw plug 903.03 together with a new joint ring 411.03.

5.2.4 Checking the direction of rotation

DANGER

Pump set running dry

Explosion hazard!

- ▷ Check the direction or rotation of explosion-proof pump sets outside potentially explosive atmospheres.

WARNING

Hands and/or foreign objects in the pump casing

Risk of injuries, damage to the pump!

- ▷ Never insert your hands or any other objects into the pump.
- ▷ Check that the inside of the pump is free from any foreign objects.
- ▷ Take suitable precautions (e.g. wear safety goggles).

WARNING

Improper positioning of pump set when checking the direction of rotation

Personal injury and damage to property!

- ▷ Use appropriate means to secure the pump set against tilting or tipping over.

	CAUTION **Pump set running dry** Increased vibrations! Damage to mechanical seals and bearings! ▷ Never operate the pump set for more than 60 seconds outside the fluid to be handled.

✓ The pump set is connected to the power supply.

1. Start the pump set and stop it again immediately to determine the motor's direction of rotation.
2. Check the direction of rotation.
   Impeller rotation must be anti-clockwise (seen from the pump mouth end). On some pump casings, the direction of rotation is marked by an arrow.

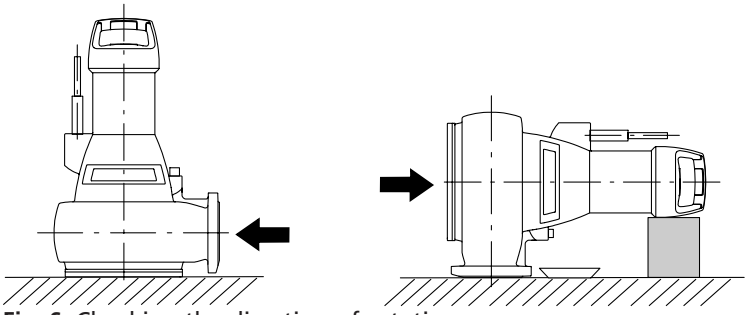


Fig. 6: Checking the direction of rotation

3. If the impeller is running in the wrong direction of rotation, check the electrical connection of the pump and the control system, if applicable.
4. Disconnect the pump set from the power supply and make sure it cannot be started unintentionally.

5.3 Installing the pump set

Always refer to and comply with the general arrangement drawing/outline drawing when installing the pump set.

5.3.1 Stationary wet installation

5.3.1.1 Fastening the flanged elbow

Fastening the flanged elbow with chemical anchors

Depending on the pump size, the flanged elbow is fastened with chemical anchors.

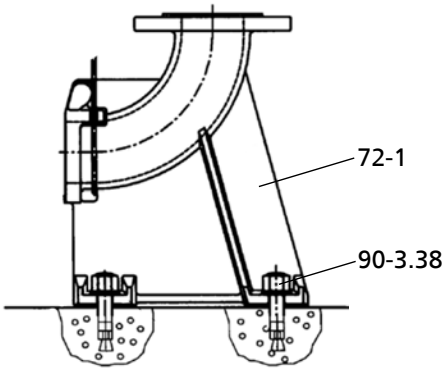


Fig. 7: Fastening the flanged elbow

1. Position base elbow 72-1 at the bottom of the tank/well.
2. Fit chemical anchors 90-3.38.
3. Bolt base elbow 72-1 to the floor using chemical anchors 90-3.38.

Chemical anchor dimensions

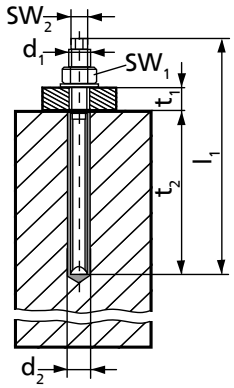


Fig. 8: Dimensions

Table 9: Chemical anchor dimensions [″]

Size ($d_1 \times l_1$)	d_2 [″]	t_1 [″]	t_2 [″]	SW_1 [7)] [″]	SW_2 [7)] [″]	M_{d1} [ft lb]
$^3/_8 \times 5\ ^1/_8$″	$^7/_{16}$	$^7/_8$	3 $^9/_{16}$	$^{11}/_{16}$	$^1/_4$	14,75
$^7/_{16} \times 6\ ^5/_{16}$″	$^9/_{16}$	1	4 $^5/_{16}$	$^3/_4$	$^5/_{16}$	29,50
$^5/_8 \times 7\ ^1/_2$″	$^{11}/_{16}$	1 $^3/_8$	4 $^{15}/_{16}$	$^{15}/_{16}$	$^7/_{16}$	44,25

Table 10: Chemical anchor dimensions [mm]

Size ($d_1 \times l_1$)	d_2 [mm]	t_1 [mm]	t_2 [mm]	SW_1 [7)] [mm]	SW_2 [7)] [mm]	M_{d1} [Nm]
M10 × 130	12	22	90	17	6	20
M12 × 160	14	25	110	19	8	40
M16 × 190	18	35	125	24	12	60

Table 11: Curing times of mortar cartridge

Floor temperature		Curing time
[°F]	[°C]	[min]
23 to 32	-5 to 0	240
32 to 50	0 to +10	45
50 to 68	+10 to +20	20
> 68	> +20	10

7) SW = Width across flats

5.3.1.2 Connecting the piping

DANGER

Impermissible loads acting on the flange of the base elbow

Danger to life from leakage of hot, toxic, corrosive or flammable fluids!

- Do not use the pump as an anchorage point for the piping.
- Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains.
- Observe the permissible flange loads.
- Take appropriate measures to compensate thermal expansion of the piping.

NOTE

When the pump set is used for draining low-level building areas, fit a swing check valve into the discharge line to avoid backflow from the sewer system.

CAUTION

Critical speed

Increased vibrations!

Damage to mechanical seals and bearings!

- In the case of longer riser pipes, fit a swing check valve to prevent the pump from excessively running in reverse after it is switched off.
  Choose the position of the swing check valve to allow proper venting.

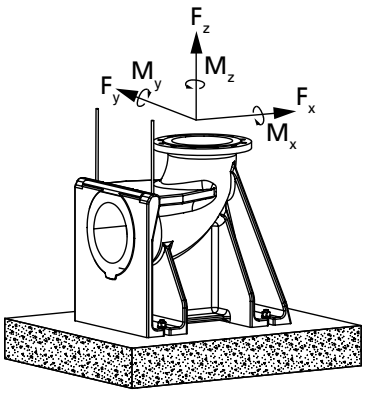


Fig. 9: Permissible flange loads

Table 12: Permissible flange loads

DN	Forces								Moments							
	F_y		F_z		F_x		ΣF		M_y		M_z		M_x		ΣM	
	[lbf]	[N]	[lbf]	[N]	[lbf]	[N]	[lbf]	[N]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]
50	303	1350	371	1650	337	1500	584	2600	738	1000	848	1150	1033	1400	1512	2050
65	303	1350	371	1650	337	1500	584	2600	738	1000	848	1150	1033	1400	1512	2050
80	461	2050	562	2500	506	2250	888	3950	848	1150	959	1300	1180	1600	1733	2350
100	607	2700	753	3350	674	3000	1180	5250	922	1250	1670	1450	1291	1750	1918	2600
150	910	4050	1124	5000	1012	4500	1765	7850	1292	1750	1513	2050	1845	2500	2694	3650
200	1214	5400	1506	6700	1349	6000	2369	10450	1697	2300	1956	2650	2399	3250	3542	4800
250	1517	6750	1877	8350	1675	7450	2934	13050	2323	3150	2692	3650	3282	4450	4831	6550
300	1810	8050	2248	10000	2012	8950	3518	15650	3172	4300	3651	4950	4462	6050	6565	8900

5.3.1.3 Fitting the guide cable arrangement

The pump set is guided into the sump or tank along two parallel, tightly stretched guide cables made of stainless steel. It attaches itself automatically to the base elbow which has been fitted to the floor.

NOTE

Should site conditions/piping layout, etc. require the guide cable to run off the vertical, do not exceed a maximum angle of 5° to ensure reliable fitting and guiding of the pump set.

Fitting the mounting bracket

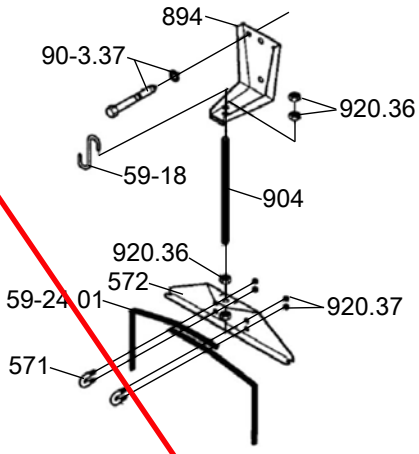


Fig. 10: Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with steel anchor bolts 90-3.37 and tighten the anchor bolts to a tightening torque of 7.4 lbf ft [10 Nm].
2. Insert clamping pieces 571 through the holes of suspension bracket 572 and fasten with nuts 920.37.
3. Fasten fully threaded stud 904 with the pre-assembled clamping arrangement to the mounting bracket with nut 920.36.
   Tighten nut 920.36 allowing sufficient play for subsequently tensioning the guide cable.

Inserting the guide cable

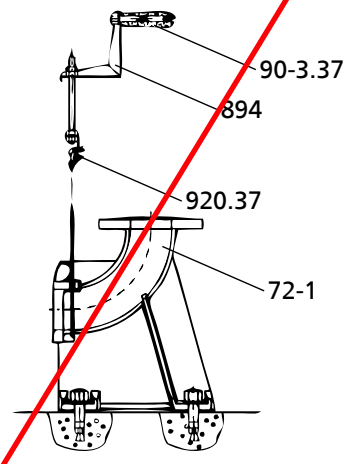


Fig. 11: Inserting the guide cable

1. Lift clamping piece 571 and insert one end of the guide cable.
2. Run cable 59-24.01 around base elbow 72-1 and back again to guide cable suspension bracket 572 and insert it into clamping piece 571.
3. Manually tension cable 59-24.01 and secure it by means of hexagon nuts 920.37.
4. Pull the cable taut by tightening hexagon nuts 920.36 on the upper side of the mounting bracket to a torque M_A=10.3 lbf ft [14 Nm] and a cable tensioning force P = 1349 lbf [6000 N].
5. Secure the nuts with a second hexagon nut.

6. The loose cable ends at guide cable suspension bracket 572 can either be twisted into a ring or the end can be cut off.
   After length adjustment tape the ends to avoid fraying.
7. Attach hook 59-18 to mounting bracket 894 for attaching the lifting chain / lifting rope at a later stage.

5.3.1.4 Fitting the guide rail arrangement

The pump set is guided into the sump or tank along two vertical guide rails. It attaches itself automatically to the base elbow which has been fitted to the floor.

NOTE

The guide rails are not included in KSB's scope of supply.
Select guide rail materials which are suitable for the fluid handled or as specified by the operator.

Observe the following dimensions for the guide rails:

Table 13: Guide rail dimensions

Size of hydraulic system	Outside diameter		Wall thickness[8)]			
			Min.		Max.	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]
DN 40 to DN 150	2,36	60	0,079	2	0,197	5
DN 200 to DN 700	3,5	89	0,118	3	0,236	6

Fitting the mounting bracket

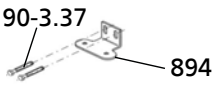


Fig. 12: Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with steel anchor bolts 90-3.37 and tighten the anchor bolts to a tightening torque of 7.4 lbf ft [10 Nm].
   (See outline drawing.)

Fitting the guide rails

CAUTION

Improper installation of guide rails

Damage to the guide rail arrangement!

- ▷ Always adjust the guide rails so that they are in a perfectly vertical position.

8) To DIN 2440/2442/2462 or equivalent standards

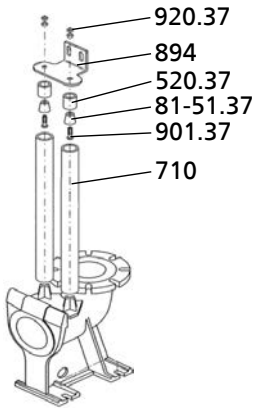


Fig. 13: Fitting the guide rails

1. Place rails 710 onto the conical bosses provided on base elbow 72-1 and position them vertically.
2. Mark the length of rails 710 (up to the lower edge of the mounting bracket), taking into account the adjusting range of the slotted holes in mounting bracket 894.
3. Shorten rails 710 with a 90° cut to the pipe axis. Debur the rails inside and outside.
4. Insert mounting bracket 894 with elastic sleeves 520.37 into guide rails 710 until the mounting bracket rests on the rail ends.
5. Tighten nuts 920.37.
   This pulls clamping sleeves 81-51.37 upwards and expands sleeves 520.37 against the inside pipe diameter.
6. Lock nuts 920.37 with a second nut each and secure them with Loctite 243.

NOTE

For installation depths of more than 19.7 ft [6 m], the scope of supply may include brackets as a middle support for the guide rails. The mounting brackets also serve as spacers between the two guide rails.

Fitting the middle support

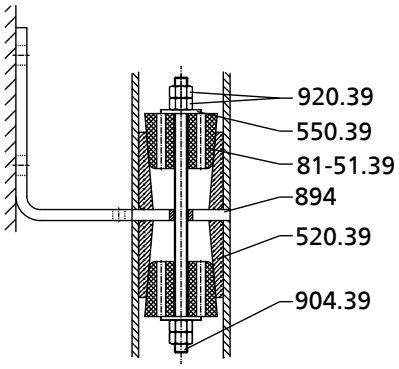


Fig. 14: Fitting the middle support

1. Measure the inside diameter of the guide rails.
2. Expand elastic sleeves 520.39 with clamping sleeves 81-51.39 to the inside diameter of the guide rails by tightening nuts 920.39.
3. Slide the guide rails onto the sleeves and check whether there is a tight fit between the guide rails and the sleeves.
4. Secure the screwed connection of the pipeline by tightening the locknuts.

5.3.1.5 Preparing the pump set

Fitting the claw

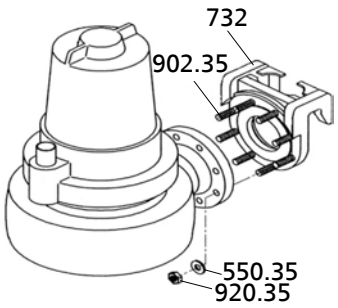


Fig. 15: Fitting the claw

1. Fasten claw 732 to the discharge flange with studs 902.35, discs 550.35 and nuts 920.35.
   Observe the tightening torques.
2. Fit profile joint 410 in the groove of the claw.
   This will seal the base elbow/pump connection.

Attaching the chain / lifting rope

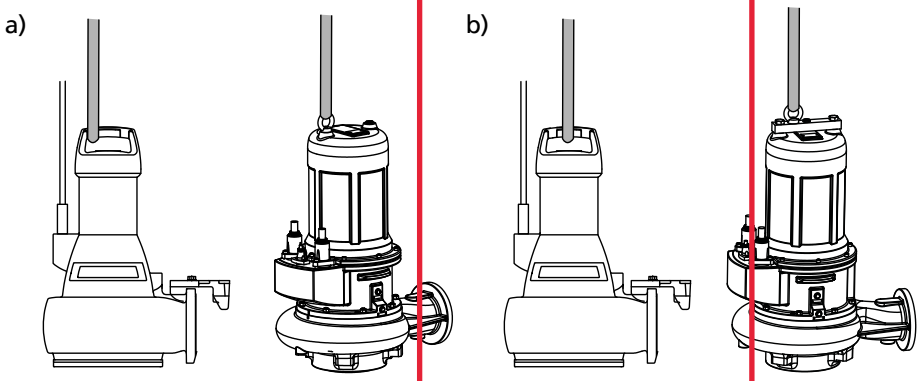


Fig. 16: Attaching the chain / lifting rope for stationary wet installation a) with guide cable arrangement b) with guide rail arrangement

1. Attach the chain or lifting rope to the pump set as illustrated.
   This attachment point achieves a forward inclination of the pump set towards the discharge nozzle, which allows the pump claw to hook onto the base elbow.

5.3.1.6 Installing the pump set

NOTE

Make sure the pump set with the pre-assembled claw can easily be guided over the mounting bracket, threaded onto the guide cables and lowered down. If required, alter the position of the crane during installation.

1. Guide the pump set over the suspension bracket/mounting bracket, thread it onto the guide cables/rails and slowly lower it down.
   The pump set attaches itself to base elbow 72-1.
2. Attach the lifting chain/rope to hook 59-18 at the mounting bracket.

5.3.2 Transportable model for wet installation

Attaching the chain / lifting rope

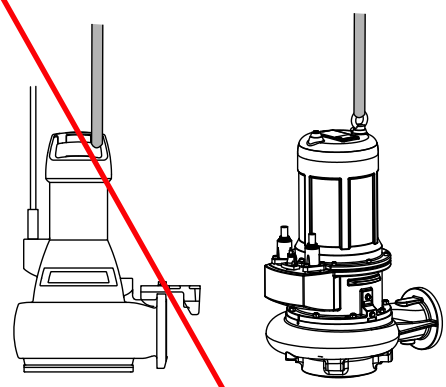


Fig. 17: Attaching the lifting chain/rope (transportable wet-installed model)

1. Attach the chain or lifting rope to the pump set on the opposite side of the discharge nozzle.

Fitting the foot plate or pump stool

Fit the foot plate or pump stool before installing the pump.
Tighten the screws/bolts as specified, observe the tightening torques
(⇨ Section 7.6, Page 82)

Connecting the piping

The DIN connection can be connected to rigid or flexible pipes.

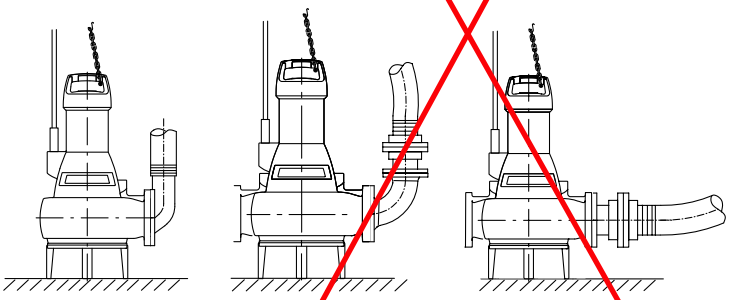


Fig. 18: Connection variants

5.3.3 Stationary dry installation

5.3.3.1 Preparing the foundation

Fastening

- Fasten the pump feet with or without foundation rails or the suction base elbow to a concrete foundation with chemical anchors.

✓ The foundation has the required strength and characteristics.

✓ The foundation has been prepared in accordance with the dimensions given in the outline drawing/general arrangement drawing.

1. Position the pump set on the foundation and level it with the help of a spirit level placed on the shaft and discharge nozzle.
   Permissible deviation: 0.2 mm/m.
2. Use shims for height compensation if necessary. Always fit shims immediately to the left and right of the chemical anchors between the foundation rails and the foundation.
   For a bolt-to-bolt distance (L) ≥ 800 mm fit additional shims halfway between the adjoining holes.
   All shims must lie perfectly flush.

3. Drill the holes as specified in the table "Chemical anchor dimensions". Then clean the holes.

⚠ WARNING

Improper handling of mortar cartridge

Skin sensitization and/or irritation!

▷ Wear suitable protective clothing.

4. Insert the mortar cartridges into the drilled holes.
   Observe the curing times of the mortar cartridges!
5. Insert threaded bolts into the corresponding drilled holes with an electric tool (e.g. impact drill, hammer drill).
6. After the curing time (see table), tighten the chemical anchors evenly and tightly.
7. Grout the baseplate using low-shrinkage concrete.

Chemical anchor dimensions

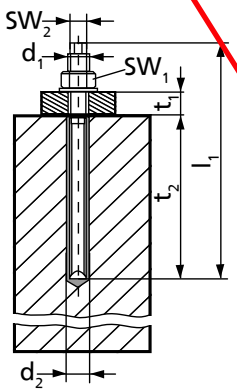


Fig. 19: Dimensions

Table 14: Chemical anchor dimensions [″]

Size ($d_1 \times l_1$)	d_2 [″]	t_1 [″]	t_2 [″]	SW_1[9] [″]	SW_2[9] [″]	M_{d1} [ft lb]
3/8 × 5 1/8″	7/16	7/8	3 9/16	11/16	1/4	14,75
7/16 × 6 5/16″	9/16	1	4 5/16	3/4	5/16	29,50
5/8 × 7 1/2″	11/16	1 3/8	4 15/16	15/16	7/16	44,25
13/16 × 10 1/4″	1	2 9/16	6 11/16	1 3/16	9/16	88,50
15/16 × 11 13/16″[10]	1 1/8	2 9/16	8 1/4	1 7/16	11/16	132,76
1 3/16 × 14 15/16″[10]	1 3/8	2 9/16	11	1 13/16	-	295,02

Table 15: Chemical anchor dimensions [mm]

Size ($d_1 \times l_1$)	d_2 [mm]	t_1 [mm]	t_2 [mm]	SW_1[9] [mm]	SW_2[9] [mm]	M_{d1} [Nm]
M10 × 130	12	22	90	17	6	20
M12 × 160	14	25	110	19	8	40
M16 × 190	18	35	125	24	12	60
M20 × 260	25	65	170	30	14	120
M24 × 300[10]	28	65	210	36	17	180
M30 × 380[10]	35	65	280	46	-	400

9) SW = Width across flats
10) Mounting accessories of the respective manufacturer are required.

Table 16: Curing times of mortar cartridge

Floor temperature		Curing time
[°F]	[°C]	[min]
23 to 32	-5 to 0	240
32 to 50	0 to +10	45
50 to 68	+10 to +20	20
> 68	> +20	10

5.3.3.2 Piping

5.3.3.2.1 Connecting the piping

DANGER

Impermissible loads acting on the pump nozzles

Danger to life from leakage of hot, toxic, corrosive or flammable fluids!

- ▷ Do not use the pump as an anchorage point for the piping.
- ▷ Anchor the pipelines in close proximity to the pump and connect them properly without transmitting any stresses or strains.
- ▷ Observe the permissible forces and moments at the pump nozzles.
- ▷ Take appropriate measures to compensate thermal expansion of the piping.

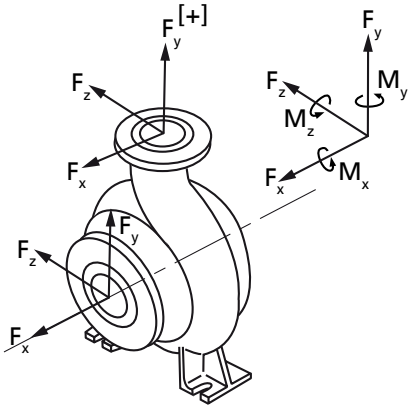
NOTE

Installing check and shut-off elements in the system is recommended, depending on the type of plant and pump. However, such elements must not obstruct proper drainage or hinder disassembly of the pump.

- ✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.
- ✓ A flow stabilization section having a length equivalent to at least twice the diameter of the suction flange has been provided upstream of the suction flange.
- ✓ The nominal diameters of the pipelines are equal to or greater than the nominal diameters of the pump nozzles.
- ✓ Adapters to larger nominal diameters are designed with a diffuser angle of approx. 8° to avoid excessive pressure losses.
- ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.

1. Thoroughly clean, flush and blow through all vessels, pipes and connections (especially of new installations).
2. Before installing the pump in the piping, remove the flange covers on the suction and discharge nozzles of the pump.
3. Connect the pump nozzles to the piping.

5.3.3.2.2 Permissible forces and moments at the pump nozzles



The resulting permissible forces have been determined according to

$$F_{res\ D} \leq \sqrt{F_x^2 + F_z^2}$$

$$F_{res\ S} \leq \sqrt{F_y^2 + F_z^2}$$

Forces and moments at the pump nozzles

The data on forces and moments apply to static piping loads only. If the limits are exceeded, they must be checked and verified.
If a computerized strength analysis is required, please contact KSB.
The values are only applicable if the pump is installed on a completely grouted baseplate and bolted to a rigid and level foundation.

Table 17: Forces and moments at the pump nozzles

Size	Impeller type	Forces [daN]									Moments [daNm]					
		Suction nozzle				Discharge nozzle					Suction nozzle			Discharge nozzle		
		F_x	F_y	F_z	F_{res}	F_x	F_{yTens}	F_{yCompr}	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
		(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)
50-215	F	115	75	90	120	70	45	90	60	90	75	55	40	50	40	25
50-216	F, S	115	75	90	120	70	45	90	60	90	75	55	40	50	40	25
65-215	F	140	95	115	150	95	60	115	75	120	95	70	50	75	55	40
65-216	E	140	95	115	150	95	60	115	75	120	95	70	50	75	55	40
65-217	F	140	95	115	150	95	60	115	75	120	95	70	50	75	55	40
80-216	E, F	180	115	140	180	115	70	140	95	150	135	100	65	95	70	50
80-217	F	180	115	140	180	115	70	140	95	150	135	100	65	95	70	50
80-252	F	180	115	140	180	115	70	140	95	150	135	100	65	95	70	50
80-253	E, F, K	180	115	140	180	115	70	140	95	150	135	100	65	95	70	50
80-315	D	180	115	140	180	115	70	140	95	150	135	100	65	95	70	50
80-317	D	180	115	140	180	140	90	180	115	180	135	100	65	135	100	65
100-215	F	180	115	140	180	140	90	180	115	180	135	100	65	135	100	65
100-253	D	180	115	140	180	140	90	180	115	180	135	100	65	135	100	65
100-253	E, K	310	205	250	320	140	90	180	115	180	230	175	115	135	100	65
100-254	F, K	180	115	140	180	140	90	180	115	180	135	100	65	135	100	65
100-255	E	180	115	140	180	140	90	180	115	180	135	100	65	135	100	65
100-315	D	245	160	195	250	140	90	180	115	180	185	140	90	135	100	65
100-316	D, F, K	310	205	250	320	140	90	180	115	180	230	175	115	135	100	65
100-317	E	245	160	195	250	140	90	180	115	180	185	140	90	135	100	65
100-400	K	310	205	250	320	140	90	180	115	180	230	175	115	135	100	65
100-401	E, F, K	245	160	195	250	140	90	180	115	180	185	140	90	135	100	65
150-253	D	310	205	250	320	250	155	310	205	320	230	175	115	230	175	115
150-315	D, F, K	310	205	250	320	250	155	310	205	320	230	175	115	230	175	115
150-317	E, K	310	205	250	320	250	155	310	205	320	230	175	115	230	175	115
150-400	D, K	490	310	380	490	250	155	310	205	320	350	255	175	230	175	115
150-401	D	670	445	535	695	250	155	310	205	320	500	380	245	230	175	115
150-401	E, F, K	310	205	250	320	250	155	310	205	320	230	175	115	230	175	115

Size	Impeller type	Forces [daN]									Moments [daNm]					
		Suction nozzle				Discharge nozzle					Suction nozzle			Discharge nozzle		
		F_x	F_y	F_z	F_{res}	F_x	F_{yTens}	F_{yCompr}	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
		(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)
150-403	K	310	205	250	320	250	155	310	205	320	230	175	115	230	175	115
151-401	K	310	205	250	320	250	155	310	205	320	230	175	115	230	175	115
151-403	K	310	205	250	320	250	155	310	205	320	230	175	115	230	175	115
200-315	D, K	490	310	380	490	380	235	490	310	490	350	255	175	350	255	175
200-316	K	490	310	380	490	380	235	490	310	490	350	255	175	350	255	175
200-317	K	490	310	380	490	380	235	490	310	490	350	255	175	350	255	175
200-318	K	490	310	380	490	380	235	490	310	490	350	255	175	350	255	175
200-330	K	490	310	380	490	380	235	490	310	490	350	255	175	350	255	175
200-400	D	310	205	250	320	380	235	490	310	490	230	175	115	350	255	175
200-401	E, K	310	205	250	320	380	235	490	310	490	230	175	115	350	255	175
200-402	K	310	205	250	320	380	235	490	310	490	230	175	115	350	255	175
200-403	K	310	205	250	320	380	235	490	310	490	230	175	115	350	255	175
250-400	D	490	310	380	490	535	335	665	445	695	350	255	175	500	380	245
250-400	K	490	310	380	490	535	335	665	445	695	350	255	175	500	380	245
250-401	K	490	310	380	490	535	335	665	445	695	350	255	175	500	380	245
250-403	K	490	310	380	490	535	335	665	445	695	350	255	175	500	380	245
300-400	D, K	800	535	665	855	665	410	800	535	855	610	460	300	610	460	300
300-401	K	800	535	665	855	665	410	800	535	855	610	460	300	610	460	300
300-403	K	800	535	665	855	665	410	800	535	855	610	460	300	610	460	300

Table 18: Forces and moments at the pump nozzles

Size	Impeller type	Forces [lbf]									Moments [ft lbf]					
		Suction nozzle				Discharge nozzle					Suction nozzle			Discharge nozzle		
		F_x	F_y	F_z	F_{res}	F_x	F_{yTens}	F_{yCompr}	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
		(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)
50-215	F	259	169	202	270	157	101	202	135	202	553	406	295	369	295	184
50-216	F, S	259	169	202	270	157	101	202	135	202	553	406	295	369	295	184
65-215	F	315	214	259	337	214	135	259	169	270	701	516	369	553	406	295
65-216	E	315	214	259	337	214	135	259	169	270	701	516	369	553	406	295
65-217	F	315	214	259	337	214	135	259	169	270	701	516	369	553	406	295
80-216	E, F	405	259	315	405	259	157	315	214	337	996	738	479	701	516	369
80-217	F	405	259	315	405	259	157	315	214	337	996	738	479	701	516	369
80-252	F	405	259	315	405	259	157	315	214	337	996	738	479	701	516	369
80-253	F, K	405	259	315	405	259	157	315	214	337	996	738	479	701	516	369
80-315	D	405	259	315	405	259	157	315	214	337	996	738	479	701	516	369
80-317	D	405	259	315	405	315	202	405	259	405	996	738	479	996	738	479
100-215	F	405	259	315	405	315	202	405	259	405	996	738	479	996	738	479
100-253	D	405	259	315	405	315	202	405	259	405	996	738	479	996	738	479
100-253	E, K	697	461	562	719	315	202	405	259	405	1696	1291	848	996	738	479
100-254	F, K	405	259	315	405	315	202	405	259	405	996	738	479	996	738	479
100-255	E	405	259	315	405	315	202	405	259	405	996	738	479	996	738	479
100-315	D	551	360	438	562	315	202	405	259	405	1364	1033	664	996	738	479
100-316	D, F, K	697	461	562	719	315	202	405	259	405	1696	1291	848	996	738	479
100-317	E	551	360	438	562	315	202	405	259	405	1364	1033	664	996	738	479
100-400	K	697	461	562	719	315	202	405	259	405	1696	1291	848	996	738	479

Size	Impeller type	Forces [lbf]									Moments [ft lbf]					
		Suction nozzle				Discharge nozzle					Suction nozzle			Discharge nozzle		
		F_x	F_y	F_z	F_{res}	F_x	F_{yTens}	F_{yCompr}	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
		(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)	(+/-)
100-401	E, F, K	551	360	438	562	315	202	405	259	405	1364	1033	664	996	738	479
150-253	D	697	461	562	719	562	348	697	461	719	1696	1291	848	1696	1291	848
150-315	D, F, K	697	461	562	719	562	348	697	461	719	1696	1291	848	1696	1291	848
150-317	E, K	697	461	562	719	562	348	697	461	719	1696	1291	848	1696	1291	848
150-400	D, K	1102	697	854	1102	562	348	697	461	719	2581	1881	1291	1696	1291	848
150-401	D	1506	1000	1203	1562	562	348	697	461	719	3688	2803	1807	1696	1291	848
150-401	E, F, K	697	461	562	719	562	348	697	461	719	1696	1291	848	1696	1291	848
150-403	K	697	461	562	719	562	348	697	461	719	1696	1291	848	1696	1291	848
151-401	K	697	461	562	719	562	348	697	461	719	1696	1291	848	1696	1291	848
151-403	K	697	461	562	719	562	348	697	461	719	1696	1291	848	1696	1291	848
200-315	D, K	1102	697	854	1102	854	528	1102	697	1102	2581	1881	1291	2581	1881	1291
200-316	K	1102	697	854	1102	854	528	1102	697	1102	2581	1881	1291	2581	1881	1291
200-317	K	1102	697	854	1102	854	528	1102	697	1102	2581	1881	1291	2581	1881	1291
200-318	K	1102	697	854	1102	854	528	1102	697	1102	2581	1881	1291	2581	1881	1291
200-330	K	1102	697	854	1102	854	528	1102	697	1102	2581	1881	1291	2581	1881	1291
200-400	D	697	461	562	719	854	528	1102	697	1102	1696	1291	848	2581	1881	1291
200-401	E, K	697	461	562	719	854	528	1102	697	1102	1696	1291	848	2581	1881	1291
200-402	K	697	461	562	719	854	528	1102	697	1102	1696	1291	848	2581	1881	1291
200-403	K	697	461	562	719	854	528	1102	697	1102	1696	1291	848	2581	1881	1291
250-400	D	1102	697	854	1102	1203	753	1495	1000	1562	2581	1881	1291	3688	2803	1807
250-400	K	1102	697	854	1102	1203	753	1495	1000	1562	2581	1881	1291	3688	2803	1807
250-401	K	1102	697	854	1102	1203	753	1495	1000	1562	2581	1881	1291	3688	2803	1807
250-403	K	1102	697	854	1102	1203	753	1495	1000	1562	2581	1881	1291	3688	2803	1807
300-400	D, K	1798	1203	1495	1922	1495	922	1798	1203	1922	4499	3393	2213	4499	3393	2213
300-401	K	1798	1203	1495	1922	1495	922	1798	1203	1922	4499	3393	2213	4499	3393	2213
300-403	K	1798	1203	1495	1922	1495	922	1798	1203	1922	4499	3393	2213	4499	3393	2213

5.3.3.2.3 Vacuum balance line

NOTE

Where fluid has to be pumped out of a vessel under vacuum, installing a vacuum balance line is recommended.

The following rules apply to vacuum balance lines:

- Minimum nominal line diameter: 0.98 inch [25 mm].
- The line extends above the highest permissible fluid level in the tank.

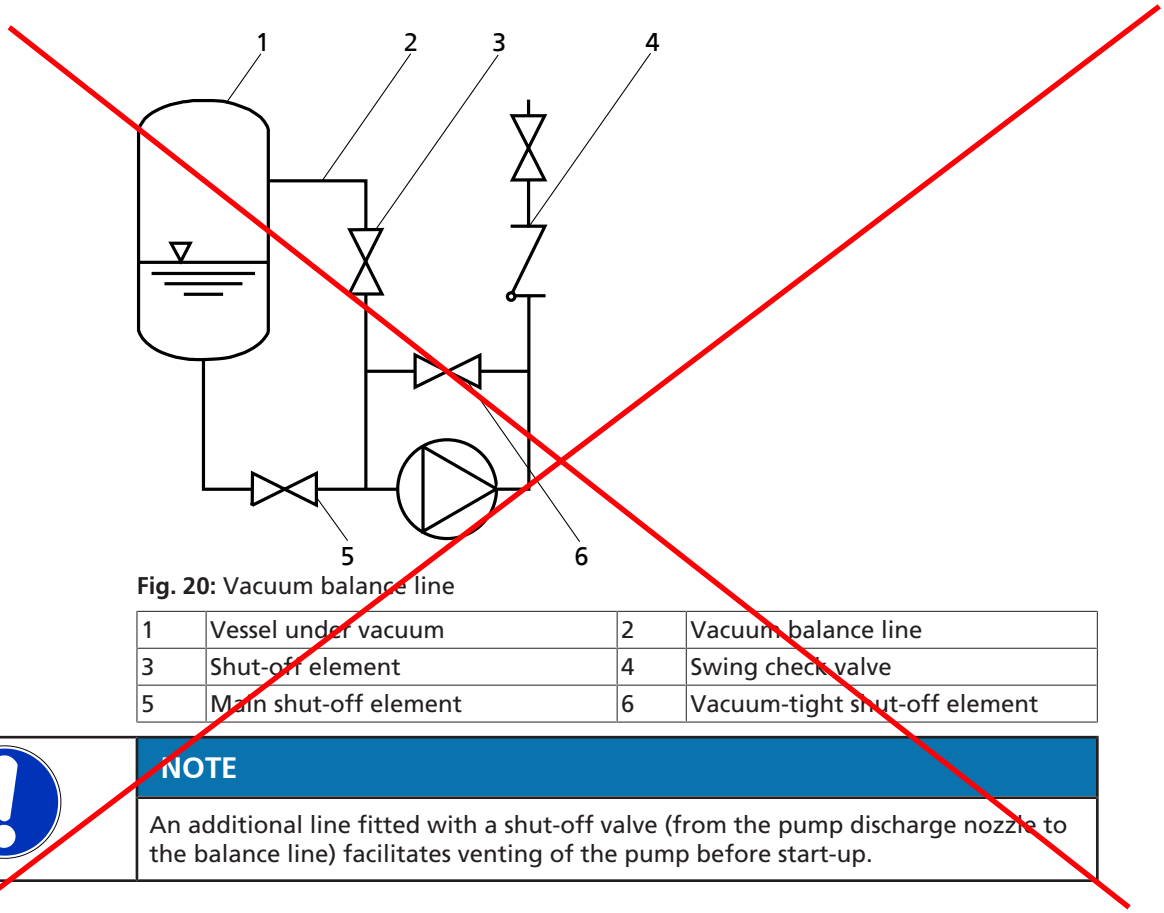


Fig. 20: Vacuum balance line

1	Vessel under vacuum	2	Vacuum balance line
3	Shut-off element	4	Swing check valve
5	Main shut-off element	6	Vacuum-tight shut-off element

NOTE

An additional line fitted with a shut-off valve (from the pump discharge nozzle to the balance line) facilitates venting of the pump before start-up.

5.3.3.3 Auxiliary connections

⚠ WARNING

Screw plugs subjected to pressure

Risk of injuries by parts flying off and escaping fluid!

- ▹ Never use screw plugs for releasing pressure from the pump casing.
- ▹ Always use a suitable venting device (e.g. vent valve).

The following auxiliary connections are available:

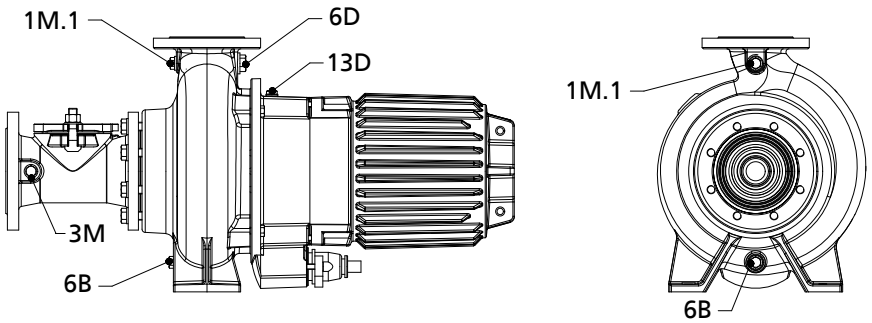


Fig. 21: Auxiliary connections

Table 19: Size of auxiliary connections

Size	Impeller type	Connection				
		Pressure gage	Vent	Pressure/ vacuum gage	Casing drain	Oil filler opening
		1 M.1	6 D	3 M	6 B	13 D
50-215	F	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2
50-216	F, S	G 1/2	G 1/2	G 1/2	G 1/2	G 1/2
65-215	F	G 1/2	G 3/4	G 1/2	G 1/2	G 1/2
65-216	E	G 1/2	G 3/4	G 1/2	G 1/2	G 1/2
65-217	F	G 1/2	G 3/4	G 1/2	G 1/2	G 1/2
80-216	E, F	G 1/2	G 1	G 1/2	G 1/2	G 1/2
80-217	F	G 1/2	G 1	G 1/2	G 1/2	G 1/2
80-252	F	G 1/2	G 1	G 1/2	G 1/2	G 1/2
80-253	E, F, K	G 1/2	G 1	G 1/2	G 1/2	G 1/2
80-315	D	G 1/2	G 1	G 1/2	G 1/2	G 1/2
80-317	D	G 1/2	G 1	G 1/2	G 1/2	G 1/2
100-215	F	G 1/2	G 1	G 1/2	G 1/2	G 1/2
100-253	D, E, K	G 1/2	G 1	G 1/2	G 1/2	G 1/2
100-254	F, K	G 1/2	G 1	G 1/2	G 1/2	G 1/2
100-255	E	G 1/2	G 1	G 1/2	G 1/2	G 1/2
100-315	D	G 1/2	G 1	G 1/2	G 1/2	G 1/2
100-316	D, F, K	G 1/2	G 1	G 1/2	G 1/2	G 1/2
100-317	E	G 1/2	G 1	G 1/2	G 1/2	G 1/2
100-400	K	G 1/2	G 1	G 1/2	G 1	G 1/2
100-401	E, F, K	G 1/2	G 1	G 1/2	G 1	G 1/2
150-253	D	G 1/2	G 1	G 1/2	G 1/2	G 1/2
150-315	D, F, K	G 1/2	G 1	G 1/2	G 1	G 1/2
150-317	E, K	G 1/2	G 1	G 1/2	G 1	G 1/2
150-400	D	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
150-400	K	G 1/2	G 1	G 1/2	G 1	G 1/2
150-401	D, E, F, K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
150-403	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
151-401	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
151-403	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
200-315	D, K	G 1/2	G 1	G 1/2	G 1	G 1/2
200-316	K	G 1/2	G 1	G 1/2	G 1	G 1/2
200-317	K	G 1/2	G 1	G 1/2	G 1	G 1/2
200-318	K	G 1/2	G 1	G 1/2	G 1	G 1/2
200-330	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
200-400	D	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
200-401	E, K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
200-402	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
200-403	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
250-400	D, K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
250-401	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
250-403	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
300-400	D, K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
300-401	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2
300-403	K	G 1/2	G 1 1/4	G 1/2	G 1	G 1/2

5.4 Electrical system

5.4.1 Information for planning the control system

For the electrical connection of the pump set observe the wiring diagrams.
(⇨ Section 9.3, Page 102)

NOTE

When laying a cable between the control system and the pump set's connection point, make sure the number of cores for the sensors is sufficient. A minimum cross-section of AWG 15 [1.5 mm²] is required.

The motors can be connected to electrical low-voltage grids with rated voltages and voltage tolerances to IEC 60038. The permissible tolerances must be observed.

5.4.1.1 Starting method

The pump set is wired for DOL starting. Star-delta starting is technically possible. This excludes:

- Pump sets with one power cable 8G1.5
- Pump sets with two power cables 4G16 and 8G1.5

For reducing the starting current autotransformers or soft starters can be used. For selecting suitable devices observe the rated current of the motor.
At least three times the rated current is required for reliable start-up. The run-up time must not exceed 4 seconds.

After start-up of the pump, a soft starter must always be bypassed.

5.4.1.2 Overload protection

1. Protect the pump set against overloading by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.
2. Set the overload protection device to the rated current specified on the name plate.

5.4.1.3 Level control

DANGER

Pump set running dry

Explosion hazard!

▷ Never allow an explosion-proof pump set to run dry.

CAUTION

Fluid level below the specified minimum

Damage to the pump set by cavitation!

▷ Never allow the fluid level to drop below the specified minimum.

Automatic operation of the pump set in a tank requires the use of level control equipment.
Observe the minimum fluid level.

5.4.1.4 Operation on a frequency inverter

The pump set is suitable for operation on a frequency inverter as per IEC 60034-17.

DANGER

Operation outside the permitted frequency range

Explosion hazard!

▷ Never operate an explosion-proof pump set outside the specified range.

DANGER

Incorrect selection and setting of the frequency inverter

Explosion hazard!

▷ Observe the following information on selecting and setting a frequency inverter.

Selection

When selecting a frequency inverter, check the following details:

- Data provided by the manufacturer
- Electrical data of the pump set, particularly the rated current
- Only voltage intermediate-circuit inverters (VSI) with pulse width modulation (PWM) and carrier frequencies between 1 and 16 kHz are suitable.

Setting

Observe the following instructions for setting a frequency inverter:

- Set the current limit to max. 1.2 times the rated current. The rated current is indicated on the name plate.

Start-up

Observe the following instructions for starting up a frequency inverter:

- Ensure short start ramps (maximum 5 seconds).
- Only start speed-controlled operation after 2 minutes at the earliest.
  Pump start-up with long start ramps and low frequency may cause clogging.

Operation

Observe the following limits when operating the pump set on a frequency inverter:

- Only utilize up to 95 % of the motor rating P_2 indicated on the name plate.
- Frequency range 30 to 60 Hz

Electromagnetic compatibility

Operation on a frequency inverter produces interference emissions whose level varies depending on the inverter used (type, interference suppression, make). To prevent the drive system, consisting of a submersible motor and a frequency inverter, from exceeding any given limits always observe the EMC information provided by the inverter manufacturer. If the inverter manufacturer recommends a shielded power cable, make sure to use a submersible motor pump with shielded power cables.

Interference immunity

The submersible motor pump generally meets interference immunity requirements. For monitoring the sensors installed the operator must ensure sufficient interference immunity by appropriately selecting and laying the power cables in the plant. No modifications are required on the power/control cable of the submersible motor pump. Suitable analyzing devices must be selected. This applies in particular to the leakage sensor inside the motor.

5.4.1.5 Sensors

DANGER

Operating an incompletely connected pump set

Explosion hazard!

Damage to the pump set!

▷ Never start up a pump set with incompletely connected power cables or non-operational monitoring devices.

CAUTION

Incorrect connection

Damage to the sensors!

- ▷ Observe the limits stated in the following sections of this manual when connecting the sensors.

The pump set features sensors that avoid hazards and damage to the pump set.

NOTE

Reliable and safe operation of the pump within the scope of our warranty is only possible if the sensor signals are properly analyzed as stipulated in this manual.

All sensors are located inside the pump set and are connected to the power cable. For information on wiring and core identification please refer to the wiring diagrams.
The individual sensors and the limit values to be set are described in the following sections.

5.4.1.5.1 Motor temperature

Pump sets of installation types P or S with 8-core power cable

DANGER

Insufficient cooling

Explosion hazard!

Winding damage!

- ▷ Never operate a pump set without operational temperature monitoring equipment.

The pump set features double monitoring of the winding temperature. The temperature switches for motor temperature 1 (terminals 20 and 21, max. 250 V~/2 A) serve as temperature control devices which open when the winding temperature is too high. Tripping must result in the pump set cutting out. Automatic re-starting is permitted.

If the temperature switches at terminals 21 and 22 are not used, the conductor for terminal 22 must be insulated or connected to a dummy terminal.

WARNING

Incorrect electrical installation

Electric shock!

- ▷ Adequately insulate conductor 22.

For an explosion-proof pump set (motor version XE or ZE) use the temperature switches for motor temperature 2 (terminals 21 and 22, maximum 250 V~/2 A) in addition to the above. Tripping must result in the pump set cutting out. After the pump set has been tripped by these temperature switches, it must not re-start automatically.

Pump sets of installation types P or S with 12-core power cable or several power cables

DANGER

Insufficient cooling

Explosion hazard!

Winding damage!

- Never operate a pump set without operational temperature monitoring.
- For explosion-proof pump sets use a thermistor tripping unit with manual reset.

CAUTION

Incorrect wiring

Winding damage!

- Never rely on the PTC thermistors alone for temperature monitoring.

The pump set features double monitoring of the winding temperature.
Two bimetal switches (terminals 21 and 22, max. 250 V AC/2 A) serve as temperature control devices which open when the winding temperature is too high. Opening of the contacts must result in the pump set cutting out. Automatic re-starting is permitted.
For explosion-proof pump sets, the three additional, series-connected PTC thermistors with terminals 10 and 11 must be used. Use a thermistor tripping unit with manual reset for this purpose.

Pump sets of installation types D, H or K

DANGER

Insufficient cooling

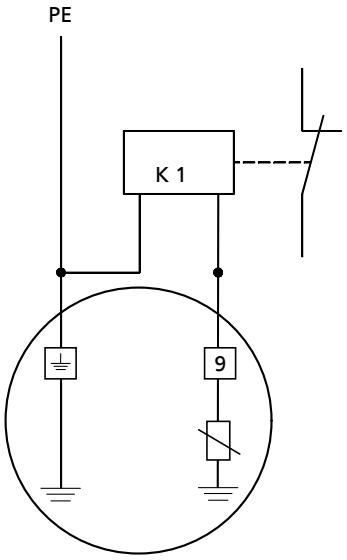
Explosion hazard!

Winding damage!

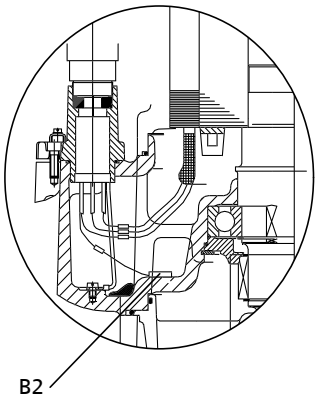
- Never operate a pump set without operational temperature monitoring.
- For explosion-proof pump sets use a thermistor tripping unit with manual reset.

The motor is monitored by three series-connected PTC thermistors with terminals 10 and 11. Tripping must result in the pump set cutting out. Automatic re-start is not permitted.
On explosion-proof pump sets, the thermistors must be connected to a thermistor tripping unit with manual reset.

5.4.1.5.2 Leakage inside the motor



Wiring of the electrode relay



Position of the electrode in the motor housing

An electrode fitted inside the motor monitors the winding space (B2) for leakage. This electrode must be connected to an electrode relay (core marked 9). Tripping of the electrode relay must result in the pump set cutting out.

The electrode relay (K1) must meet the following requirements:

- Sensor circuit 10 to 30 V AC
- Tripping current 0.5 to 3 mA
  (equivalent to a tripping resistance of 3 to 60 kΩ)

5.4.1.5.3 Bearing temperature

As an option, the pump set can be supplied with temperature monitoring in the area of the lower bearing assembly.
Check in the data sheet whether the pump set is equipped with bearing temperature monitoring.

The bearing temperature sensor is a Pt100 resistance thermometer. It has to be connected to a temperature control device with a Pt100 input and 2 separate outputs for two different switching points (sensor circuit maximum 6 V/2 mA).

Set the following limits:

- Alert at 230 °F [110 °C]
- Cut-out of the pump set at 266 °F [130 °C]

5.4.2 Electrical connection

DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

- ▷ Always have the electrical connections installed by a trained electrician.
- ▷ Observe IEC 60364 regulations as well as any locally applicable regulations.

WARNING

Incorrect connection to the mains

Damage to the mains network, short circuit!

- ▷ Observe the technical specifications of the local energy supply companies.

CAUTION

Improper routing of power cables

Damage to the power cables!

- Never move the power cables at temperatures below -13 °F [-25 °C].
- Never kink or crush the power cables.
- Never lift the pump set by the power cables.
- Adjust the length of the power cables to the site requirements.

CAUTION

Motor overload

Damage to the motor!

- Protect the motor by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.

For the electrical connection of the pump set observe the wiring diagrams (⇨ Section 9.3, Page 102) in the Annex and the information for planning the control system .

The pump set is supplied complete with connection cables. Always use all cables provided and connect all marked cores of the control cable.

DANGER

Incorrect connection

Explosion hazard!

- The connection point of the cable ends must be located outside hazardous areas or in an area approved for electrical equipment.

DANGER

Operating an incompletely connected pump set

Explosion hazard!

Damage to the pump set!

- Never start up a pump set with an incompletely connected power cable or non-operational monitoring devices.

DANGER

Connection of damaged power cables

Danger of death from electric shock!

- Check the power cables for damage before connecting them.
- Never connect damaged power cables.
- Replace damaged power cables.

CAUTION

Flow-induced motion

Damage to the power cable!

- Run the power cable upwards without slack.

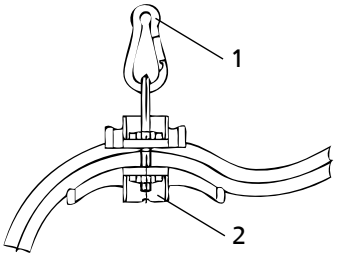


Fig. 22: Fastening the power cables

1. Run the power cables directly upwards without slack, and fasten them.
2. Only remove the protective caps from the power cables immediately before connecting the cables.
3. If necessary, adjust the length of the power cables to the site requirements.
4. After shortening the cables, correctly re-affix the markings of the individual cores at the cable ends.

5.4.2.1 Potential equalization

Wet installation (installation types K, P, S)

The pump set does not have an external PE connection (risk of corrosion).

	DANGER **Incorrect connection** Explosion hazard! ▷ Explosion-proof pump sets installed in a tank must never be retrofitted with an external potential equalization connection!

	DANGER **Touching the pump set during operation** Electric shock! ▷ Make sure that the pump set cannot be touched during operation.

Dry installation (installation types D and H)

Pump sets for dry installation are provided with an external potential equalization connection. Potential equalization shall be provided for in compliance with IEC 60204.

Connecting the potential equalization conductor

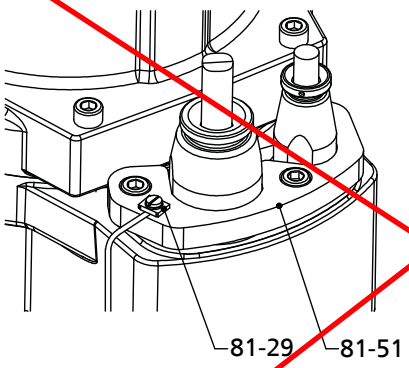


Fig. 23: Connecting the potential equalization conductor

81-29	Connection terminal
81-51	Clamping element

1. Connect the potential equalization conductor to terminal 81-29 provided on clamping element 81-51.

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/start-up

6.1.1 Prerequisites for commissioning/start-up

Before commissioning/starting up the pump set, make sure that the following conditions are met:

- The pump set has been properly connected to the electric power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked.
- All auxiliary connections required are connected and operational.
- The lubricant has been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the pump (set) to service have been carried out. (⇨ Section 6.4, Page 56)

DANGER

Persons in the tank during pump operation

Electric shock!

Risk of personal injury!

Danger of death from drowning!

▷ Never start up the pump set when there are persons in the tank.

DANGER

Exceeding the operating limits

Pump casing could burst/leak!

Pressurized hot or toxic fluid could escape!

Flying parts!

▷ Maintain an adequate safety distance from pump sets which are in operation.

6.1.2 Priming and venting the pump set (dry installation only - installation types D and H)

DANGER

Shaft seal failure caused by insufficient lubrication

Hot or toxic fluid could escape!

Damage to the pump!

▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.

1. Vent the pump and suction line and prime both with the fluid to be handled.
2. Fully open the shut-off element in the suction line.
3. Fully open all auxiliary connections (barrier fluid, flushing liquid, etc).

6.1.3 Commissioning/start-up

Wet installation (installation types K, P, S)

CAUTION

Re-starting while motor is still running down

Damage to the pump set!

- ▷ Do not re-start the pump set before it has come to a standstill.
- ▷ Never start the pump set while the pump is running in reverse.

✓ The fluid level is sufficiently high.

CAUTION

Start-up against a closed shut-off element

Increased vibrations!

Damage to mechanical seals and bearings!

- ▷ Never start up the pump set against a closed shut-off element.

1. Fully open the discharge line shut-off element, if any.
2. Start up the pump set.

Dry installation (installation types D and H)

⚠ DANGER

Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed.

Leakage of hot or toxic fluids!

- ▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.
- ▷ Only start up the pump set with the discharge side gate valve slightly or fully open.

⚠ DANGER

Excessive temperatures due to insufficient lubrication of shaft seal or excessive gas content in the fluid handled

Damage to the pump set!

- ▷ Never operate the pump set without liquid fill.
- ▷ Prime the pump as per operating instructions.
- ▷ Always operate the pump within the permissible operating range.

⚠ WARNING

Hot surface

Risk of burns

- ▷ Never touch a pump set which is in operation.

⚠ WARNING

Very high noise emission during operation

Personal injury!

- ▷ Minimize exposure in the vicinity of the pump set.
- ▷ For required work near running pump sets use appropriate ear protection.

⚠ WARNING

Abnormal noises, vibrations, temperatures or leakage

Damage to the pump!

Risk of personal injury!

- ▷ Switch off the pump (set) immediately.
- ▷ Eliminate the causes before returning the pump set to service.

✓ Pump, suction line and inlet tank (if fitted) have been vented and primed with the fluid to be handled.

✓ The priming lines and venting lines have been closed.

CAUTION

Start-up against open discharge line

Motor overload!

- ▷ Make sure the motor has sufficient power reserves.
- ▷ Use a soft starter.
- ▷ Use speed control.

1. Fully open the shut-off element in the suction head/suction lift line.
2. Slightly open the shut-off element in the discharge line.
3. Start up the motor.
4. Immediately after the pump has reached full rotational speed, slowly open the shut-off element in the discharge line and adjust it to comply with the duty point.

6.1.4 Shutdown (dry installation only – installation types D and H)

✓ The shut-off element in the suction line is and remains open.

1. Switch off the motor.
2. Immediately after having switched off the motor, close the shut-off element in the discharge line.

NOTE

If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open provided that the system conditions and system regulations are considered and observed.

For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close any auxiliary lines.

CAUTION

Danger of freezing!

Damage to the pump set!

- ▷ Drain the pump set or protect it against freezing.

6.2 Operating limits

DANGER

Non-compliance with operating limits

Damage to the pump set!

- Comply with the operating data indicated in the data sheet.
- Avoid operation against a closed shut-off element.
- Never operate the pump set at ambient or fluid temperatures exceeding those specified in the data sheet or on the name plate.
- Never operate the pump set outside the limits specified below.

6.2.1 Frequency of starts

CAUTION

Excessive frequency of starts

Damage to the motor!

- Never exceed the specified frequency of starts.

To prevent high temperature increases in the motor and excessive loads on the motor, sealing elements and bearings, the switching frequency shall not exceed the following number of starts per hour.

Table 20: Frequency of starts

Motor rating		Maximum frequency of starts
[kW]	[hp]	[Starts/hour]
≤ 7,5	< 10,0	30
> 7,5	> 10,0	10

These values apply to mains start-up (DOL or with star-delta contactor, autotransformer, soft starter). These limits do not apply to operation on a frequency inverter.

6.2.2 Operation on the power supply mains

DANGER

Non-compliance with permissible supply voltage tolerances

Explosion hazard!

- Never operate an explosion-proof pump (set) outside the specified range.

The maximum permissible deviation in supply voltage is ±10 % of the rated voltage. The voltage difference between the individual phases must not exceed 1 %.

6.2.3 Operation on a frequency inverter

DANGER

Operation outside the permitted frequency range

Explosion hazard!

- Never operate an explosion-proof pump set outside the specified range.

CAUTION

Pumping solids-laden fluids at reduced speed

Increased wear and clogging!

- Never operate the pump set with flow velocities below approx. 25 $^{in.}/_{s}$ [0.7 $^{m}/_{s}$] in horizontal pipes and approx. 45 $^{in.}/_{s}$ [1.2 $^{m}/_{s}$] in vertical pipes.

Frequency inverter operation of the pump set is permitted in the frequency range from 30 to 60 Hz.

6.2.4 Fluid handled

6.2.4.1 Temperature of the fluid handled

The pump set is designed for transporting liquids. The pump set is not operational under freezing conditions.

CAUTION

Danger of freezing!

Damage to the pump set!

- Drain the pump set or protect it against freezing.

Refer to the maximum permissible fluid temperature and ambient temperature indicated on the name plate and/or in the data sheet.

6.2.4.2 Minimum level of fluid handled (for installation types K, P and S only)

DANGER

Pump set running dry

Explosion hazard!

- Never allow an explosion-proof pump set to run dry.

CAUTION

Fluid level below the specified minimum

Damage to the pump set by cavitation!

- Never allow the fluid level to drop below the specified minimum.

Installation types P and S

The pump set is designed for continuously **submerged** operation. This condition has to be fulfilled for the motor to be cooled sufficiently.

Ready for operation

The pump set is ready for operation as soon as the motor is fully submerged.

The pump can be operated at a lower fluid level for short periods.
If the motor is not sufficiently cooled, an internal temperature monitoring device will trip the pump set and automatically re-start it after the motor has cooled down. The fluid level must not drop below the specified minimum (dimension B). Exact dimensions see general arrangement drawing/outline drawing.
(⇨ Section 1.4, Page 8)

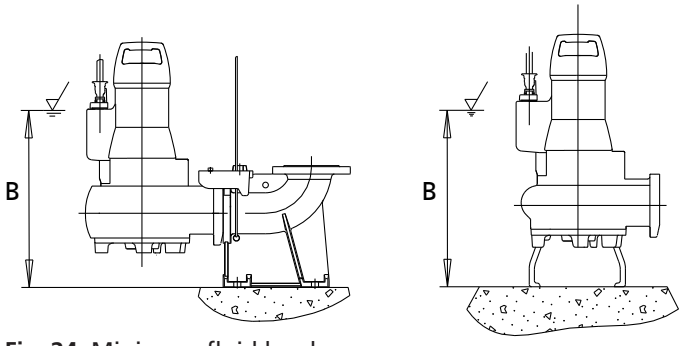


Fig. 24: Minimum fluid level

NOTE

Compliance with dimension B does not guarantee trouble-free operation of the pump set.
Depending on the pump's duty point, higher fluid levels may be required. Observe the NPSH values indicated in the characteristic curve (see hydraulic characteristic curves).

Installation type K

Pump sets of installation type K are suitable for continuous operation with the motor outside the fluid.

Ready for operation

The pump set is ready for operation when the minimum fluid level has been reached (dimension B). Exact dimensions see general arrangement drawing/outline drawing.

Use in the Amajet system

Slurp mode

For pumps with F impeller, slurp mode (partly involving air intake) is permissible for a period of up to 60 seconds.
For pumps with D impeller, slurp mode is impermissible! Make sure that the pump set switches off in time.

6.2.4.3 Density of the fluid handled

The power input of the pump changes in proportion to the density of the fluid handled.

CAUTION

Impermissibly high density of fluid handled.

Motor overload!

- ▷ Observe the information on fluid density in the data sheet.
- ▷ Make sure the motor has sufficient power reserves.

6.2.4.4 Abrasive fluids

Do not exceed the maximum permissible solids content specified in the data sheet. When the pump handles fluids containing abrasive substances, increased wear of the hydraulic system and the shaft seal is to be expected. In this case, halve the intervals commonly recommended for servicing and maintenance.

6.3 Shutdown/storage/preservation

6.3.1 Measures to be taken for shutdown

The pump set remains installed

⚠ WARNING

Unintentional starting of pump set

Risk of injury by moving components and shock currents!

- ▹ Make sure that the pump set cannot be started up unintentionally.
- ▹ Always make sure the electrical connections are disconnected before carrying out work on the pump set.

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Risk of personal injury!

- ▹ Observe all relevant laws.
- ▹ When draining the fluid take appropriate measures to protect persons and the environment.
- ▹ Decontaminate pumps which handle fluids posing a health hazard.

CAUTION

Danger of frost/freezing

Damage to the pump set!

- ▹ If there is any danger of frost/freezing, remove the pump set from the fluid handled and clean, preserve and store it.

✓ Make sure sufficient fluid is available for the operation check run of the pump set.

1. For prolonged shutdown periods, start up the pump set regularly once every three months for approximately one minute.
   This will prevent the formation of deposits within the pump and the pump intake area.

The pump (set) is removed from the pipe and stored

✓ The pump has been properly drained

✓ The safety instructions for dismantling the pump have been observed.

1. Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative.
2. Spray the preservative through the suction nozzle and discharge nozzle.
   It is advisable to then close the pump nozzles (e.g. with plastic caps).
3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil and grease, food-approved if required) to protect them against corrosion.
   Observe the additional instructions on preservation.

6.4 Returning to service

For returning the pump set to service, observe the items on commissioning/start-up. (⇨ Section 6.1, Page 50)

Refer to and comply with the operating limits. (⇨ Section 6.2, Page 53)

For returning the pump set to service after storage also follow the instructions for maintenance/inspection. (⇨ Section 7.2, Page 59)

⚠ WARNING

Failure to re-install or re-activate protective equipment/devices

Risk of personal injury from moving parts or escaping fluid!

- ▷ As soon as the work is completed, re-install and/or re-activate any safety-relevant devices and protective devices.

NOTE

On pumps/pump sets older than 5 years we recommend replacing all elastomer seals.

7 Servicing/Maintenance

7.1 Safety regulations

The operator ensures that all maintenance, all inspections and all installation work is performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.

DANGER

Sparks produced during maintenance work

Explosion hazard!

- Observe the safety regulations in force at the place of installation.
- Never open a pump set that is connected to the power supply.
- Always perform maintenance work on pump sets outside potentially explosive atmospheres.

DANGER

Risk of falling when working at great heights

Danger to life by falling from great heights!

- Do not step onto the pump (set) during installation work or dismantling work.
- Pay attention to safety equipment, such as railings, covers, barriers, etc.
- Observe the applicable local occupational safety regulations and accident prevention regulations.

WARNING

Unintentional starting of pump set

Risk of injury by moving components and shock currents!

- Make sure that the pump set cannot be started up unintentionally.
- Always make sure the electrical connections are disconnected before carrying out work on the pump set.

WARNING

Hands, other body parts or foreign objects in the impeller or intake area

Risk of personal injury! Damage to the submersible motor pump!

- Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area.
- Check that the impeller can rotate freely.

WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Risk of personal injury!

- Observe all relevant laws.
- When draining the fluid take appropriate measures to protect persons and the environment.
- Decontaminate pumps which handle fluids posing a health hazard.

⚠ WARNING

Hot surface

Risk of personal injury!

- ▷ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

⚠ WARNING

Insufficient stability

Risk of crushing hands and feet!

- ▷ During assembly/dismantling, secure the pump (set)/pump parts against tilting or tipping over.

NOTE

Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.

A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation of the pump (set) with a minimum of maintenance expenditure and work.

NOTE

All maintenance work, service work and installation work can be carried out by KSB Service or authorized workshops. Find your contact in the attached "Addresses" booklet or on the Internet at "www.ksb.com/contact".

Never use force when dismantling and reassembling the pump set.

7.2 Maintenance/inspection

KSB recommends the following regular maintenance schedule:

Table 21: Overview of maintenance work

Maintenance interval	Maintenance work	For details see ...
Every 4000 operating hours[11)]	Measuring the insulation resistance	(⇨ Section 7.2.2.3, Page 61)
	Checking the power cables	(⇨ Section 7.2.2.2, Page 60)
	Visual inspection of the lifting chain/lifting rope	(⇨ Section 7.2.2.1, Page 60)
Every 10,000 operating hours[12)]	Checking the sensors	(⇨ Section 7.2.2.4, Page 61)
	Changing the lubricant	(⇨ Section 7.2.3.1.4, Page 65)
Every 5 years	General overhaul	-

11) At least once per year
12) At least every three years

7.2.1 Supervision of operation (for installation types D and H only)

DANGER

Formation of a potentially explosive atmosphere inside the pump

Explosion hazard!

- ▷ The pump internals in contact with the fluid handled, including the seal chamber and auxiliary systems, must be filled with the fluid handled at all times.
- ▷ Provide sufficient inlet pressure.
- ▷ Provide an appropriate monitoring system.

CAUTION

Increased wear due to dry running

Damage to the pump set!

- ▷ Never operate the pump set without liquid fill.
- ▷ Never close the shut-off element in the suction line and/or supply line during pump operation.

CAUTION

Impermissibly high temperature of fluid handled

Damage to the pump!

- ▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).
- ▷ Observe the temperature limits in the data sheet and in the section on operating limits.

While the system is in operation, observe and check the following:

- The pump set must run quietly and free from vibrations at all times.
- Monitor the correct functioning of any auxiliary connections.
- Monitor the stand-by pump.
  To make sure that stand-by pumps are ready for operation, start them up once a week.

7.2.2 Inspection work

7.2.2.1 Checking the lifting chain/rope

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Inspect the lifting chain/rope as well as their fasteners for any visible damage.
2. Replace any damaged components by original spare parts.

7.2.2.2 Checking the power cables

Visual inspection

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Inspect the power cables for visible damage.
2. Replace any damaged components by original spare parts.

Checking the ground conductor

✓ The pump set has been lifted out of the pump sump and cleaned.

1. Measure the resistance between the ground conductor and chassis ground.
   The electrical resistance must be lower than 1 Ω.
2. Replace any damaged components by original spare parts.

DANGER

Defective ground conductor

Electric shock!

▹ Never switch on a pump set with a defective ground conductor.

7.2.2.3 Measuring the insulation resistance

Measure the insulation resistance of the motor winding during annual maintenance work.

✓ The pump set has been disconnected in the control cabinet.

✓ Use an insulation resistance measuring device.

✓ The maximum measuring voltage is 500 V (maximum permissible voltage 1000 V).

1. Measure the winding to chassis ground.
   To do so, connect all winding ends together.
2. Measure the winding temperature sensor to chassis ground.
   To do so, connect all core ends of the winding temperature sensors together and connect all winding ends to chassis ground.

⇨ The insulation resistance of the core ends to chassis ground must not be lower than 1 MΩ.
If the resistance measured is lower, power cable and motor resistance must be measured separately. Disconnect the power cable from the motor for this purpose.

NOTE

If the insulation resistance of the power cable is lower than 1 MΩ, the power cable is defective and must be replaced.

NOTE

If the insulation resistances measured on the motor are too low, the winding insulation is defective. The pump set must not be returned to service in this case.

7.2.2.4 Checking the sensors

CAUTION

Excessive test voltage

Damage to the sensors!

▹ Use a commercially available ohmmeter to measure the resistance.

The tests described below measure the resistance at the core ends of the power cable. The actual function of the sensors is not tested.

Temperature sensors in the motor winding

Table 22: Resistance measurement

Measurement between terminals ...	Resistance
	[Ω]
20 and 21[13)]	< 1
21 and 22	< 1
10 and 11[13)]	100-1000

13) If any

If the specified tolerances are exceeded, disconnect the connection cable at the pump set and repeat the check inside the motor.
If the tolerances are exceeded here, too, the motor part must be opened and overhauled. The temperature sensors are fitted in the stator winding and cannot be replaced.

Leakage sensor in the motor

Table 23: Resistance measurement of the leakage sensor in the motor

Measurement between terminals ...	Resistance
	[kΩ]
9 and ground conductor (PE)	> 60

Lower resistance values would suggest water ingress into the motor. In this case the motor section must be opened and serviced.

Bearing temperature sensor

Table 24: Resistance measurement of the bearing temperature sensors

Measurement between terminals ...	Resistance
	[Ω]
15 and 16	100 to 120

7.2.2.5 Visual inspection through the inspection hole (for inspection types D and H only and for pump sets with nominal diameters ≥100)

If there are problems with clogging, the inside of the casing and/or the impeller can be checked via the inspection hole.

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▹ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▹ Wear safety clothing and a protective mask if required.
- ▹ Observe all legal regulations on the disposal of fluids posing a health hazard.

⚠ WARNING

Hands and/or foreign objects in the pump casing

Risk of injuries, damage to the pump!

- ▹ Check that the inside of the pump is free from any foreign objects. Remove any foreign objects.
- ▹ Never insert your hands or any other objects into the pump, if the pump set has not been disconnected from the power supply and secured against unintentional start-up.

If a problem has occurred which requires visual inspection, observe the following instructions:

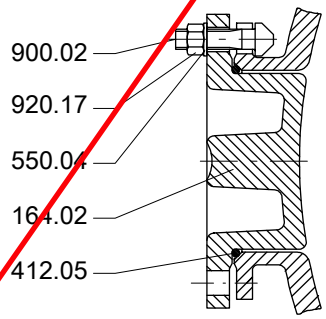


Fig. 25: Inspection hole in the casing

Opening the inspection hole

- Close the shut-off element on the suction side.
- Switch off the drive and make sure it cannot be re-started unintentionally.
- Close the shut-off element on the discharge side.
- Open the drain plug (auxiliary connection 6B).
- Collect and dispose of any liquid residues.
- Loosen nuts 920.17 at the inspection hole and remove inspection cover 164.02.
- Perform a visual inspection with a lamp or similar.

Closing the inspection hole

- Fit new O-ring 412.05.
- Fit inspection cover 164.02.
- Place discs 550.04 and nuts 920.17 on screws 900.02 and tighten.
- Observe the instructions on commissioning/start-up.

7.2.3 Lubrication and lubricant change

7.2.3.1 Lubricating the mechanical seal

The mechanical seal is supplied with lubricant from the lubricant chamber.

7.2.3.1.1 Intervals

Replace the lubricant every 10,000 operating hours but at least every 3 years.

7.2.3.1.2 Lubricant quality

The lubricant chamber is filled at the factory with environmentally friendly, non-toxic lubricant of medicinal quality (unless otherwise specified by the customer).
The following lubricants can be used to lubricate the mechanical seals:

Table 25: Lubricant quality

Description	Properties	
Paraffin oil or white oil. Alternative: motor oil grades SAE 10W to SAE 20W	Kinematic viscosity at 104 °F [40 °C]	< 0.065 ft/s² [< 20 mm/s²]
	Flash point (to Cleveland)	> 320 °F [> 160 °C]
	Solidification point (pour point)	< -5 °F [< -15 °C]

Recommended lubricants:

- Merkur WOP 40 PB, made by SASOL
- Merkur white oil Pharma 40, made by DEA
- Thin-bodied paraffin oil No. 7174, made by Merck
- Equivalent brands of medical quality, non-toxic
- Water-glycol mixture

⚠ WARNING

Contamination of fluid handled by lubricant

Hazard to persons and the environment!

▷ Using machine oil is only permitted if the oil is disposed of properly.

7.2.3.1.3 Lubricant quantity

Size	Impeller type	Lubricant quantity depending on the motor											
		3 2.E 2 4.E 3 4.E		4 2.E 5 2.E 7 2.E 4 4.E 5 4.E		11 2.E 15 2.E 18 2.E 22 2.E 26 2.E		7 4.E 11 4.E 15 4.E 18 4.E 22 4.E 7 6.E 11 6.E 15 6.E 18 6.E		30 4.E 37 4.E 22 6.E 30 6.E 11 8.E 15 8.E 18 8.E 22 8.E		55 2.E 65 2.E 75 2.E 45 4.E 55 4.E 65 4.E 75 4.E 31 6.E 37 6.E 45 6.E 55 6.E 30 8.E 37 8.E 45 8.E	
		[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]
40-252	F, K, S	-	-	2,7	2,9	2,6	2,8	2,6	2,8	-	-	-	-
50-215	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
50-216	F, S	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
65-215	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
65-216	E	3,1	3,3	3,1	3,3	3,1	3,3	3,1	3,3	-	-	-	-
65-217	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
80-216	E	3,1	3,3	3,1	3,3	3,1	3,3	3,1	3,3	-	-	-	-
80-216	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
80-217	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
80-252	F	-	-	2,7	2,9	2,6	2,8	2,6	2,8	-	-	-	-
80-253	E, F, K	-	-	2,4	2,5	2,5	2,7	2,5	2,7	-	-	-	-
80-315	D	-	-	-	-	-	-	4,5	4,8	-	-	1,4	1,5
80-317	D	-	-	-	-	-	-	4,1	4,3	-	-	-	-
100-215	F	1,9	2,0	1,9	2,0	2,0	2,1	2,0	2,1	-	-	-	-
100-253	D	-	-	-	-	-	-	2,5	2,7	-	-	-	-
100-253	E, K	-	-	2,4	2,5	2,5	2,7	2,5	2,7	-	-	-	-
100-254	F, K	-	-	2,7	2,9	2,6	2,8	2,6	2,8	-	-	-	-
100-255	E	-	-	2,4	2,5	2,5	2,7	2,5	2,7	-	-	-	-
100-315	D	-	-	-	-	-	-	4,5	4,8	4,9	5,2	1,4	1,5
100-316	D	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
100-316	F, K	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
100-317	E	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
100-400	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
100-401	E, F, K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
150-253	D	-	-	-	-	-	-	2,5	2,7	-	-	-	-
150-315	D	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
150-315	F, K	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
150-317	E, K	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
150-400	D	-	-	-	-	-	-	-	-	-	-	1,4	1,5
150-400	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
150-401	D	-	-	-	-	-	-	-	-	-	-	1,4	1,5
150-401	E, F, K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
150-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
151-401	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
151-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0

Size	Impeller type	Lubricant quantity depending on the motor											
		3 2.E 2 4.E 3 4.E		4 2.E 5 2.E 7 2.E 4 4.E 5 4.E		11 2.E 15 2.E 18 2.E 22 2.E 26 2.E		7 4.E 11 4.E 15 4.E 18 4.E 22 4.E 7 6.E 11 6.E 15 6.E 18 6.E		30 4.E 37 4.E 22 6.E 30 6.E 11 8.E 15 8.E 18 8.E 22 8.E		55 2.E 65 2.E 75 2.E 45 4.E 55 4.E 65 4.E 75 4.E 31 6.E 37 6.E 45 6.E 55 6.E 30 8.E 37 8.E 45 8.E	
		[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]	[l]	[quart]
200-315	D	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
200-315	K	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
200-316	K	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
200-317	K	-	-	-	-	-	-	4,5	4,8	4,9	5,2	-	-
200-318	K	-	-	-	-	-	-	4,1	4,3	4,9	5,2	-	-
200-330	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
200-400	D	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
200-401	E, K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
200-402	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
200-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
250-400	D	-	-	-	-	-	-	-	-	-	-	1,4	1,5
250-400	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
250-401	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
250-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
300-400	D	-	-	-	-	-	-	-	-	-	-	1,4	1,5
300-400	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
300-401	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0
300-403	K	-	-	-	-	-	-	-	-	6,5	6,9	6,6	7,0

7.2.3.1.4 Changing the lubricant

⚠ WARNING

Lubricants posing a health hazard and/or hot lubricants

Hazard to persons and the environment!

- ▷ When draining the lubricant take appropriate measures to protect persons and the environment.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Collect and dispose of any lubricants.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

⚠ WARNING

Excess pressure in the lubricant chamber

Liquid spurting out when the lubricant chamber is opened at operating temperature!

- ▷ Open the screw plug of the lubricant chamber very carefully.

Draining the lubricant

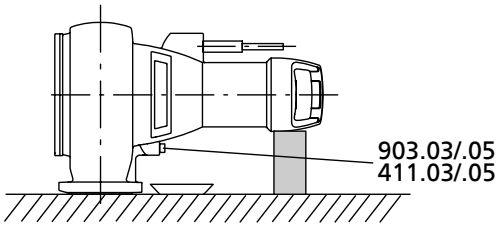


Fig. 26: Draining the lubricant

1. Position the pump set as shown.
2. Place a suitable container under the screw plug.
3. Undo screw plug 903.03/.05 with joint ring 411.03/.05 and drain off the lubricant.

Filling in the lubricant

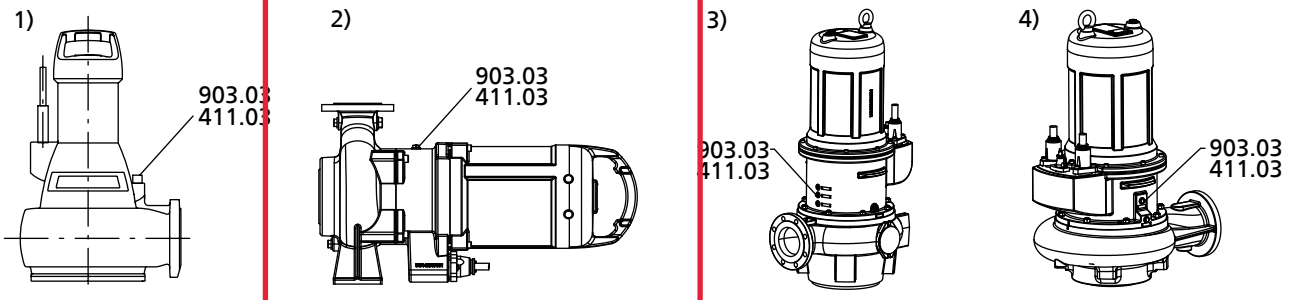


Fig. 27: Filling in the lubricant

Table 26: Filling in the lubricant

Motor	Impeller type	Variant			
		1	2	3	4
3 2.E - 7 2.E	E, F, K, S	✘	-	-	-
11 2.E - 26 2.E	E, F, K, S	-	✘	-	-
55 2.E - 75 2.E	D	-	-	✘	-
2 4.E - 5 4.E	E, F, K, S	✘	-	-	-
7 4.E - 37 4.E	D, E, F, K, S	-	✘	-	-
45 4.E - 75 4.E	D	-	-	✘	-
45 4.E - 75 4.E	E, F, K	-	-	-	✘
7 6.E - 30 6.E	D, E, F, K, S	-	✘	-	-
31 6.E - 55 6.E	D	-	-	✘	-
31 6.E - 55 6.E	E, F, K	-	-	-	✘
11 8.E - 22 8.E	D, E, F, K	-	✘	-	-
30 8.E - 45 8.E	D	-	-	✘	-
30 8.E - 45 8.E	E, F, K	-	-	-	✘

1. Position the pump set as shown.
2. Undo and remove screw plug 903.03 and joint ring 411.03.
3. Fill lubricant through the lubricant filler opening until the lubricant level reaches the opening.
4. Fit screw plug 903.03 together with a new joint ring 411.03.

7.2.3.2 Lubricating the rolling element bearings

The pump set is equipped with grease-lubricated, maintenance-free rolling element bearings.

7.2.3.3 Lubricating the rolling element bearings

The rolling element bearings of the pump set are grease-packed and maintenance-free, with the exception described below.

On pump sets with reinforced bearings the pump-end rolling element bearings can be relubricated; they must be relubricated as part of the maintenance work.

7.2.3.3.1 Grease quality

The following greases can be used to lubricate the rolling element bearings:

Grease quality

- Lithium soap grease suitable for high temperatures

Recommended commercially available brands

- ESSO UNIREX N3
- FAG ARCANOL L40
- TEXACO HYTEX EP3/DEA Pragon

7.2.3.3.2 Grease quantity

Use 60 g of grease to lubricate the rolling element bearings.

7.2.3.3.3 Re-lubrication

Pump sets with reinforced bearings

An encapsulated water-tight lubricating nipple allows re-lubrication of the angular contact ball bearings without opening the pump.

DANGER

Dry running

Explosion hazard!

▷ Re-lubricate explosion-proof pump sets outside potentially explosive atmospheres.

WARNING

Hands inside the pump casing

Risk of injuries, damage to the pump!

▷ Never insert your hands or any other objects into the pump if the pump has not been de-energized and secured against unintentional start-up.

CAUTION

Incomplete re-lubrication

Bearing damage!

▷ Always re-lubricate the bearings with the pump set in operation.

✓ The pump set has been positioned on a level surface.

✓ The pump set is secured against tipping over.

1. Remove screw plug 903.46 and joint ring 411.46.
2. Connect the pump set to the power supply.

CAUTION

Pump set running dry

Increased vibrations!

Damage to mechanical seals and bearings!

▷ Never operate the pump set for more than 60 seconds outside the fluid to be handled.

3. Start up the pump set.

4. Fill in grease via lubricating nipple 636.02.
5. Disconnect the pump set from the power supply again and make sure it cannot be started unintentionally.
6. Close screw plug 903.46 with joint ring 411.46 again.

7.3 Drainage/cleaning

⚠ WARNING

Fluids handled, consumables and operating supplies which are hot or pose a health hazard

Hazard to persons and the environment!

- ▹ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled.
- ▹ Wear safety clothing and a protective mask if required.
- ▹ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Always flush the pump if it has been used for handling noxious, explosive, hot or other hazardous fluids.
2. Always flush and clean the pump before transporting it to the workshop. Always complete and enclose a certificate of decontamination when returning the pump set. (⇨ Section 10, Page 118)

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

⚠ WARNING

Unqualified personnel performing work on the pump (set)

Risk of personal injury!

- ▹ Always have repair work and maintenance work performed by specially trained, qualified personnel.

⚠ WARNING

Hot surface

Risk of personal injury!

- ▹ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▹ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

Observe the general safety instructions and information.

For dismantling and reassembly observe the general assembly drawing.

In the event of damage you can always contact our service staff.

DANGER

Insufficient preparation of work on the pump (set)

Risk of personal injury!

- ▷ Properly shut down the pump set.
- ▷ Close the shut-off elements in the suction line and discharge line.
- ▷ Drain the pump and release the pump pressure.
- ▷ Shut off any auxiliary feed lines.
- ▷ Allow the pump set to cool down to ambient temperature.

WARNING

Components with sharp edges

Risk of cutting or shearing injuries!

- ▷ Always use appropriate caution for installation and dismantling work.
- ▷ Wear work gloves.

7.4.2 Preparing the pump set

7.4.2.1 Preparing the pump set (for installation types K, P and S only)

- ✓ The pump set has been removed from the pump sump.
- ✓ The pump set has been cleaned. (⇨ Section 7.3, Page 68)
- ✓ The lubricant has been drained.

1. De-energize the pump set and secure it against unintentional start-up.
2. Drain the leakage chamber and leave it open for the duration of the disassembly.

7.4.2.2 Preparing the pump set (for installation types D and H only)

7.4.2.2.1 Separating the pump from the piping

- ✓ The pump set has been switched off properly.
- ✓ The shut-off elements in the suction line and discharge line have been closed.
- ✓ Any auxiliary connections have been closed.
- ✓ The pump has been drained and the pump pressure has been released.

1. Disconnect any auxiliary feed lines.
2. Remove the discharge nozzle and suction nozzle from the piping.

NOTE

After the pump set has been removed from the piping, the suction casing should be cleaned with water. Suitable protective clothing is recommended.

7.4.2.2.2 Removing the pump set from the piping

⚠ WARNING

Pump set tilting

Risk of squashing hands and feet!

▷ Suspend or support the pump set.

✓ The pump set has been disconnected from the piping.
(⇨ Section 7.4.2.2.1, Page 69)

1. Suspend the pump set as specified for transport.
2. Depending on the type of installation, loosen the fastening bolts at the pump foot or at the soleplate.
3. Place the pump set in a horizontal position.

7.4.2.2.3 Removing the back pull-out unit

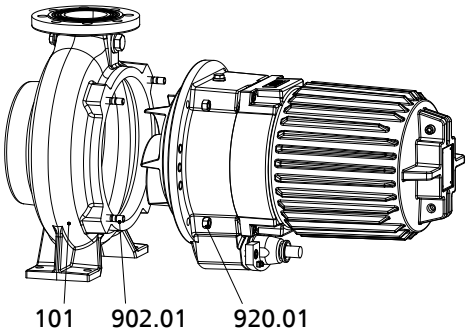


Fig. 28: Removing the back pull-out unit

1. Undo screwed connections 902.01 and 920.01 and pull the complete back pull-out unit out of pump casing 101.
2. Place the back pull-out unit in a safe and dry assembly area and secure it against tipping over or rolling off.

7.4.3 Dismantling the pump section

Dismantle the pump section in accordance with the relevant general assembly drawing.

7.4.3.1 Removing the impeller

1. Remove pump casing 101.
2. Undo and remove impeller fastening screw 914.10.
The impeller/shaft connection is a tapered fit.
3. For dismantling of the impeller, a jacking thread is provided at the impeller hub. Screw in the forcing screw and remove the impeller.

NOTE

The forcing screw is not included in the scope of supply. It can be ordered separately from KSB.

Table 27: Forcing screws for pulling off the impeller

Size	Impeller type	Forcing screw	
		Thread	Code
40-252	F, K, S	M16	ADS 8
50-215	F	M10	ADS 0

Size	Impeller type	Forcing screw	
		Thread	Code
50-216	F	M10	ADS 6
50-216	S	M10	ADS 0
65-215	F	M10	ADS 6
65-216	E	M12	ADS 7
65-217	F	M10	ADS 6
80-216	E	M12	ADS 7
80-216	F	M10	ADS 6
80-217	F	M10	ADS 6
80-252	F	M16	ADS 8
80-253	E, F, K	M20	ADS 2
80-315	D	M24	ADS 5
80-317	D	M20	ADS 2
100-215	F	M10	ADS 6
100-253	D, E, K	M16	ADS 3
100-254	F, K	M16	ADS 8
100-255	E	M20	ADS 2
100-315	D	M24	ADS 5
100-316	D	M20	ADS 2
100-316	F, K	M20	ADS 4
100-317	E	M20	ADS 2
100-400	K	M24	ADS 9
100-401	E, F, K	M24	ADS 9
150-253	D	M16	ADS 3
150-315	D	M20	ADS 4
150-315	F, K	M20	ADS 2
150-317	E, K	M20	ADS 2
150-400	D	M24	ADS 5
150-400	K	M24	ADS 9
150-401	D	M24	ADS 5
150-401	E, F, K	M24	ADS 9
150-403	K	M24	ADS 9
151-401	K	M24	ADS 9
151-403	K	M24	ADS 9
200-315	D	M20	ADS 4
200-315	K	M20	ADS 2
200-316	K	M20	ADS 2
200-317	K	M20	ADS 2
200-318	K	M20	ADS 2
200-330	K	M24	ADS 9
200-400	D	M24	ADS 5
200-401	E, K	M24	ADS 9
200-402	K	M24	ADS 9
200-403	K	M24	ADS 9
250-400	D	M24	ADS 5
250-400	K	M24	ADS 9
250-401	K	M24	ADS 9
250-403	K	M24	ADS 9
300-400	D	M24	ADS 5

Size	Impeller type	Forcing screw	
		Thread	Code
300-400	K	M24	ADS 9
300-401	K	M24	ADS 9
300-403	K	M24	ADS 9

7.4.3.2 Removing the mechanical seal

Remove the mechanical seal in accordance with the general arrangement drawings.

7.4.3.2.1 Removing the pump-end mechanical seal

✓ The back pull-out unit and the impeller have been removed as described above.

1. Pull the rotating assembly of mechanical seal 433.02 off shaft 210.
2. Remove discharge cover 163 from motor housing 811 or bearing bracket 350.
3. Press the stationary seat of mechanical seal 433.02 out of discharge cover 163.

7.4.3.2.2 Removing the drive-end mechanical seal

✓ The back pull-out unit and the impeller have been removed as described above.

1. Remove taper lock ring 515 or circlip 932.03.
2. Pull the rotating assembly of mechanical seal 433.01 off shaft 210.

7.4.3.2.3 Removing the double cartridge seal

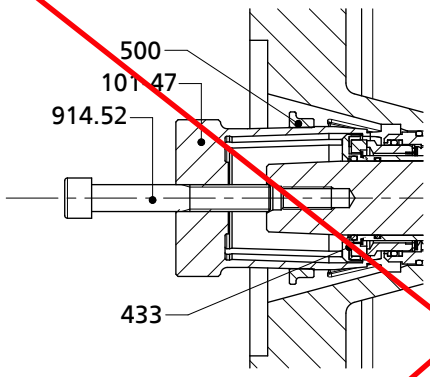


Fig. 29: Removing the double cartridge seal

✓ The back pull-out unit and impeller have been removed.

1. Fix discharge cover 163 to bearing housing 350 using suitable bolts/screws and washers.
2. Remove O-ring 412.58 from the shaft.
3. Slide puller 101-47 over the shoulder of mechanical seal 433 and lock with ring 500.
4. Press forcing screw 914.52 against shaft 210 and pull mechanical seal 433 out of discharge cover 163.

7.4.3.3 Removing the wear plate

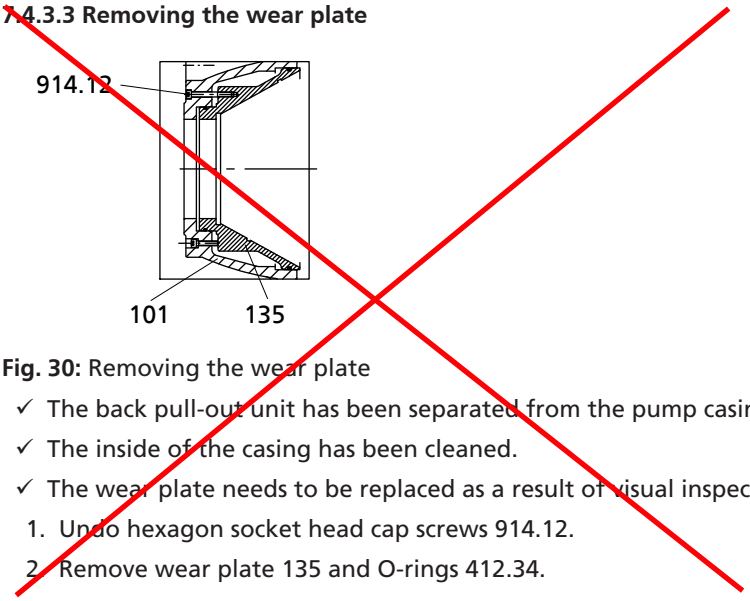


Fig. 30: Removing the wear plate

✓ The back pull-out unit has been separated from the pump casing.

✓ The inside of the casing has been cleaned.

✓ The wear plate needs to be replaced as a result of visual inspection.

1. Undo hexagon socket head cap screws 914.12.
2. Remove wear plate 135 and O-rings 412.34.

7.4.4 Dismantling the motor section

	NOTE Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.

	NOTE The motors of explosion-proof pump sets are supplied in "flameproof enclosure" type of protection. Any work on the motor section which could affect explosion protection, such as re-winding and repair work involving machining, must be inspected by an approved expert or performed by the motor manufacturer. No modifications must be made to the internal configuration of the motor space. Repair work at the flameproof joints must only be performed in accordance with the manufacturer's instructions.

When dismantling the motor section and the connection cable make sure that the cores/terminals are clearly marked for future reassembly.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

	⚠ WARNING **Improper lifting/moving of heavy assemblies or components** Personal injury and damage to property! ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

	⚠ WARNING **Components with sharp edges** Risk of cutting or shearing injuries! ▷ Always use appropriate caution for installation and dismantling work. ▷ Wear work gloves.

CAUTION

Improper reassembly

Damage to the pump!

- ▷ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.
- ▷ Use original spare parts only.

NOTE

Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Refer to the flamepath positions specified in the Annex.

Sequence

Always reassemble the pump set in accordance with the corresponding general assembly drawing.

Sealing elements

- O-rings
  - Check O-rings for any damage and replace by new O-rings, if required.
  - Never use O-rings that have been made by cutting an O-ring cord to size and gluing the ends together.
- Assembly adhesives
  - Avoid the use of assembly adhesives, if possible.

Tightening torques

When reassembling the pump set, tighten all screws/bolts as indicated.
In addition, secure all screwed connections closing off the flameproof enclosure with a thread-locking agent (Loctite type 243).

7.5.2 Reassembling the pump section

7.5.2.1 Installing the mechanical seal

Observe the following to ensure trouble-free operation of the mechanical seal:

- Only remove the protective wrapping of the seal faces immediately before assembly takes place.
- Make sure the surface of the shaft is absolutely clean and undamaged.
- Immediately before installing the mechanical seal, wet the contact faces with a drop of oil.
- For easier installation of bellows-type mechanical seals, wet the inside diameter of the bellows with soapy water (not oil).
- To prevent any damage to the rubber bellows, place a thin foil (of approximately 0.1 to 0.3 mm thickness) around the free shaft stub.
  Slip the rotating assembly over the foil into its installation position.
  Then remove the foil.

✓ The shaft and rolling element bearings have been properly fitted in the motor.

1. Guide drive-end mechanical seal 433.01 onto shaft 210. Secure it with taper lock ring 515.
2. Insert O-rings 412.04 and 412.15 into discharge cover 163.
3. Guide discharge cover 163 into bearing housing 350 or motor housing 811 as far as it will go.
4. Guide the pump-end mechanical seal 433.02 onto shaft 210.

For special mechanical seals with covered spring, tighten the socket head cap screw at the rotating assembly before fitting the impeller. Observe installation dimension "A". (⇨ Section 9.5.2, Page 116)

Table 28: Installation dimension "A" for mechanical seal with covered springs (HJ)

Size	Impeller type	Installation dimension "A" (⇨ Section 9.5.2, Page 116)	
		[mm]	[inch]
100-400	K	48,3	1,902
100-401	E, F, K	48,3	1,902
150-400	D, K	48,3	1,902
150-401	D, E, F, K	48,3	1,902
150-403	K	48,3	1,902
151-401	K	48,3	1,902
151-403	K	48,3	1,902
200-330	K	48,3	1,902
200-400	D	48,3	1,902
200-401	E, K	48,3	1,902
200-402	K	48,3	1,902
200-403	K	48,3	1,902
250-400	D, K	48,3	1,902
250-401	K	48,3	1,902
250-403	K	48,3	1,902
300-400	D, K	48,3	1,902
300-401	K	48,3	1,902
300-403	K	48,3	1,902

NOTE

The puller/ mounting device for the KSB double cartridge seal is not included in the scope of supply. It can be ordered separately from KSB.

7.5.2.2 Installing the double cartridge seal

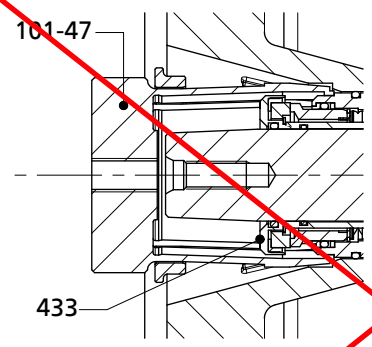


Fig. 31: Installing the double cartridge seal

✓ Install the mechanical seal as shown in the installation drawing.

✓ The back pull-out unit of the pump has been placed in a clean and level assembly area.

✓ The 4STQ double cartridge seal is fully assembled and undamaged.

1. Insert circlip 932.59 in the shaft groove and make sure that circlip 932.59 is positioned correctly in the shaft groove. When fitting the circlip take care to prevent damage to the shaft.

CAUTION

Use of grease or other permanent lubricants

Torque transmission impeded / overheating of and damage to the pump!

- ▷ Never use grease or other permanent lubricants for fitting the torque-transmitting elements of a mechanical seal.
- ▷ Use soft soap to reduce any friction caused by assembly.
- ▷ Do not coat the mechanical seal faces with grease or oil.

2. Prior to assembly, wet the external elastomers (O-rings and gasket) and the seats of the mechanical seal at the shaft, discharge cover 163 and seal housing with a suitable lubricant (e.g. soap suds).
3. Press mechanical seal 433 into discharge cover 163 by hand as far as possible.
4. Fit mechanical seal 433 using mounting device 101-47. Check the mechanical seal position against reference dimensions "K" (see table: Reference dimension "K") and correct the installation position if required.
5. Slide O-ring 412.58 onto the shaft until it abuts against the mechanical seal.

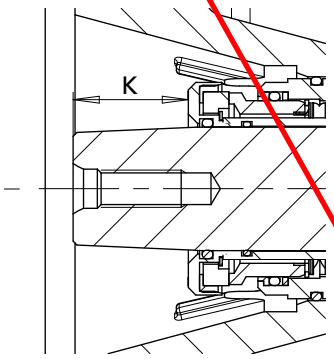


Fig. 32: Reference dimension "K" from shaft end to double cartridge seal

Table 29: Reference dimension "K"

Size	Impeller type	Reference dimension "K"	
		[mm]	[inch]
40-252	F, K, S	38+/- 0,5	1,496+/-0.02
50-215	F	24+/- 0,5	0,944+/-0.02
50-216	F, S	24+/- 0,5	0,944+/-0.02
65-215	F	24+/- 0,5	0,944+/-0.02
65-216	E	32+/- 0,5	1,259+/-0.02
65-217	F	24+/- 0,5	0,944+/-0.02
80-216	E	32+/- 0,5	1,259+/-0.02
80-216	F	24+/- 0,5	0,944+/-0.02
80-217	F	24+/- 0,5	0,944+/-0.02
80-252	F	38+/- 0,5	1,496+/-0.02
80-253	E, F, K	41+/- 0,5	1,614+/-0.02
80-315	D	41+/- 0,5	1,614+/-0.02
80-317	D	41+/- 0,5	1,614+/-0.02
100-215	F	24+/- 0,5	0,944+/-0.02
100-253	D, E, K	41+/- 0,5	1,614+/-0.02
100-254	F, K	38+/- 0,5	1,496+/-0.02
100-255	E	41+/- 0,5	1,614+/-0.02
100-315	D	41+/- 0,5	1,614+/-0.02

Size	Impeller type	Reference dimension "K"	
		[mm]	[inch]
100-316	D, F, K	41+/- 0,5	1,614+/-0.02
100-317	E	41+/- 0,5	1,614+/-0.02
150-253	D	41+/- 0,5	1,614+/-0.02
150-315	D, F, K	41+/- 0,5	1,614+/-0.02
150-317	E, K	41+/- 0,5	1,614+/-0.02
200-315	D, K	41+/- 0,5	1,614+/-0.02
200-316	K	41+/- 0,5	1,614+/-0.02
200-317	K	41+/- 0,5	1,614+/-0.02
200-318	K	41+/- 0,5	1,614+/-0.02

7.5.2.3 Fitting the impeller

NOTE

For bearing brackets with tapered fit make sure that the tapered fit of impeller and shaft is undamaged and assembled free from grease.

✓ The shaft and rolling element bearings have been properly installed.

✓ The mechanical seals have been properly installed.

1. Slide impeller 230 onto the shaft end.
2. Apply Loctite 243 as thread-locking agent to the thread of the impeller screw.
3. Screw in impeller screw 914.10 and disc 550.23, if any. Tighten with a torque wrench. Observe the tightening torques.

Table 30: Tightening torques for impeller screws

Size	Impeller type	Thread	Tightening torque	
			[Nm]	[ft lbf]
40-252	F, K, S	M16	150	110,6
50-215	F	M8	26	19,2
50-216	F, S	M8	26	19,2
65-215	F	M8	26	19,2
65-216	E	M10	35	25,8
65-217	F	M8	26	19,2
80-216	E	M10	35	25,8
80-216	F	M8	26	19,2
80-217	F	M8	26	19,2
80-252	F	M16	150	110,6
80-253	E, F, K	M20	290	213,9
80-315	D	M20	290	213,9
80-317	D	M20	290	213,9
100-215	F	M8	26	19,2
100-253	D	M16	150	110,6
100-253	E, K	M10	35	25,8
100-254	F, K	M16	150	110,6
100-255	E	M20	290	213,9
100-315	D	M20	290	213,9
100-316	D, F, K	M20	290	213,9
100-317	E	M20	290	213,9
100-400	K	M20	290	213,9

Size	Impeller type	Thread	Tightening torque	
			[Nm]	[ft lbf]
100-401	E, F, K	M20	290	213,9
150-253	D	M10	35	25,8
150-315	D, F, K	M20	290	213,9
150-317	E, K	M20	290	213,9
150-400	D, K	M20	290	213,9
150-401	D, E, F, K	M20	290	213,9
150-403	K	M20	290	213,9
151-401	K	M20	290	213,9
151-403	K	M20	290	213,9
200-315	D, K	M20	290	213,9
200-316	K	M20	290	213,9
200-317	K	M20	290	213,9
200-318	K	M20	290	213,9
200-330	K	M20	290	213,9
200-400	D	M20	290	213,9
200-401	E, K	M20	290	213,9
200-402	K	M20	290	213,9
200-403	K	M20	290	213,9
250-400	D, K	M20	290	213,9
250-401	K	M20	290	213,9
250-403	K	M20	290	213,9
300-400	D, K	M20	290	213,9
300-401	K	M20	290	213,9
300-403	K	M20	290	213,9

7.5.2.3.1 Fitting the cutter

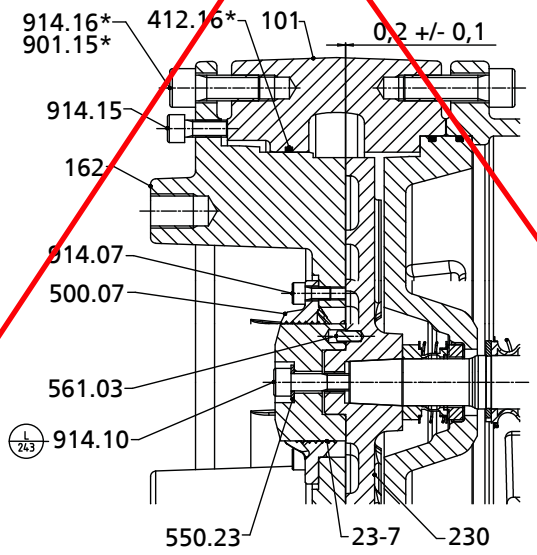


Fig. 33: Fitting the cutter

✓ Pump-end mechanical seal 433.02 has been installed.

1. Slide impeller 230 onto the tapered shaft end.
2. Insert grooved pin 561.03 into the impeller. Place impeller body 23-7 onto the centering hub.
3. Screw in hexagon socket head cap screw 914.10 and use a torque wrench to tighten the screw to a torque of 26 Nm.

4. Fasten the pump casing with hexagon socket head cap screw 914.74. Tighten the screw with a torque wrench.
5. Fasten ring 500.07 with hexagon socket head cap screw 914.07 in the suction cover.
6. Insert the suction cover into the pump casing, making sure the suction cover touches the impeller vanes.
7. Screw in hexagon socket head cap screw 914.16 to hold the suction cover in place. Do not tighten it yet.
8. Measure the distance between the impeller and the suction cover.
   Distance S should measure approximately 0.2 ± 0.1 mm.
9. If required, adjust the position of the suction cover in relation to the pump casing using hexagon socket head cap screw 914.15.
10. Tighten hexagon socket head cap screw 914.16.
11. Rotate the impeller body to check that the impeller turns smoothly.
    Make sure that the suction cover and impeller do not touch each other.

7.5.2.4 Installing the back pull-out unit

7.5.2.4.1 Design with axial clearance

NOTE

After casing wear rings with a radial clearance have been fitted in pump casing 101 they have the required inner diameter and do not need to be readjusted.

NOTE

The axial clearance must be adjusted quickly before the Loctite hardens.

1. Apply Loctite 2701 to the outside diameter of the casing wear ring.
2. Use a rubber mallet to insert casing wear ring 502 into pump casing 101 as far as it will go.
3. Insert the complete back pull-out unit into the pump casing.
4. Evenly tighten bolted/screwed connection 902.01 and 920.01 and/or 914.74 between pump casing and bearing housing.

CAUTION

Axial displacement of the rotor

Damage to shaft seal and bearings!

- ▷ Always adjust and check the axial clearance with the pump set in a vertical position.

5. Use a rubber mallet to insert casing wear ring 502 until it is close to impeller 230.

6. Suspend the pump set as illustrated.

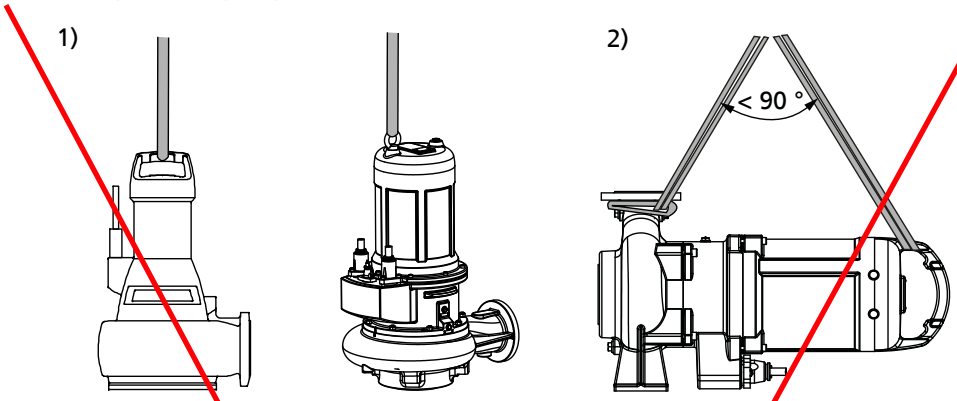


Fig. 34: Suspending the pump set 1) vertical installation 2) horizontal installation

7. Lift off the pump set and adjust the axial clearance to A = 0.3 ± 0.1 mm.

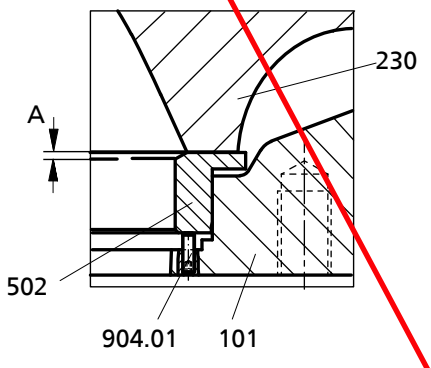


Fig. 35: Fitting the casing wear ring

7.5.2.4.2 Design with wear plate

✓ The shaft, rolling element bearings, mechanical seal and impeller have been assembled properly.

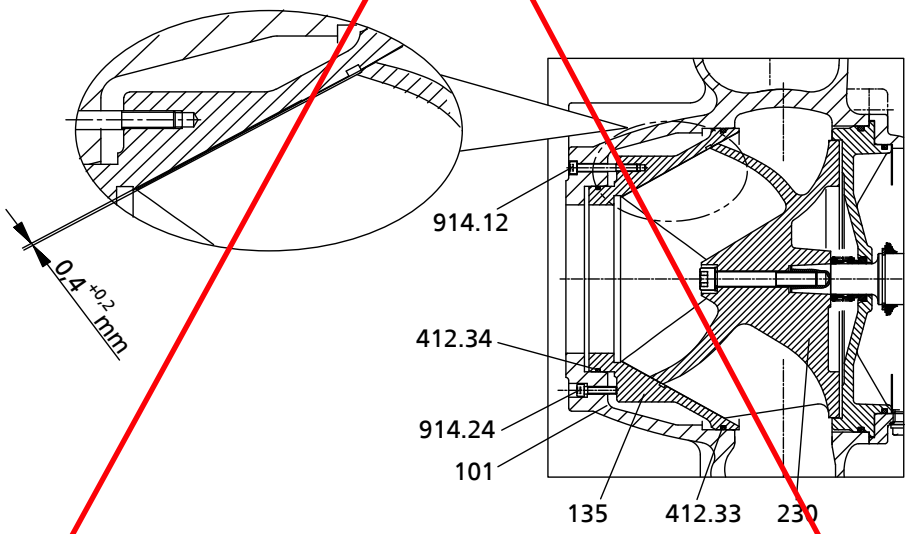


Fig. 36: Fitting the wear plate

1. Equip wear plate 135 with two new O-rings 412.33 and 412.34.
2. Insert wear plate 135 into pump casing 101.
3. Fasten wear plate 135 to pump casing 101 with hexagon socket head cap screws 914.12.

4. Adjust the clearance between impeller 230 and wear plate 135 by tightening and loosening screws 914.12 and 914.24.
   ⇨ Screw 914.24 presses the wear plate in the direction of the impeller.
   ⇨ The clearance equals 0.4 $^{+0.2}$ mm (measured on the suction side from the outer surface of the impeller vane to the wear plate).
5. Insert the complete back pull-out unit into the pump casing.
6. Evenly tighten bolted/screwed connection 920.01 and 902.01 and/or 914.74 between pump casing and bearing housing.

7.5.3 Reassembling the motor section

NOTE

Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Only use original spare parts made by KSB for explosion-proof pumps. Observe the flamepath positions specified in the Annex. Secure all screwed connections closing off the flameproof enclosure with a thread-locking agent (Loctite type 243).

DANGER

Wrong screws/bolts

Explosion hazard!

- Always use the original screws/bolts for assembling an explosion-proof pump set.
- Never use screws/bolts of different dimensions or of a lower property class.

7.5.4 Leak testing

After reassembly, the mechanical seal area/lubricant chamber must be tested for leakage. The leak test is performed at the lubricant filler opening.

Observe the following values for leak testing:

- **Test medium:** compressed air
- **Test pressure:** 11.6 psi [0.8 bar] maximum
- **Test duration:** 2 minutes

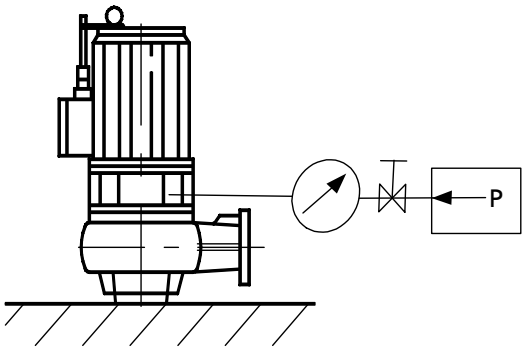


Fig. 37: Screwing in the testing device

1. Unscrew and remove the screw plug and joint ring of the lubricant chamber.
2. Screw the testing device tightly into the lubricant filler opening.
3. Carry out the leak test with the values specified above.
   The pressure must not drop during the test period.
   If the pressure does drop, check the seals and screwed connections.
   Repeat the leak test.
4. If the leak test has been successful, fill in the lubricant.

7.5.5 Checking the connection of motor/power supply

Check the power cables after reassembly. (⇨ Section 7.2.2, Page 60)

7.6 Tightening torques

Table 31: Tightening torques [lbf ft] depending on thread, material and property class

Thread	Material				
	A4-50	A4-70	A4-70	1.4462	8.8
	Property class Rp 0.2 $^{N}/_{mm^2}$				
	210	250	450	450	640
M5	-	-	2,95	2,95	4,43
M6	-	-	5,16	5,16	7,38
M8	-	-	12,54	12,54	18,44
M10	-	-	25,81	25,81	36,88
M12	-	-	44,25	44,25	62,69
M14	-	-	66,34	66,34	95,88
M16	-	-	110,63	110,63	154,88
M20	-	-	213,89	213,89	301,66

Table 32: Tightening torques [Nm] depending on thread, material and property class

Thread	Material				
	A4-50	A4-70	A4-70	1.4462	8.8
	Property class Rp 0.2 $^{N}/_{mm^2}$				
	210	250	450	450	640
M5	-	-	4,00	4,00	6,00
M6	-	-	7,00	7,00	10,00
M8	-	-	17,00	17,00	25,00
M10	-	-	35,00	35,00	50,00
M12	-	-	60,00	60,00	85,00
M14	-	-	90,00	90,00	130,00
M16	-	-	150,00	150,00	210,00
M20	-	-	290,00	290,00	410,00

7.7 Spare parts stock

7.7.1 Ordering spare parts

Always quote the following data when ordering replacement parts or spare parts:

- Order number
- Order item number
- Type series
- Size
- Year of construction
- Motor number

Refer to the name plate for all data.

Also supply the following data:

- Part No. and description (⇨ Section 9.1, Page 85)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

7.7.2 Recommended spare parts stock for 2 years' operation to DIN 24296

Table 33: Quantity of spare parts for recommended spare parts stock[14)]

Part No.	Description	Number of pump sets (including stand-by pump sets)						
		2	3	4	5	6 and 7	8 and 9	10 and more
230	Impeller	1	1	1	2	2	3	30 %
433.01	Mechanical seal, motor end	2	3	4	5	6	7	90 %
433.02	Mechanical seal, pump end	2	3	4	5	6	7	90 %
322	Rolling element bearing, motor end	1	1	2	2	3	4	50 %
321	Rolling element bearing, pump end	1	1	2	2	3	4	50 %
834	Cable gland	1	1	2	2	2	3	30 %
99-9	Set of sealing elements	4	6	8	8	9	10	100 %

14) For two years of continuous operation or 17,800 operating hours

8 Trouble-shooting

A Pump is running but does not deliver

B Pump delivers insufficient flow rate

C Excessive current/power input

D Insufficient discharge head

E Vibrations and noise during pump operation

Table 34: Trouble-shooting

A	B	C	D	E	Possible cause	Remedy
-	✗	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point.
-	✗	-	-	-	Gate valve in the discharge line is not fully open.	Fully open the gate valve.
-	-	✗	-	✗	Pump is running in off-design conditions (part load/overload).	Check the pump's operating data.
✗	-	-	-	-	Pump and/or piping are not vented.	Vent by lifting the pump off the base elbow and lowering it again.
✗	-	-	-	-	Pump intake clogged by deposits	Clean the intake, pump components and lift check valve.
-	✗	-	✗	✗	Inlet pipe or impeller clogged	Remove deposits in the pump and/or piping.
-	-	✗	-	✗	Dirt/fibers in the clearance between the casing wall and impeller; sluggish rotor.	Check whether the impeller can be easily rotated. Clean the impeller, if required.
-	✗	✗	✗	✗	Wear of internal parts	Replace worn parts by new ones.
✗	✗	-	✗	-	Defective riser (pipe and sealing elements)	Replace defective riser pipes. Replace sealing elements.
-	✗	-	✗	✗	Impermissible air or gas content in the fluid handled	Contact KSB.
-	-	-	-	✗	System-induced vibrations	Contact KSB.
-	✗	✗	✗	✗	Wrong direction of rotation	Check the electrical connection of the motor and the control system, if any.
-	-	✗	-	-	Wrong supply voltage	Check the mains power supply. Check the cable connections.
✗	-	-	-	-	Motor is not running because of lack of voltage.	Check the electrical installation. Contact the energy supplier.
✗	-	✗	-	-	Motor winding or power cable are defective.	Replace by new original KSB parts or contact KSB.
-	✗	-	✗	-	In case of star-delta configuration: motor running in star configuration only	Check star-delta contactor.
-	-		-	✗	Defective rolling element bearing(s)	Contact KSB.
-	✗	-	-	-	Water level lowered too much during operation	Check level control equipment.
✗	-	-	-	-	Temperature control device monitoring the winding has tripped the pump as a result of excessive winding temperatures.	The motor will restart automatically once it has cooled down.
✗	-	-	-	-	Temperature limiter (explosion protection) has tripped the pump as a result of the permissible winding temperature being exceeded.	Have cause determined and eliminated by qualified and trained personnel.
✗	-	-	-	-	Motor has been tripped by leakage monitor.	Have cause determined and eliminated by qualified and trained personnel.

9.1.2 Amarex KRT, motor type 2

Sizes:
40-252
50-215
50-216
65-215
65-216
65-217
65-253
80-215
80-216
80-217
80-252
80-253
80-255
80-315
80-316
80-317
100-215
100-253
100-254
100-255
150-253
150-315
150-317
200-315
200-316
200-317
200-318

Motors:
11 2
15 2
18 2
22 2
26 2
7 4
11 4
15 4
18 4
22 4
7 6
11 6
15 6
18 6

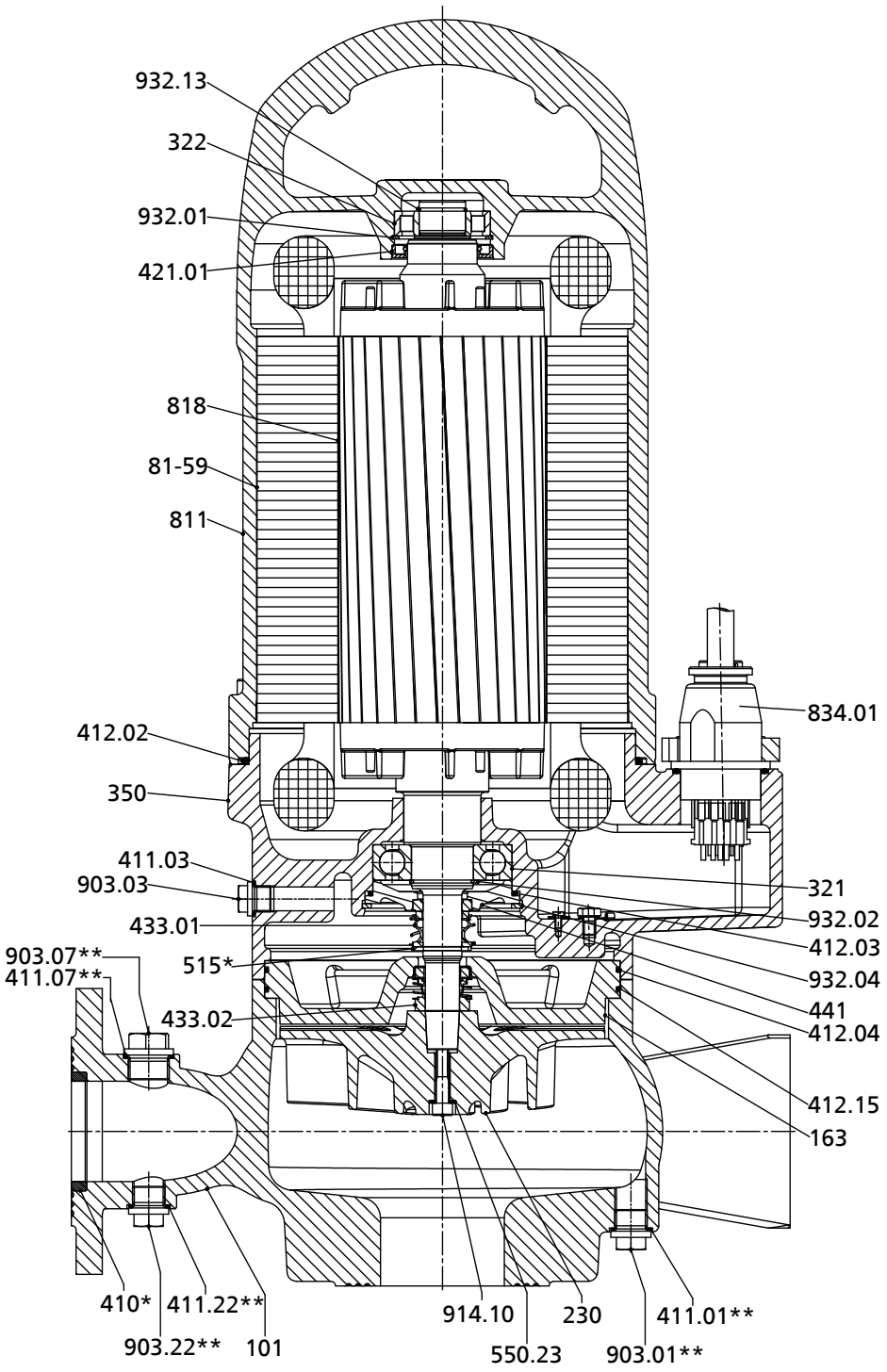


Fig. 39: General assembly drawing Amarex KRT, motor type 2

*: On specific designs only

** Only for installation types K, D and H

Table 36: List of components

Part No.	Description	Part No.	Description
101	Pump casing	441	Shaft seal housing
163	Discharge cover	515	Taper lock ring
230	Impeller	550.23	Disc
321	Radial ball bearing	81-59	Stator

Part No.	Description	Part No.	Description
322	Radial roller bearing	811	Motor housing
350	Bearing housing	818	Rotor
410	Profile joint	834.01	Cable gland
411.01/.03/.07/.22	Joint ring	903.01/.03/.07/.22	Screw plug
412.02/.03/.04/.15	O-ring	914.10	Hexagon socket head cap screw
421.01	Lip seal	932.01/.02/.04/.13	Circlip
433.01/.02	Mechanical seal		

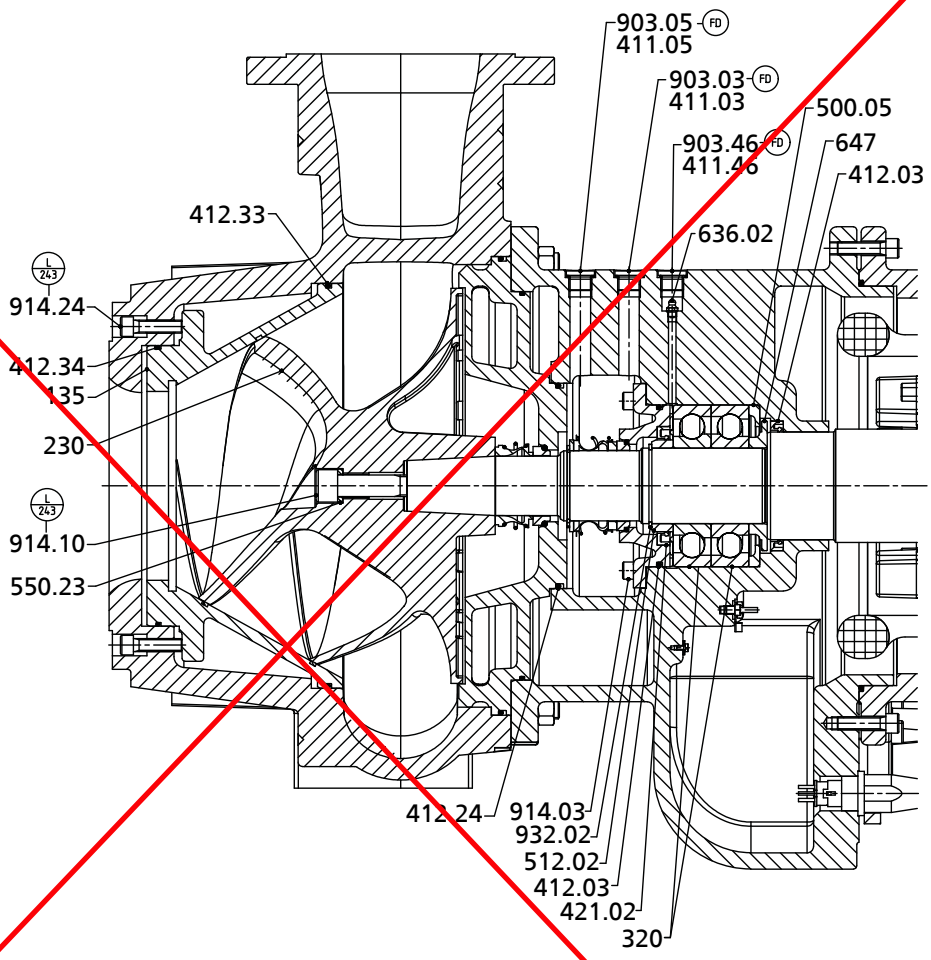


Fig. 47: Reinforced bearings

Table 46: Reinforced bearings

Part No.	Description	Part No.	Description
135	Wear plate	512.02	Wear ring
230	Impeller	550.23	Disc
320	Rolling element bearing	636.02	Lubricating nipple
411.03/.05/.46	Joint ring	647	Grease regulator
412.03/.24/.33/.34	O-ring	903.03/.05/.46	Screw plug
421.02	Lip seal	914.03/.10/.24	Hexagon socket head cap screw
500.05	Ring	932.02	Circlip

9.2.8 Attachment elements

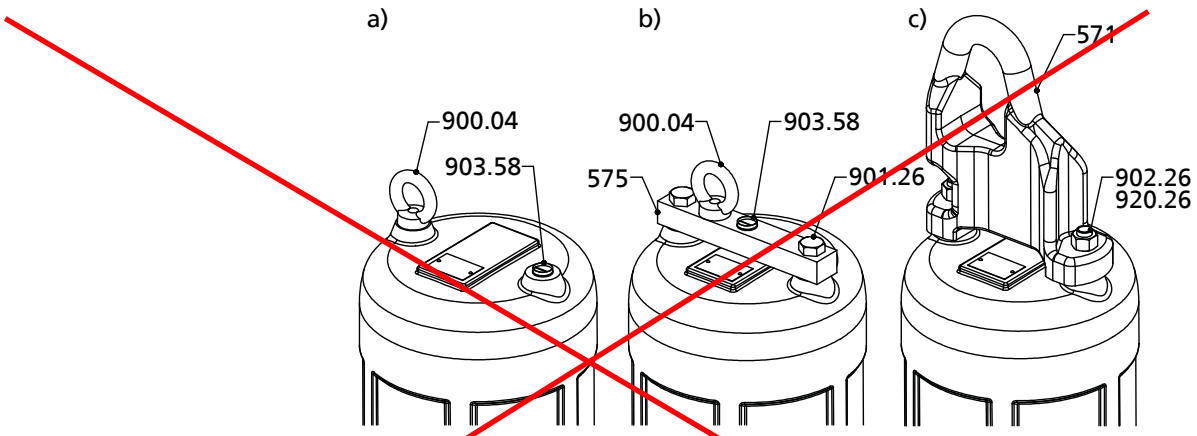


Fig. 48: Attachment elements a) bolt for guide cable arrangement b) bolt for guide rail arrangement c) bail

Table 47: Attachment elements

Part No.	Description	Part No.	Description
571	Bail	902.26	Stud
575	Strip	903.58	Screw plug
900.04	Bolt/screw	920.26	Nut
901.26	Hexagon head bolt		

9.2.9 Electrode for leakage monitoring

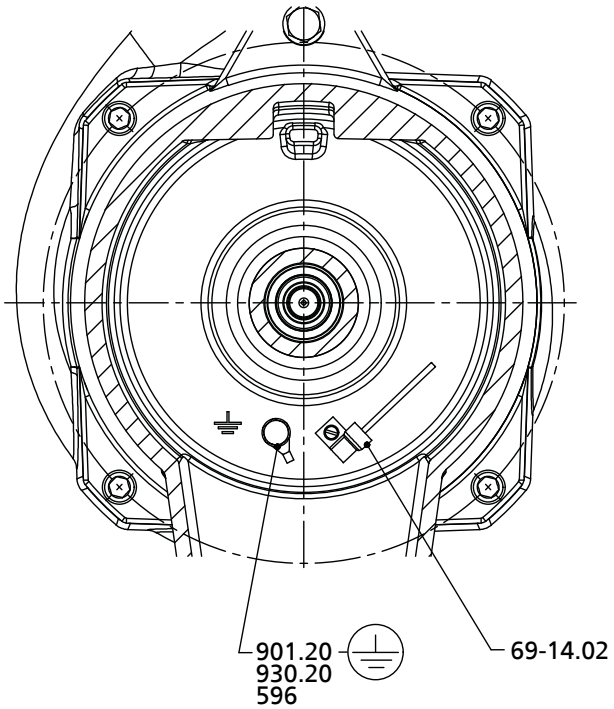


Fig. 49: Electrode for leakage monitoring

Table 48: Electrode for leakage monitoring

Part No.	Description	Part No.	Description
596	Wire	901.20	Hexagon head bolt
69-14.02	Leakage sensor	930.20	Safety device

9.2.10 Electrode for leakage monitoring and motor temperature sensor

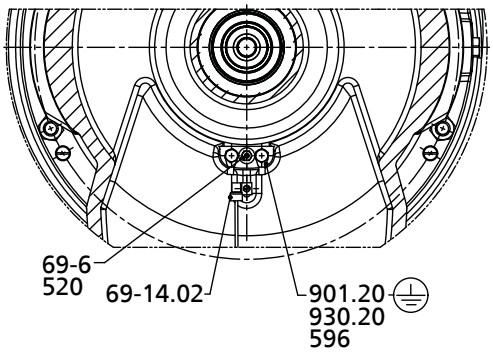


Fig. 50: Electrode for leakage monitoring and motor temperature sensor

Table 49: Electrode for leakage monitoring and motor temperature sensor

Part No.	Description	Part No.	Description
520	Sleeve	69-14.02	Leakage sensor
596	Wire	901.20	Hexagon head bolt
69-6	Temperature sensor	930.20	Safety device

9.2.11 Motor and fastening elements for the cable glands

9.2.11.1 Amarex KRT, motor type 1

Sizes:
40-252
50-215
50-216
65-215
65-216
65-217
65-253
80-215
80-216
80-217
80-252
80-253
80-255
100-215
100-253
100-254
100-255
150-253

Motors:
3 2
4 2
5 2
7 2
2 4
3 4
4 4
5 4

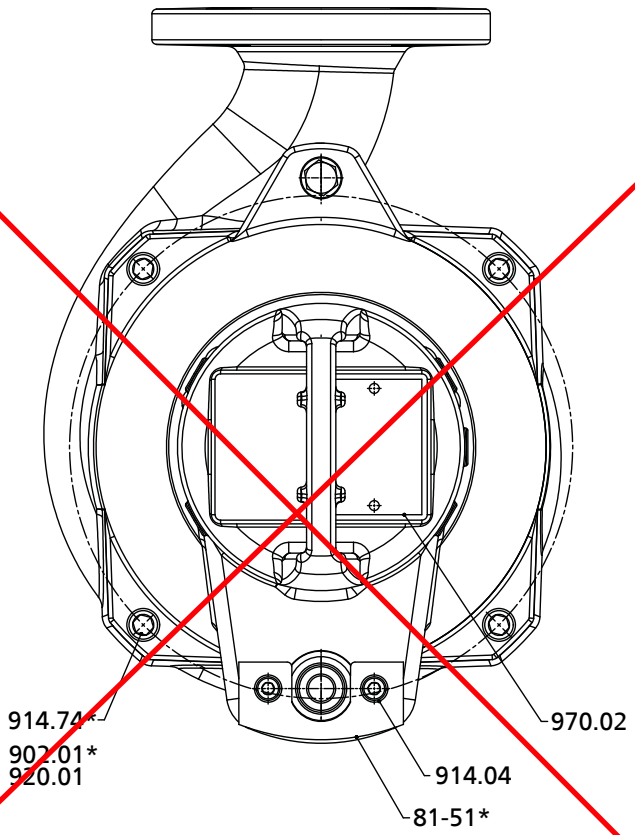


Fig. 51: Motor and fastening elements for the cable glands Amarex KRT, motor type 1
*: On specific designs only

Table 50: List of components

Part No.	Description	Part No.	Description
81-51*	Clamping element	920.01*	Nut
902.01*	Stud	970.02	Label/plate
914.04/.74*	Hexagon socket head cap screw		

9.2.11.2 Amarex KRT, motor type 2

Sizes:
40-252
50-215
50-216
65-215
65-216
65-217
65-253
80-215
80-216
80-217
80-252
80-253
80-255
80-315
80-316
80-317
100-215
100-253
100-254
100-255
150-253
150-315
150-317
200-315
200-316
200-317
200-318

Motors:
11 2
15 2
18 2
22 2
26 2
7 4
11 4
15 4
18 4
22 4
7 6
11 6
15 6
18 6

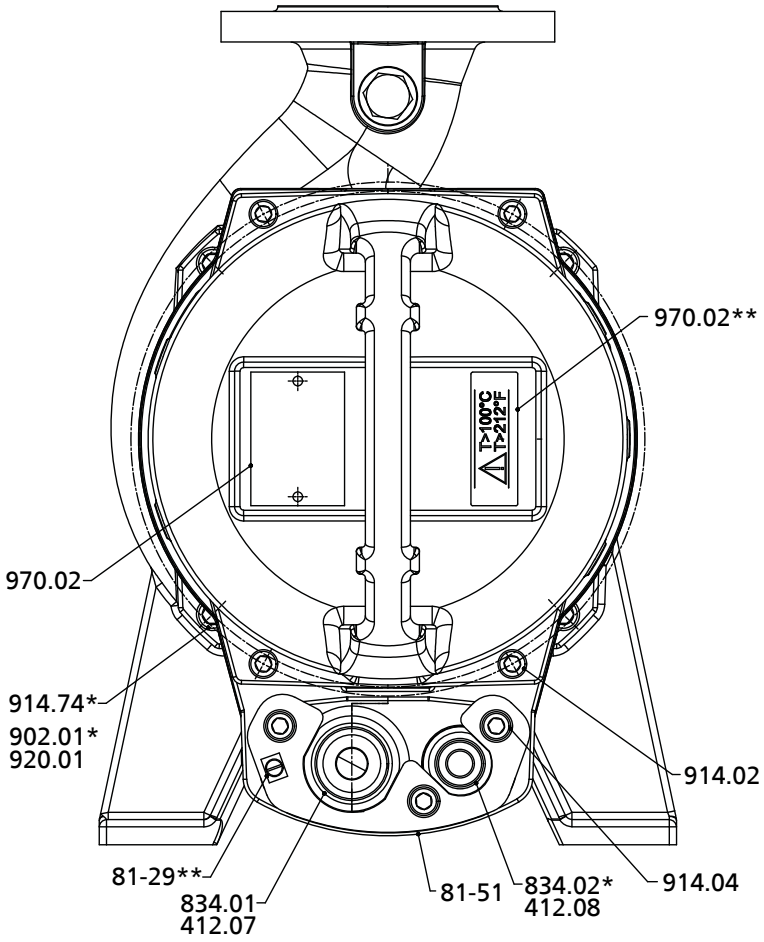


Fig. 52: Motor and fastening elements for the cable glands Amarex KRT, motor type 2

*: On specific designs only

** Only for installation types K, D and H

Table 51: List of components

Part No.	Description	Part No.	Description
412.07/.08*	O-ring	902.01*	Stud
81-29**	Terminal	914.02/.04/.74*	Hexagon socket head cap screw
81-51	Clamping element	920.01*	Nut
834.01/.02*	Cable gland	970.02/.20**	Label/plate

9.3.1.2 Wiring diagram for one power cable 12G1.5 or 12G2.5 (AWG 15-12 oder 13-12)

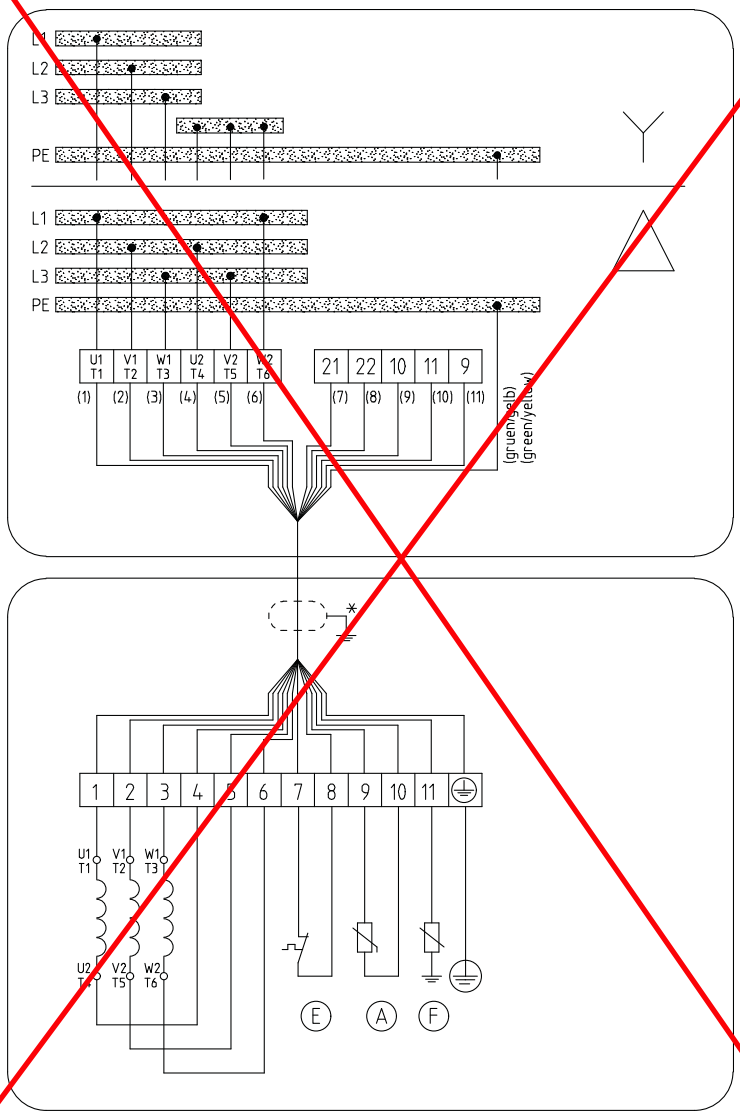


Fig. 56: Wiring diagram for pump sets of installation types P or S with one power cable 12G1.5 or 12G2.5

Ⓐ	Motor temperature (PTC thermistor)
Ⓔ	Motor temperature
Ⓕ	Leakage inside the motor
*	Shielded cable optional

9.3.1.3 Wiring diagram for one power cable 7G4 + 5×1.5, 7G6 + 5×1.5 or 7G10 + 5×1.5 (AWG 11 - 7 + 15 - 5, AWG 9 - 7 + 15 - 5 or AWG 7 - 7 + 15 - 5)

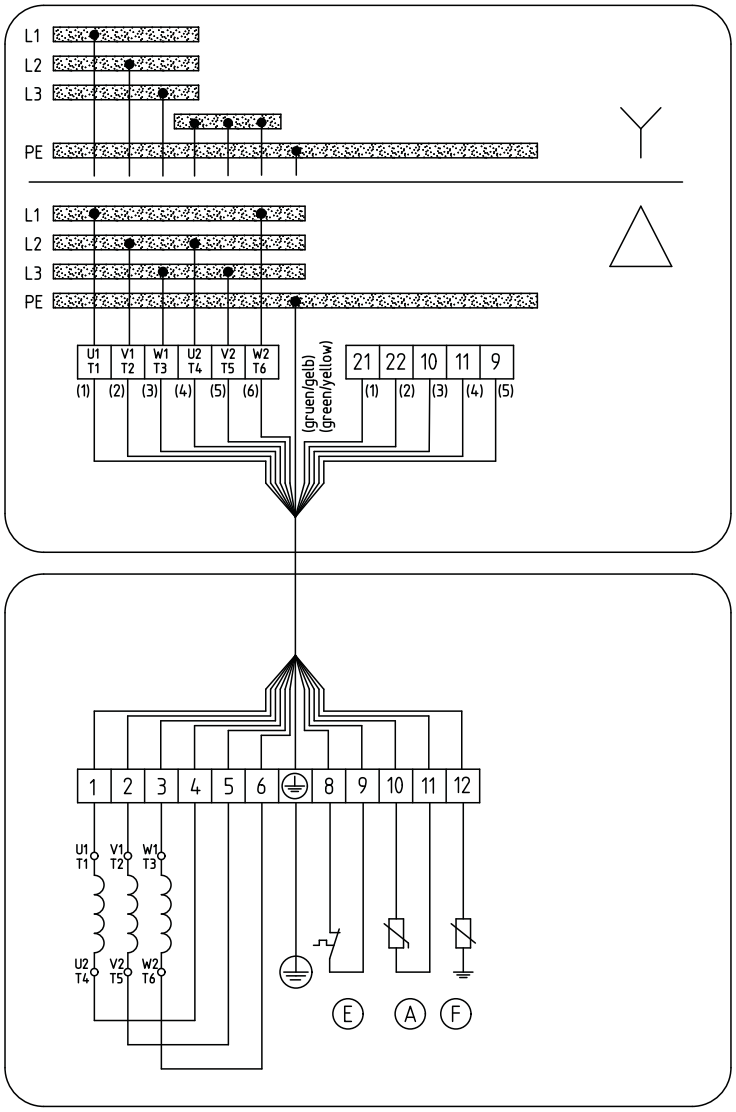


Fig. 57: Wiring diagram for pump sets of installation types P or S with one power cable 7G4 + 5×1.5, 7G6 + 5×1.5 or 7G10 + 5×1.5

Ⓐ	Motor temperature (PTC thermistor)
Ⓔ	Motor temperature
Ⓕ	Leakage inside the motor
*	Shielded cable optional

9.3.2.4 Wiring diagram for one power cable 7G4 + 5×1.5, 7G6 + 5×1.5 or 7G10 + 5×1.5 (AWG 11 - 7 + 15 - 5, AWG 9 - 7 + 15 - 5 or AWG 7 - 7 + 15 - 5)

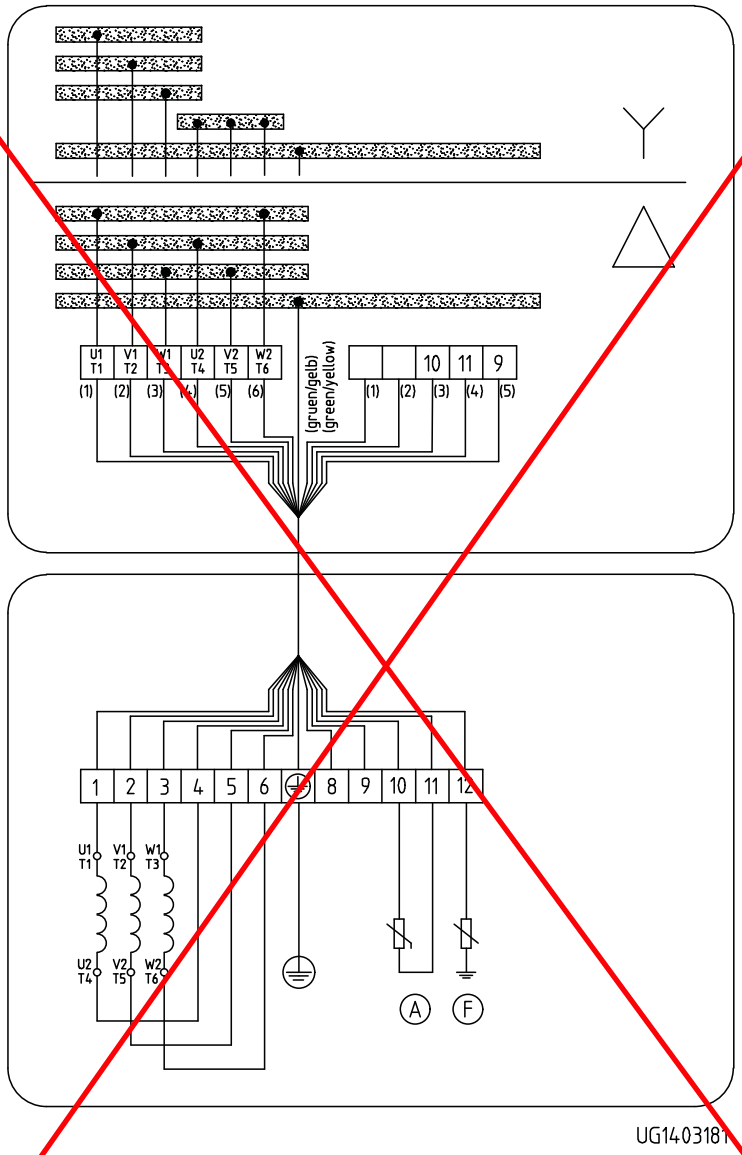


Fig. 65: Wiring diagram for pump sets of installation types D, H or K with power cables 7G4 + 5×1.5, 7G6 + 5×1.5 or 7G10 + 5×1.5

Ⓐ	Motor temperature 1
Ⓕ	Leakage inside the motor
*	Shielded cable optional

9.4 Flamepaths on explosion-proof motors

9.4.1 Amarex KRT, motor type 1

Motors:
3 2
4 2
5 2
7 2
2 4
3 4
4 4
5 4

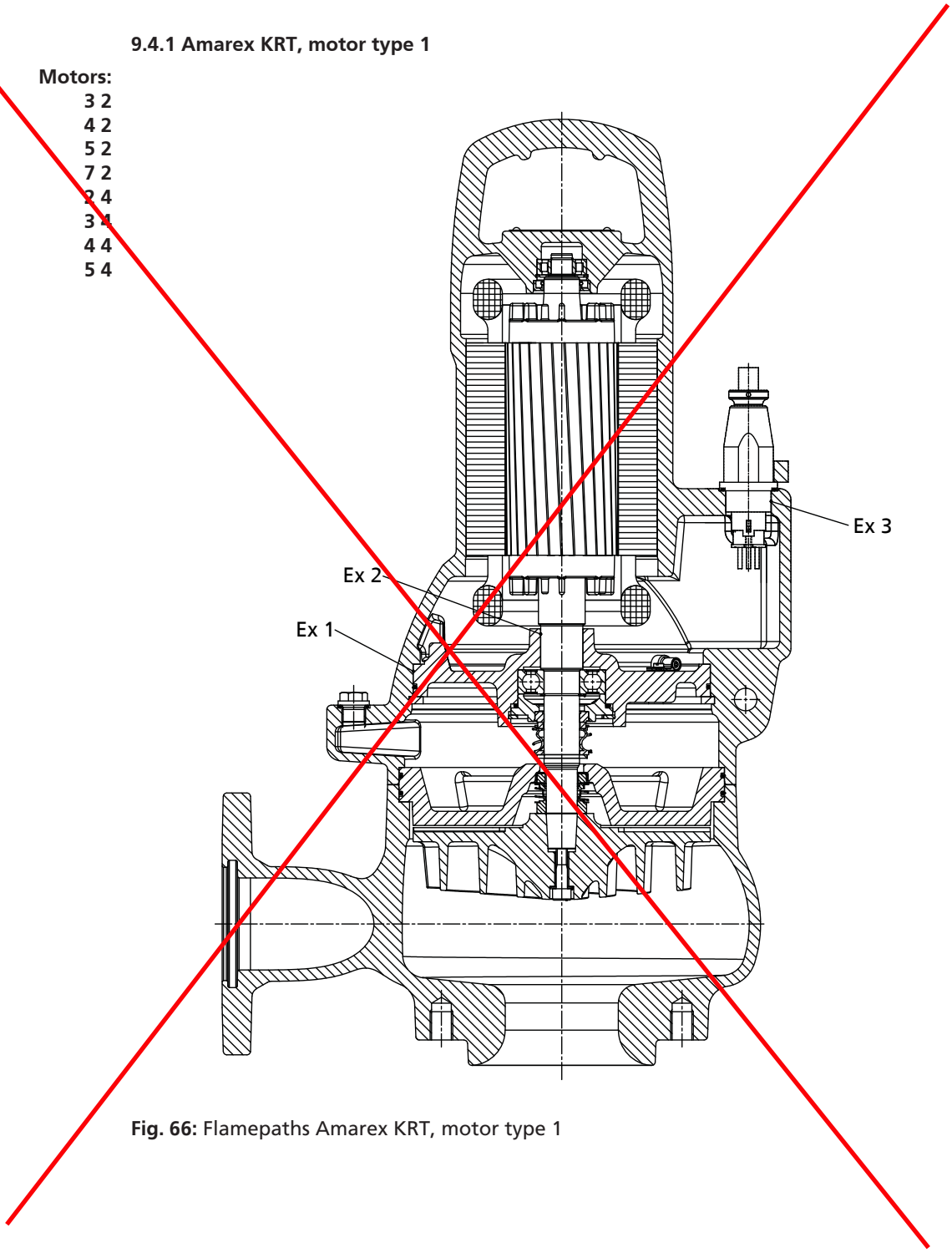


Fig. 66: Flamepaths Amarex KRT, motor type 1

9.4.2 Amarex KRT, motor type 2

Motors:
11 2
15 2
18 2
22 2
26 2
7 4
11 4
15 4
18 4
22 4
7 6
11 6
15 6
18 6

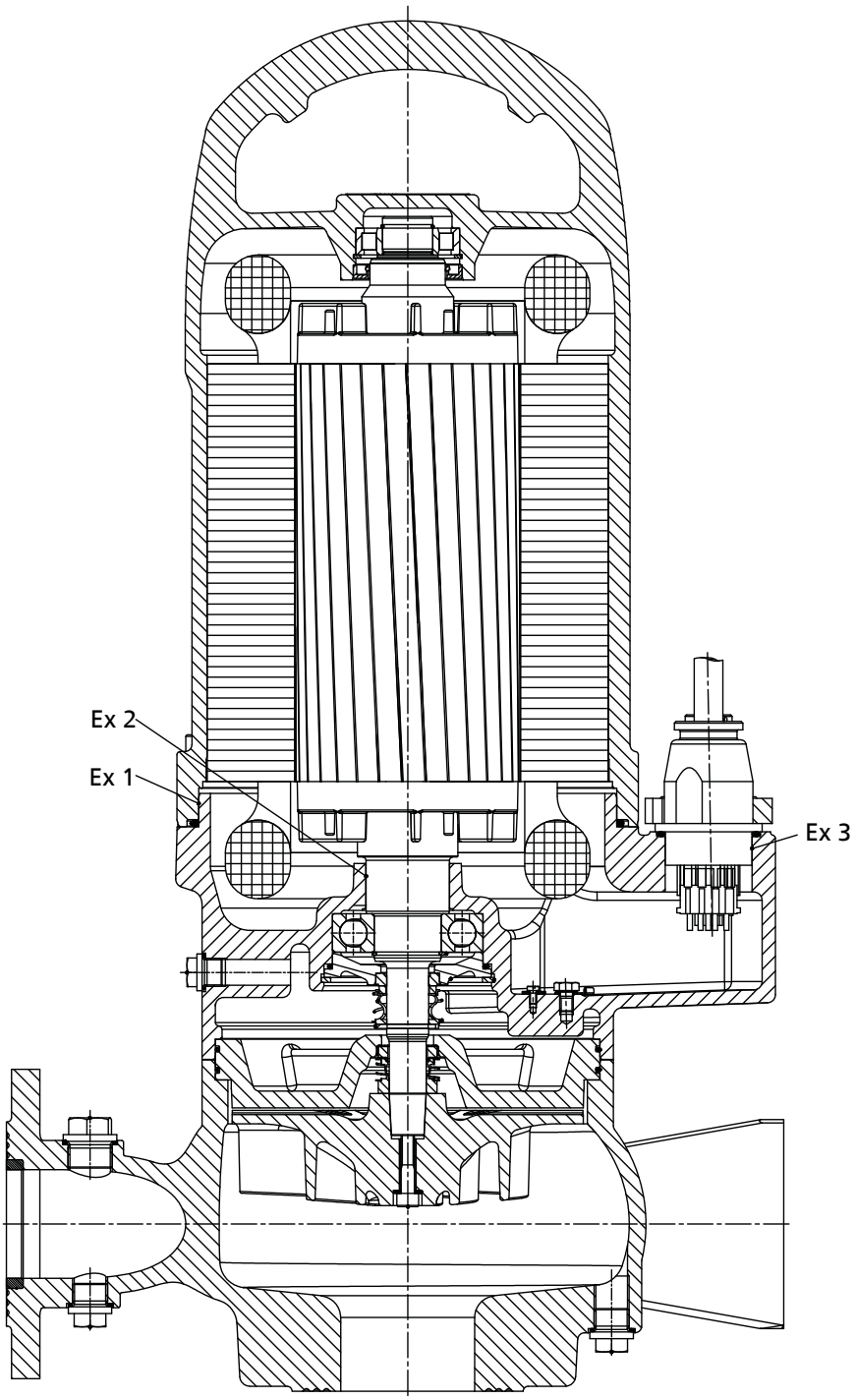


Fig. 67: Flamepaths Amarex KRT, motor type 2

9.4.3 Amarex KRT, motor type 3

Motors:
55 2
65 2
75 2
30 4
37 4
45 4
55 4
65 4
75 4
22 6
30 6
31 6
37 6
45 6
55 6
11 8
15 8
18 8
22 8
30 8
37 8
45 8

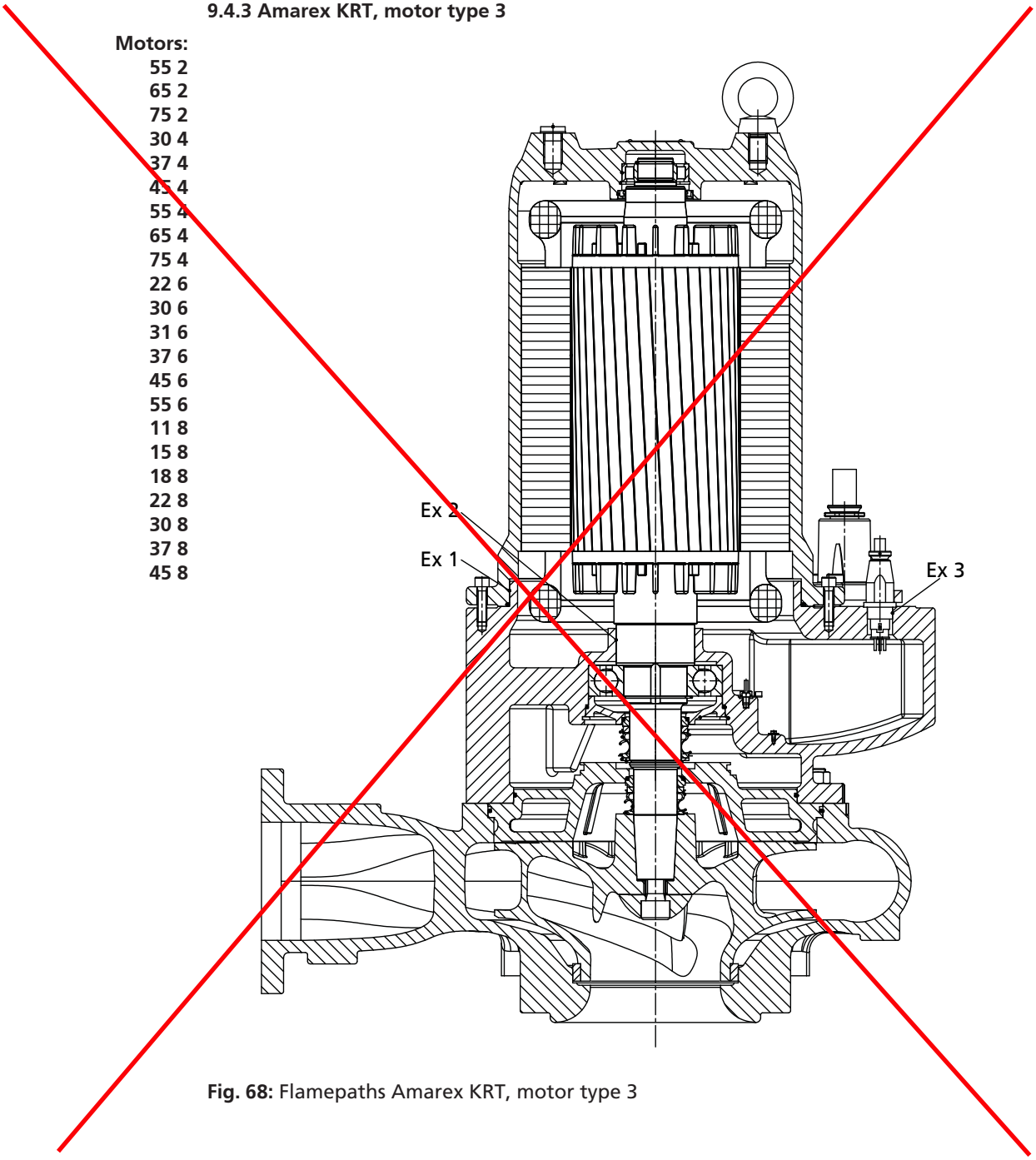


Fig. 68: Flamepaths Amarex KRT, motor type 3

9.5 Sectional drawings of the mechanical seal

9.5.1 Bellows-type mechanical seal

Mechanical seal for material variants G, G1, G2, GH, C1

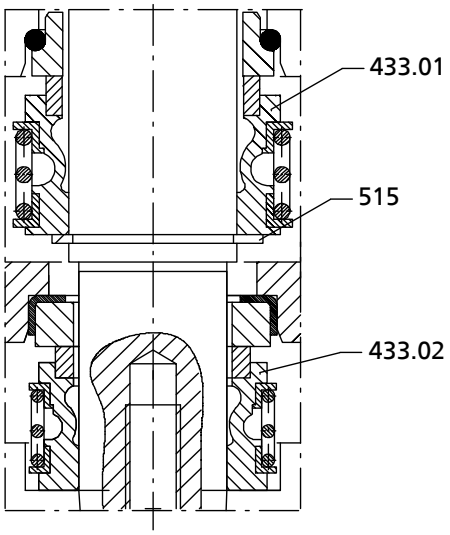


Fig. 69: Sectional drawing of bellows-type mechanical seal

Table 54: Bellows-type mechanical seal

Part No.	Description	Part No.	Description
433.01/.02	Mechanical seal	515	Taper lock ring

9.5.2 Mechanical seal with covered springs (HJ)

Mechanical seal for material variants H, C2[15)]

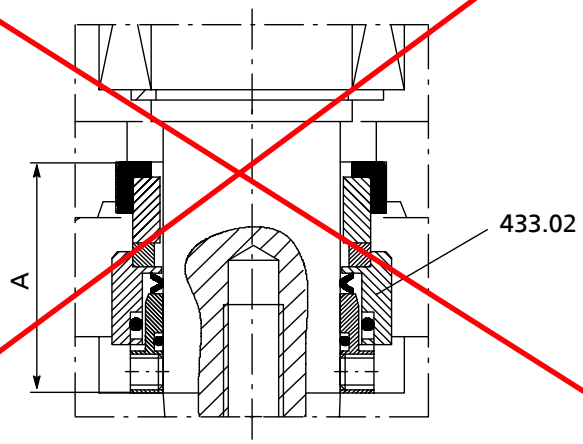


Fig. 70: Sectional drawing of mechanical seal with covered springs (HJ)

Table 55: Mechanical seal with covered springs (HJ)

Part No.	Description	Part No.	Description
433.02	Mechanical seal		

15) Optional for material variants G, G1, G2, GH, C1

9.5.3 Double cartridge seal

Mechanical seal for material variants H, C2[16)17)]

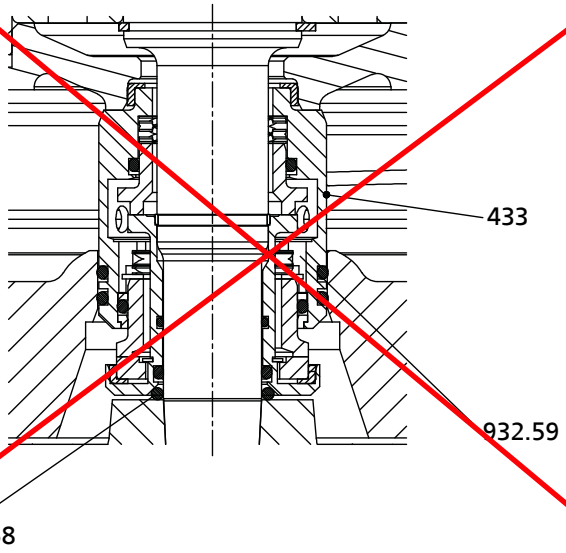


Fig. 71: Sectional drawing of double cartridge seal

Table 56: Double cartridge seal

Part No.	Description	Part No.	Description
412.58	O-ring	932.59	Circlip
433	Mechanical seal		

16) Only on sizes 50-215, 50-216, 65-215, 65-216, 65-217, 80-215, 80-216, 80-217, 100-215
17) Optional for material variants G, G1, G2, GH, C1

10 Certificate of Decontamination

Type: .....

Order number/

order item number[18]: .....

Delivery date: .....

Field of application: .....

Fluid handled[18]: .....

Please check where applicable[18]:

☐ Radioactive

☐ Explosive

☐ Corrosive

☐ Toxic

☐ Harmful

☐ Bio-hazardous

☐ Highly flammable

☐ Safe

Reason for return[18]: .....

Comments: .....

.....

The product/accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch/ placing at your disposal.

We herewith declare that this product is free from any hazardous chemicals as well as from biological and radioactive substances.

For mag-drive pumps, the inner rotor unit (impeller, casing cover, bearing ring carrier, plain bearing, inner rotor) has been removed from the pump and cleaned. In cases of containment shroud leakage, the outer rotor, bearing bracket lantern, leakage barrier and bearing bracket or intermediate piece have also been cleaned.

For canned motor pumps, the rotor and plain bearing have been removed from the pump for cleaning. In cases of leakage at the stator can, the stator space has been examined for fluid leakage; if fluid handled has penetrated the stator space, it has been removed.

☐ No special safety precautions are required for further handling.

☐ The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

.....

We confirm that the above data and information are correct and complete and that dispatch is effected in accordance with the relevant legal provisions.

.....	.....	.....
Place, date and signature	Address	Company stamp

18) Required fields

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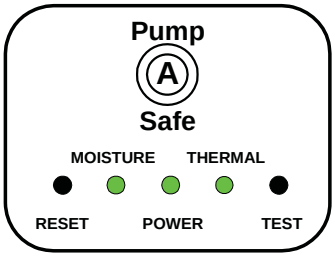
PumpSafe™

Monitoring Modules for KSB Submersible Pumps



Monitoring Module
O/A Size 3.75"H x 2.62"W x 2.25"D

Module Types
(by sensor types and pump leads)

A – Bi-Metal (21 & 22) *or* Thermistor (10 & 11)
& Moisture Probe (9 & Pump Ground)

~~**B** – Bi-Metal (21 & 22) *or* Thermistor (10 & 11)~~
~~& Float Switch (3 & 4)~~

~~**D** – Bearing RTD (15 & 16) & Float Switch (3 & 4)~~

Overview: KSB submersible pump motors have varying combinations of over-temperature and moisture intrusion protection. The alternatives employed by the KSB factory are motor specific. The alternatives include bi-metal or thermistors for winding thermal protection, an RTD for bearing temperature monitoring and either conductivity probe, a float switch or on some motors both sensor types. The appropriate module(s) should be specified accordingly.

PumpSafe™ Module 'A': Monitors both thermal winding sensor (bi-metal or thermistor) and the conductivity probe to detect moisture intrusion. This sensor combination is typical for low horsepower motors. Each type module monitors one thermal and one moisture function input (see above listing). Each module type likewise has one set of form C output contacts per alarm function to provide remote pump monitoring or to directly control the pump's operation.

Installation: The PumpSafe™ Module can be installed locally or in a MCC on the supplied 12 pin socket. Modules can be combined in a single Nema 4X local control panel for monitoring multiple pump installations.

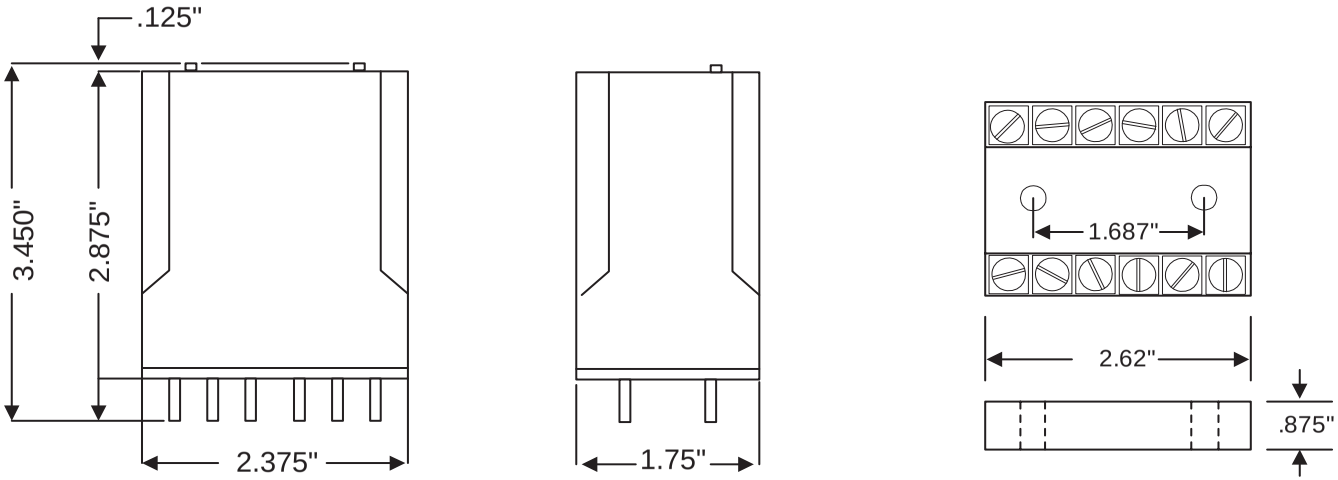
Operation: Integrally the module indicates using bi-colored LEDs, one each for each fault type; **GREEN** being OK, **ORANGE** (Channel A) or **RED** (Channel B) a failure "ALARM" condition. In addition a power ON LED and a "TEST" and a "RESET" button are provided. A self correcting fault, either moisture or thermal, causes the respective LED to change from a steady (alarm) to a flashing signal. This LED continues to flash until locally cleared, providing the plant operator annunciation of a potential intermittent fault condition. Rev 1.7, 3/28/06

Module Specifications:
Power supply: 24-240VAC/1/60 or 50 cycle
Thermal circuit: <25 ma @ 12VDC
Moisture Sensor Circuit: <300uA @ 5 Volts VDC
Output Contact Rating: 5A @ 120 Volts AC
Power Consumption: 2.8 Watts Maximum

Pin Configuration & Function:
1 & 2 Motor Thermal Circuit – Input
3 & 4 Motor Moisture Circuit – Input
5 & 6 24-240 Volts AC – Input
7/8/9 Thermal NC/COM/NO Output Contacts
10/11/12 Moisture NC/COM/NO Output Contacts

www.PumpSafe.com – Presently under construction

4415 Sarellen Road, Richmond, VA 23231
www.ksb-inc.com
804-222-1818



REV.	Dwg. By	Date
		3/27/2006

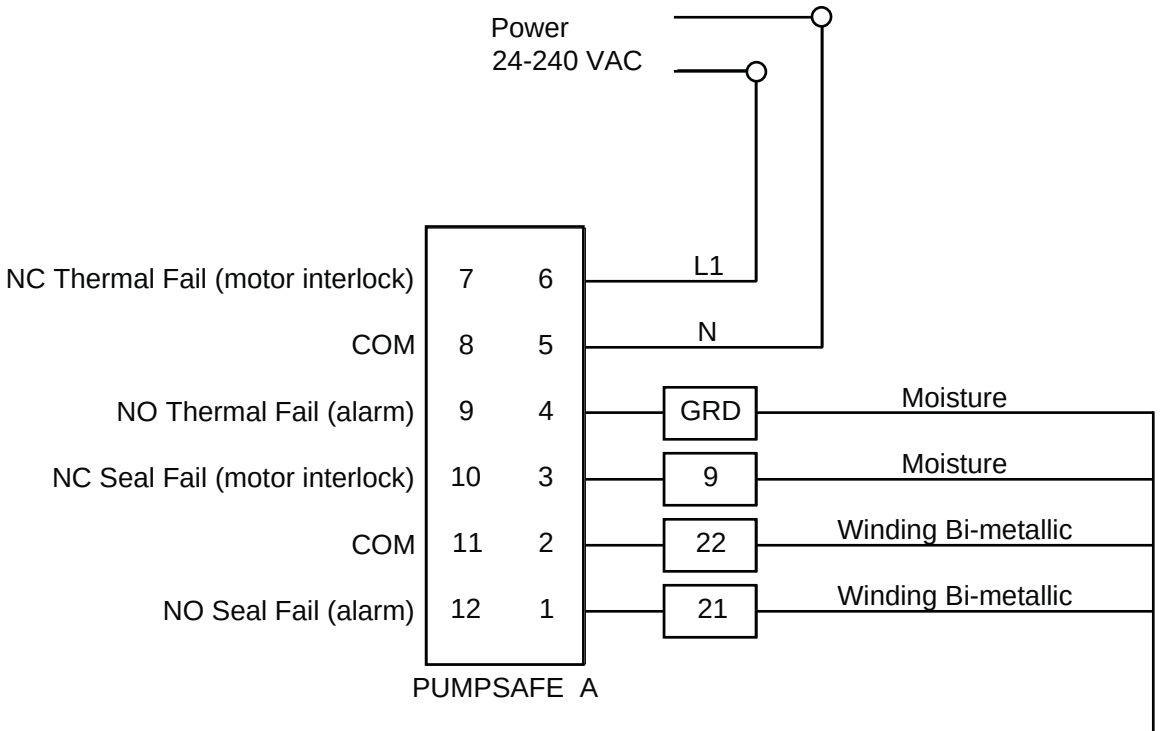
Customer/Project:	Drwg. No. Project No.	**PumpSafe™** KSB Pump Monitoring System **Module A, B & D**

PumpSafe™ Wiring Diagram

KRT Submersible Pumps - Drawing # 1

JAB 8/05

PumpSafe™ Relays Required:
(1) Module A with form C outputs rated 5A @ 120VAC



Note: Relays are fail safe. Relays shown in the energized state. Contacts change state at loss of power. Therefore, pushbutton resets on the front of control panel should be used with timers. PumpSafe™ relays have built in reset button.

READ THIS FIRST!

IMPORTANT SETUP PROCEDURES

PumpSafe Model A – Moisture (seal failure) /Thermal (high temp) Relay

Upon application of power to the Model A relay, it immediately starts an internal test routine to verify correct operation. This test routine lasts for 15 seconds, after which the relay is ready to monitor the Chan A (Moisture) and Chan B (Thermal) inputs. (*The output relay contacts for each channel do not change state until after the test routine is completed and the input channels have been polled.)*

(*Pressing the Reset pushbutton will also initiate the internal test routine*.)

After the test routine is complete, the **Green** Power On LED and the Chan A and Chan B LED's will be illuminated. If there is no fault condition present on either input channel, both channel LED's will be Illuminated **Green.**

The Chan A and Chan B input channels have built in time delays to prevent false failure indications.

A Seal Failure condition will be indicated on Chan A if:
a resistance of 125k ohms or less exists for a **minimum of 15 seconds, 3 times in a 24-hour period**
OR
a resistance of 125k ohms or less exists for a **minimum of 45 seconds.**

If an alarm condition exists, the Chan A LED will illuminate **ORANGE.**
If/when the alarm condition clears, the Chan A LED will flash to indicate an alarm existed, but does not exist currently, until the Reset pushbutton is pressed.

A High Temperature condition will be indicated on Chan B if:
an open circuit exits for a **minimum of 2 seconds, 3 times in a 24-hour period**
OR
an open circuit exits for a **minimum of 7 seconds.**

If an alarm condition exists, the Chan B LED will illuminate **RED**.
If/when the alarm condition clears, the Chan B LED will flash to indicate an alarm existed, but does not exist currently, until the Reset pushbutton is pressed.

Once an alarm has occurred on either channel once in a 24-hour period, and cleared, any subsequent occurrence will not be restricted to the time delay. The circuit will indicate an alarm instantly upon recurrence of an alarm condition.

ATLANTIC FLUID TECHNOLOGY
WATER & WASTEWATER EQUIPMENT

Tel: (508) 755-0440
Fax: (800) 672-6960

354 West Boylston St., Suite 114 West Boylston, MA 01583

DATE: March 30, 2021 **TIME:** 1:36 PM

TO: TYLER – UNITED CONCRETE

FROM: DAN WEAVER

RE: FACTORY TEST REPORTS 11306 SUBMERSIBLE PUMPS

Number of pages including cover sheet: 1

We have received the KSB factory testing results. Please see attached and forward to AECOM for review and approval. Below are a few comments and clarifications to include with the submission.

1. Attached are Test Reports for the submersible pumps 11306. The pumps all tested out well and exceeded contract requirements.
2. Note that all pumps exceeded HI 1U tolerances as required by contract. The test reports state an acceptance class of 2B or ISO 9906, however results exceed HI 1U requirements.
3. For PS3 pumps, design point of 305 GPM @ 71 ft is achieved at 1675 RPM per approved submittal. Factory test requirements were based actual motor speed of 1762 RPM, which provides a point of 305 GPM @ 82 ft. Both pumps tested within HI 1U for this test point of 305 GPM @ 82 ft.
4. Spec 11306 requires pump temperature testing 2.11.B.3.e. The units are submerged, so temperature testing is through motor temperature PTC Thermistors. Reading after 4 hour operation is highlighted (red box) on each motor test report for clarity. Thermistor range is 150-300 ohms (cool) to 4000 ohm trip point. All readings were below 1000 ohms and acceptable.

I hope the above information is satisfactory. Please call if you have any questions.

Sincerely,

Dan Weaver

PS1 and PS2 Pumps

KSB SE & Co. KGaA
test field

Test Record 3.1

KSB

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412739**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412739		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	552,37	gal/min	*head H:*	88,12	feet
pump input power P:	21,63	hp (electric	*speed n:*	1762	r.p.m.
pump efficiency η:	56,82	%	*density ρ:*	998	kg/m³
			kin. viscosity:	0,000001	m²/s
acceptance test class	HI 11.6 2 B		*fluid temperature T:*	20,00	°C

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7
speed n	r.p.m.	1789,8	1780,9	1773,0	1771,4	1769,6	1765,7	1765,2
temperature T	°C	21,5	21,4	21,4	21,4	21,5	21,5	21,5
capacity Q	**gal/min**	**0,00**	**281,66**	**527,19**	**583,18**	**647,12**	**864,04**	**1052,18**
motor input power Pel	hp (electric	9,60	17,13	23,88	25,29	26,89	30,24	30,71
voltage U	V	469,0	458,6	455,0	455,8	460,3	458,1	457,8
current I1	A	20,37	24,38	29,71	30,97	32,30	35,32	35,77
current I2	A	20,35	24,30	29,67	30,96	32,31	35,34	35,82
current I3	A	20,28	24,21	29,49	30,78	32,09	35,11	35,59
cos phi	-	0,434	0,662	0,763	0,773	0,780	0,806	0,809
calculated values								
density ρ	kg/m³	998,0	998,0	998,0	997,9	997,9	997,9	997,9
total head H	**feet**	**110,96**	**98,48**	**92,30**	**91,21**	**89,64**	**78,14**	**67,50**
motor efficiency η mot	%	83,54	87,88	89,09	89,22	89,33	89,48	89,49
pump input power P2	**hp (electric**	**8,02**	**15,06**	**21,28**	**22,57**	**24,02**	**27,06**	**27,48**
pump power P2 ρ ordered	hp (electric	8,02	15,06	21,28	22,57	24,02	27,06	27,48
pump efficiency η	**%**	**0,00**	**46,49**	**57,72**	**59,48**	**60,95**	**62,96**	**65,21**
η total (pump+motor)	%	0,00	40,86	51,42	53,07	54,45	56,34	58,36

Remarks:

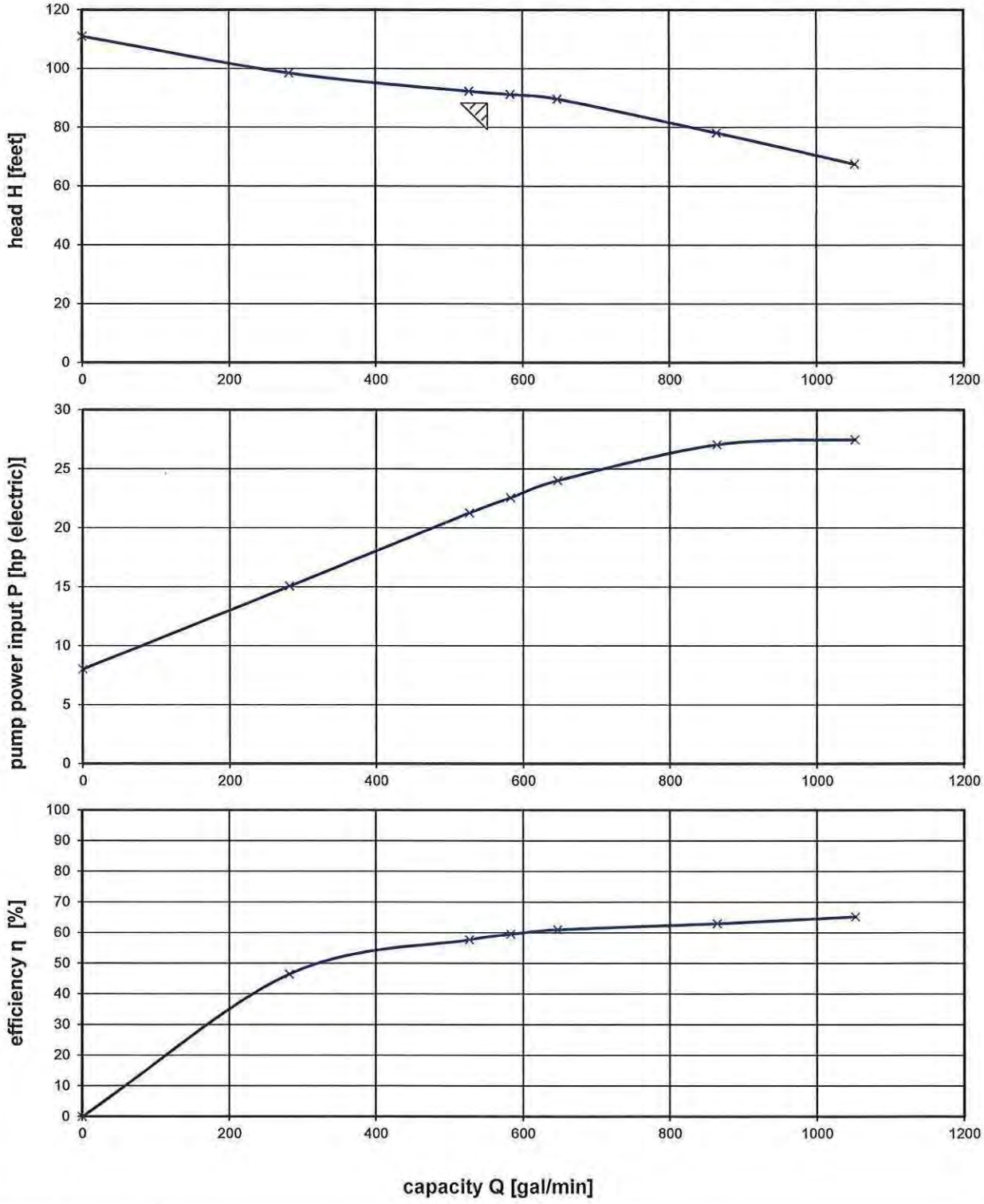
P+C/B.Bock QP1909483

\ DN 080 \ 9974530833_000100_412739

test record nr.	20210318-102712
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	18.03.2021

**) This report was created electronically and is valid without signature*

performance curves at operation speed from 1765 to 1790 r.p.m.



KSB	performance curves				client reference				
	\ DN 080 \ 9974530833_000100_412739				order nr. 9974530833_000100		date 18.03.2021		
pump data	type KRTF 80-252/224XEG1-S				D2 [mm]				
report nr.	manufactur. KSB Halle				260				
20210318-102712	curve no.								
motor data	type KA16MN04-250			frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur. KSB Halle			Hz	hp	r.p.m.	Volt	Ampere	–
VERTIKAL	serial no. 412739			60	29,998659	1762	460	37,4	0,84
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet	hp (electric)	%	r.p.m.		kg/m³	°C	m²/s
HI 11.6 2 B	552,37	88,12	21,63	56,82	1762		998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

49 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412739**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412739		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	400	gal/min	*head H:*	59 feet
			frequency	49 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	8
frequency	Hz	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0
temperature T	°C	21,4	21,2	21,2	21,2	21,2	21,3	21,3	21,3
capacity Q	**gal/min**	**0,00**	**195,25**	**296,13**	**401,87**	**503,79**	**604,84**	**802,91**	**942,97**
motor input power Pel	hp (electric	5,32	8,83	10,81	12,80	14,49	15,84	17,12	17,03
calculated values									
density ρ	kg/m³	998,0	998,0	998,0	998,0	998,0	998,0	997,9	997,9
total head H	**feet**	**69,57**	**62,82**	**60,05**	**58,21**	**56,80**	**53,55**	**45,43**	**40,08**
η total (pump+motor)	%	0,00	35,06	41,50	46,12	49,83	51,61	53,78	56,01

Remarks:

test record nr.	20210318-104311
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	18.03.2021

\ DN 080 \ 9974530833_000100_412739.49Hz

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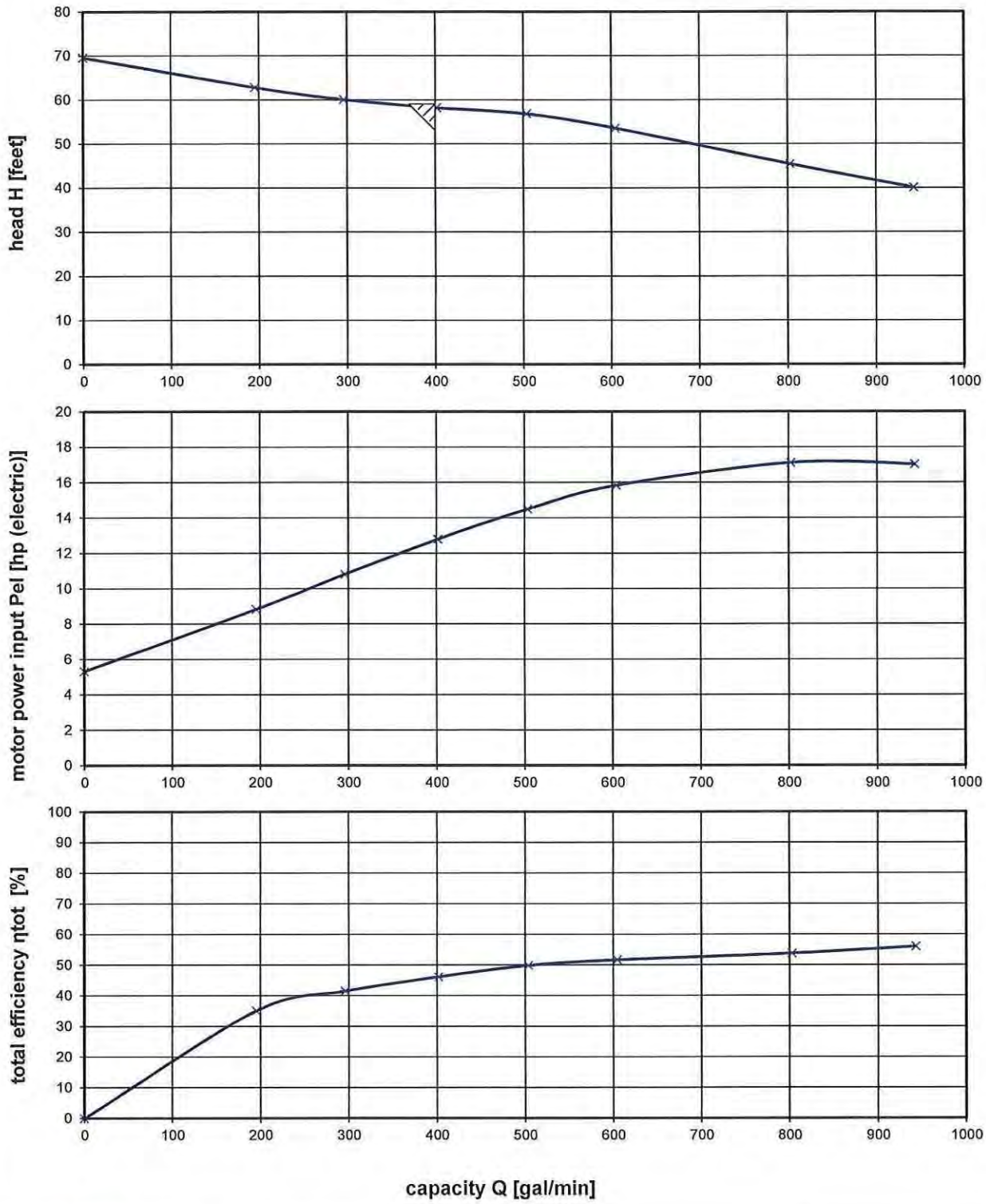
performance curves at operation speed from 49 to 49 Hz



KSB	**performance curves**			*client reference*					
	\ DN 080 \ 9974530833_000100_412739.49Hz			*order nr.* 9974530833_000100			*date*	18.03.2021	
pump data	*type* KRTF 80-252/224XEG1-S			*D2 [mm]*					
report nr.	*manufactur.* KSB Halle			260					
20210318-104311	*curve no.*								
motor data	*type* KA16MN04-250		*frequency*	*P motor*	*speed n*	*voltage*	*current*	*cos φ*	
client motor	*manufactur.* KSB Halle		*Hz*	*hp*	*r.p.m.*	*Volt*	*Ampere*	–	
VERTIKAL	*serial no.* 412739		60	29,998659	1762	460	37,4	0,84	
ordered data	*capacity Q*	*head H*	*P pump*	*η pump*	*speed n*	*NPSH*	*density ρ*	*temp. hot*	*kin. visk*
acceptance test class	*gal/min*	*feet*	*0*	*0*	*Hz*	*0*	*0*	*0*	*0*
	400,00	59,00			49				

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KSB SE & Co. KGaA
test field

Test Record 3.1

38 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412739**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412739		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	160	gal/min	*head H:*	39 feet
			frequency	38 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	38,0	38,0	38,0	38,0	38,0	38,0	38,0	
temperature T	°C	21,6	21,5	21,5	21,4	21,4	21,4	21,3	
capacity Q	**gal/min**	**0,00**	**107,30**	**161,82**	**293,41**	**455,62**	**607,28**	**740,01**	
motor input power Pel	hp (electric)	2,87	4,10	4,76	6,33	7,96	8,75	8,76	
calculated values									
density ρ	kg/m³	997,9	997,9	997,9	997,9	997,9	997,9	997,9	
total head H	**feet**	**41,20**	**38,41**	**36,74**	**34,14**	**32,03**	**26,94**	**22,93**	
η total (pump+motor)	%	0,00	25,34	31,53	39,92	46,29	47,21	48,87	

Remarks:

test record nr.	20210318-105133
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	18.03.2021

\ DN 080 \ 9974530833_000100_412739.38Hz

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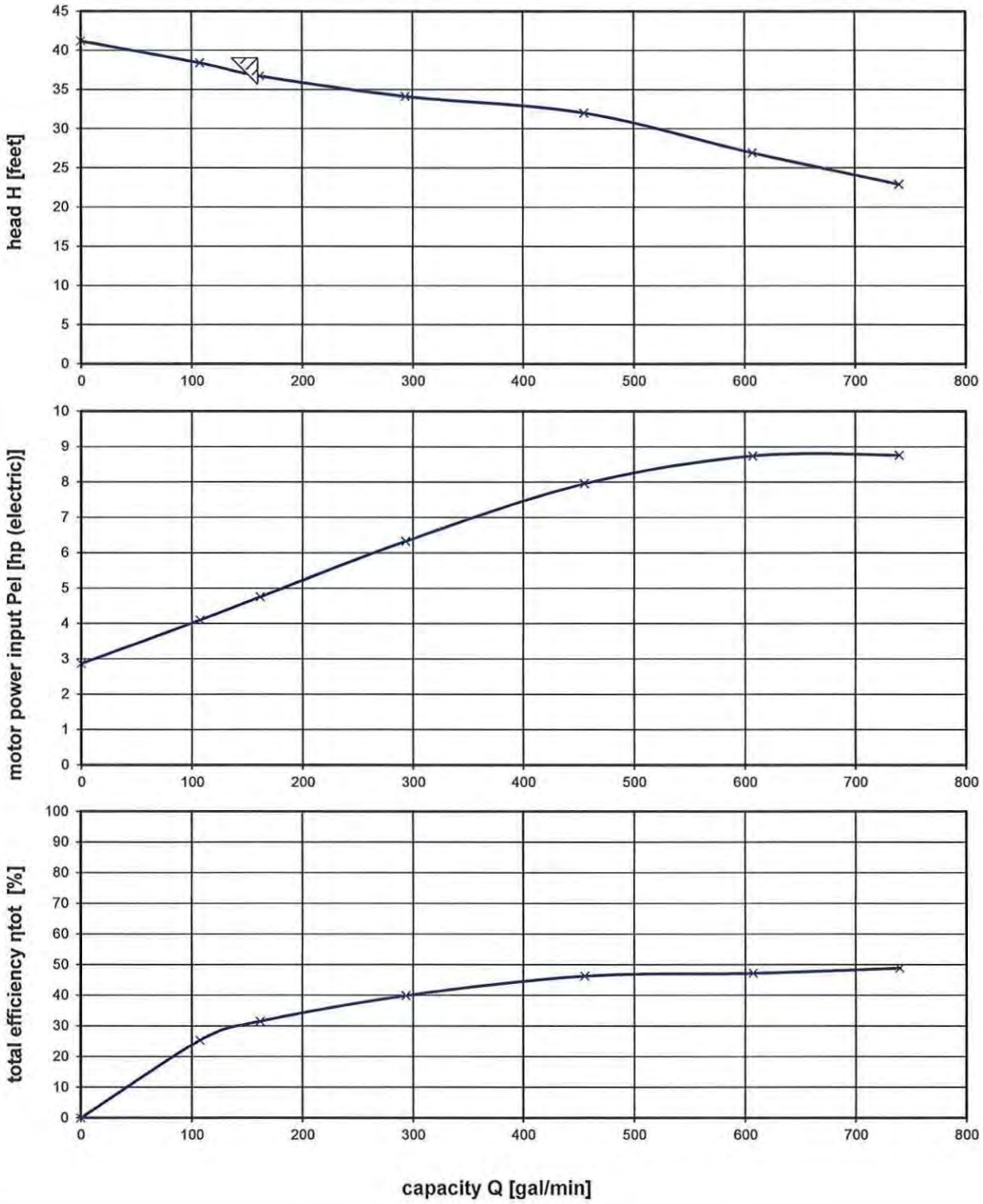
performance curves at operation speed from 38 to 38 Hz



KSB	performance curves			client reference					
	\ DN 080 \ 9974530833_000100_412739.38Hz			order nr. 9974530833_000100			date 18.03.2021		
pump data	type KRTF 80-252/224XEG1-S			D2 [mm]					
report nr.	manufactur. KSB Halle			260					
20210318-105133	curve no.								
motor data	type KA16MN04-250		frequency	P motor	speed n	voltage	current	cos φ	
client motor	manufactur. KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–	
VERTIKAL	serial no. 412739		60	29,998659	1762	460	37,4	0,84	
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet	0	%	Hz	m	kg/m³	°C	m²/s
HI 11.6 2 B	160,00	39,00		56,82	38	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

KSB

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412740**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412740		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	552,37	gal/min	*head H:*	88,12	feet
pump input power P:	21,63	hp (electric	*speed n:*	1762	r.p.m.
pump efficiency η:	56,82	%	*density ρ:*	998	kg/m³
			kin. viscosity:	0,000001	m²/s
acceptance test class	HI 11.6 2 B		*fluid temperature T:*	20,00	°C

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7
speed n	r.p.m.	1790,0	1781,0	1773,3	1771,5	1769,7	1766,0	1765,3
temperature T	°C	21,8	21,8	21,8	21,8	21,8	21,8	21,8
capacity Q	**gal/min**	**0,00**	**281,61**	**521,43**	**579,68**	**643,62**	**863,01**	**1041,81**
motor input power Pel	hp (electric	9,50	17,05	23,68	25,25	26,76	30,02	30,61
voltage U	V	463,4	459,9	456,4	455,5	454,6	452,3	452,0
current I1	A	20,10	24,55	29,73	31,02	32,34	35,42	35,97
current I2	A	20,05	24,50	29,70	31,02	32,37	35,47	36,04
current I3	A	19,97	24,37	29,52	30,78	32,11	35,24	35,79
cos phi	-	0,440	0,653	0,754	0,772	0,786	0,808	0,812
calculated values								
density ρ	kg/m³	997,9	997,9	997,9	997,9	997,9	997,8	997,8
total head H	**feet**	**110,12**	**98,49**	**91,95**	**91,21**	**89,26**	**77,29**	**66,51**
motor efficiency η mot	%	83,42	87,86	89,07	89,21	89,32	89,47	89,49
pump input power P2	**hp (electric**	**7,92**	**14,98**	**21,09**	**22,52**	**23,90**	**26,86**	**27,39**
pump power P2 ρ ordered	hp (electric	7,92	14,99	21,10	22,53	23,90	26,86	27,40
pump efficiency η	**%**	**0,00**	**46,71**	**57,36**	**59,23**	**60,66**	**62,67**	**63,83**
η total (pump+motor)	%	0,00	41,04	51,08	52,84	54,18	56,07	57,12

Remarks:

P+C/B.Bock QP19009483

\ DN 080 \ 9974530833_000100_412740

test record nr.	20210318-113435
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	18.03.2021

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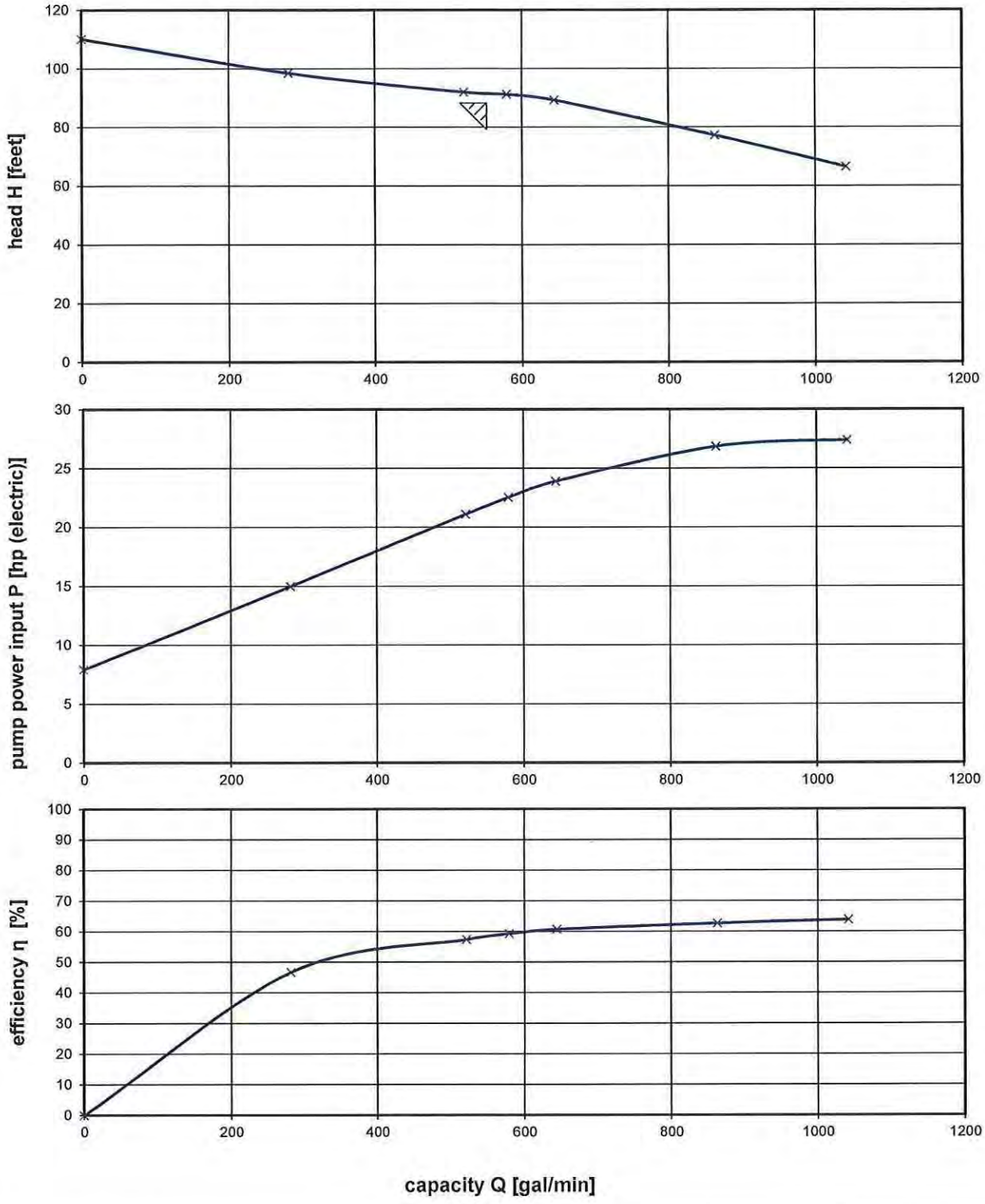
performance curves at operation speed from 1765 to 1790 r.p.m.



KSB	**performance curves**				*client reference*				
	\ DN 080 \ 9974530833_000100_412740				*order nr.* 9974530833_000100			*date*	18.03.2021
pump data	*type* KRTF 80-252/224XEG1-S				*D2 [mm]*				
report nr.	*manufactur.* KSB Halle				260				
20210318-113435	*curve no.*								
motor data	*type* KA16MN04-250			*frequency*	*P motor*	*speed n*	*voltage*	*current*	*cos φ*
client motor	*manufactur.* KSB Halle			*Hz*	*hp*	*r.p.m.*	*Volt*	*Ampere*	–
VERTIKAL	*serial no.* 412740			60	29,998659	1762	460	37,4	0,84
ordered data	*capacity Q*	*head H*	*P pump*	*η pump*	*speed n*	*NPSH*	*density ρ*	*temp. hot*	*kin. visk*
acceptance test class	*gal/min*	*feet*	*hp (electric)*	*%*	*r.p.m.*		*kg/m³*	*°C*	*m²/s*
HI 11.6 2 B	552,37	88,12	21,63	56,82	1762		998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

49 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412740**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle			*motor type:*	KA16MN04-250	
serial no.:	412740			*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp		*speed:*	1762	r.p.m.
voltage:	460	Volt		*current:*	37,4	Ampere
cos φ:	0,84	-		*frequency:*	60	Hz

Guarantee Data

capacity	400	gal/min	*head H:*	59 feet
			frequency	49 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	8
frequency	Hz	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0
temperature T	°C	21,6	21,5	21,5	21,5	21,5	21,5	21,5	21,5
capacity Q	**gal/min**	**0,00**	**198,59**	**293,78**	**395,98**	**503,85**	**600,32**	**800,53**	**939,94**
motor input power Pel	hp (electric	5,48	9,23	11,10	13,04	14,93	16,32	17,73	17,65
calculated values									
density ρ	kg/m³	997,9	997,9	997,9	997,9	997,9	997,9	997,9	997,9
total head H	**feet**	**71,31**	**64,58**	**61,79**	**59,87**	**58,22**	**54,97**	**46,39**	**40,78**
η total (pump+motor)	%	0,00	35,06	41,29	45,87	49,59	51,02	52,86	54,80

Remarks:

\ DN 080 \ 9974530833_000100_412740.49Hz

test record nr.	20210318-120202
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	18.03.2021

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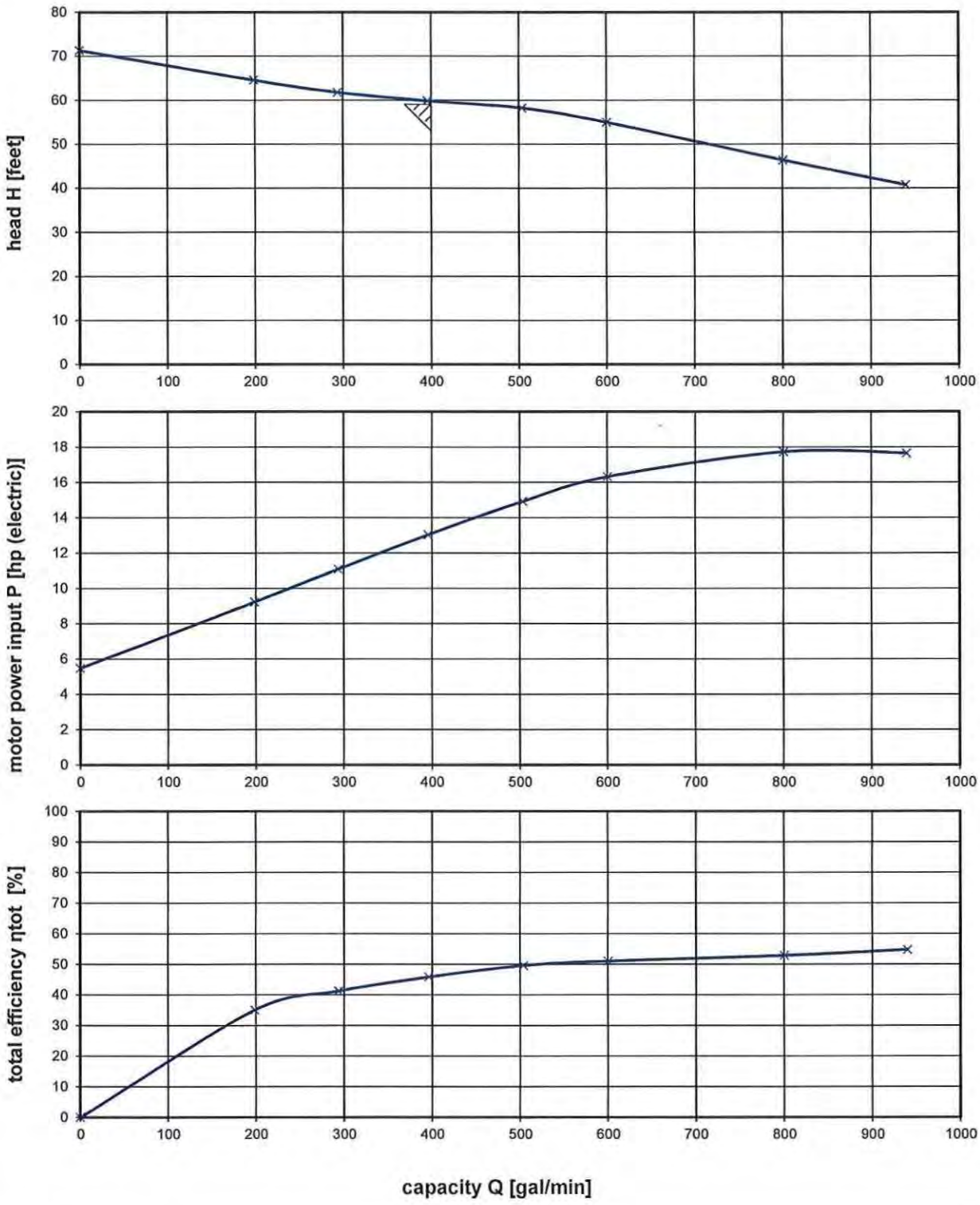
performance curves at operation speed from 49 to 49 Hz



KSB	**performance curves**			*client reference*					
	\ DN 080 \ 9974530833_000100_412740.49Hz			*order nr.* 9974530833_000100			*date*	18.03.2021	
pump data	*type* KRTF 80-252/224XEG1-S			*D2 [mm]*					
report nr.	*manufactur.* KSB Halle			260					
20210318-120202	*curve no.*								
motor data	*type* KA16MN04-250		*frequency*	*P motor*	*speed n*	*voltage*	*current*	*cos φ*	
client motor	*manufactur.* KSB Halle		*Hz*	*hp*	*r.p.m.*	*Volt*	*Ampere*	–	
VERTIKAL	*serial no.* 412740		60	29,998659	1762	460	37,4	0,84	
ordered data	*capacity Q*	*head H*	*P pump*	*η pump*	*speed n*	*NPSH*	*density ρ*	*temp. hot*	*kin. visk*
acceptance test class	*gal/min*	*feet*	*0*	*%*	*Hz*	*m*	*kg/m³*	*°C*	*m²/s*
HI 11.6 2 B	400,00	59,00		56,82	49	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

37 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412740**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412740		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	105	gal/min	*head H:*	38 feet
			frequency	37 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	37,0	37,0	37,0	37,0	37,0	37,0	37,0	
temperature T	°C	21,7	21,7	21,6	21,6	21,6	21,6	21,6	
capacity Q	**gal/min**	**0,00**	**103,39**	**160,86**	**295,86**	**447,90**	**608,65**	**730,42**	
motor input power Pel	hp (electric)	2,67	3,80	4,45	5,97	7,40	8,14	8,12	
calculated values									
density ρ	kg/m³	997,9	997,9	997,9	997,9	997,9	997,9	997,8	
total head H	**feet**	**38,77**	**36,05**	**34,38**	**32,00**	**29,67**	**24,73**	**21,22**	
η total (pump+motor)	%	0,00	24,73	31,33	40,01	45,33	46,63	48,19	

Remarks:

\ DN 080 \ 9974530833_000100_412740.38Hz

test record nr.	20210318-121149
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	18.03.2021

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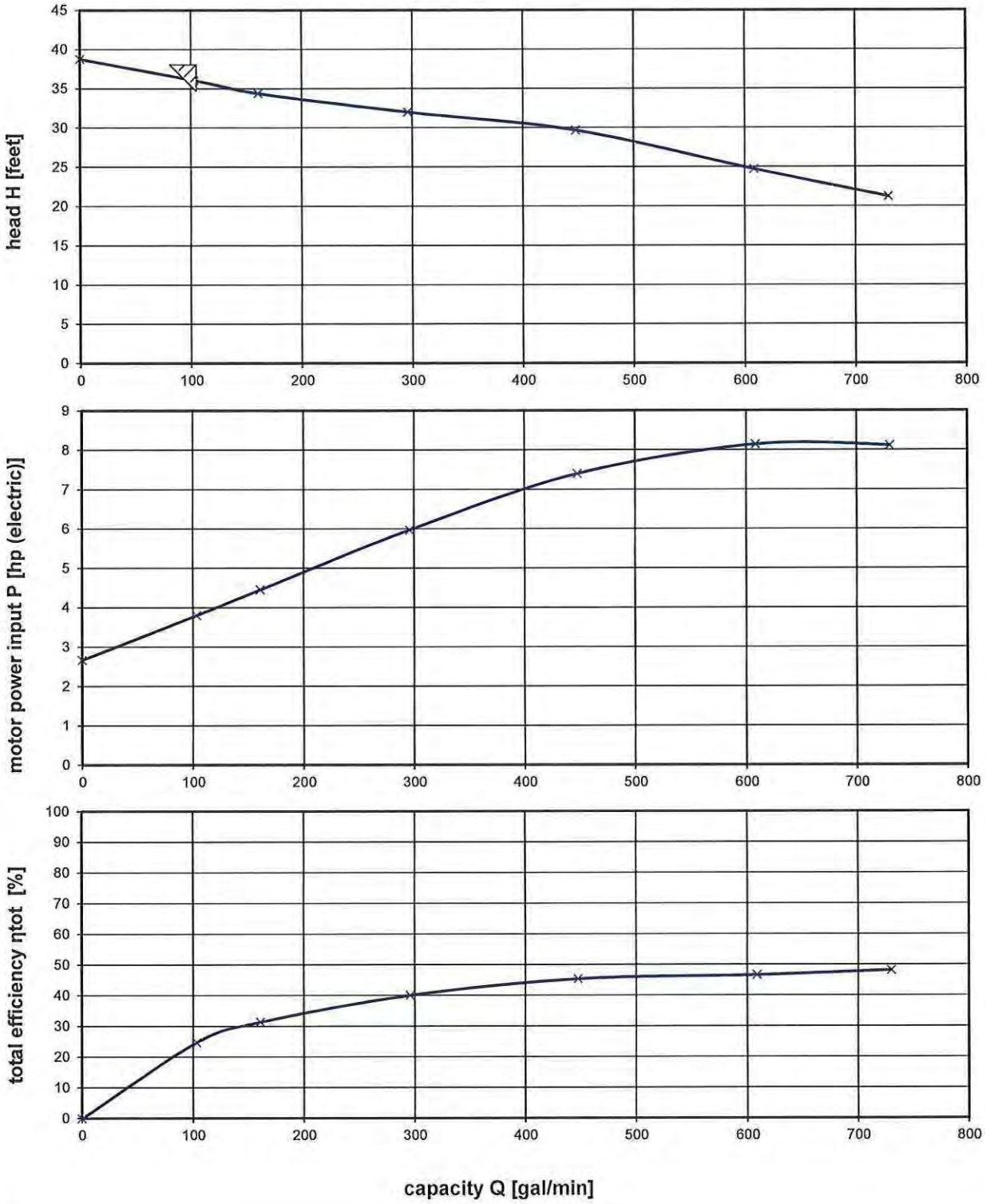
performance curves at operation speed from 37 to 37 Hz



KSB	performance curves			client reference					
	\ DN 080 \ 9974530833_000100_412740.38Hz			order nr.	9974530833_000100		date	18.03.2021	
pump data	type	KRTF 80-252/224XEG1-S		D2 [mm]					
report nr.	manufactur.	KSB Halle		260					
20210318-121149	curve no.								
motor data	type	KA16MN04-250	frequency	P motor	speed n	voltage	current	cos φ	
client motor	manufactur.	KSB Halle	Hz	hp	r.p.m.	Volt	Ampere	–	
VERTIKAL	serial no.	412740	60	29,998659	1762	460	37,4	0,84	
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet		%	Hz	m	kg/m³	°C	m²/s
HI 11.6 2 B	105,00	38,00		56,82	37	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

KSB

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412741**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412741		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	552,37	gal/min	*head H:*	88,12	feet
pump input power P:	21,63	hp (electric	*speed n:*	1762	r.p.m.
pump efficiency η:	56,82	%	*density ρ:*	998	kg/m³
			kin. viscosity:	0,000001	m²/s
acceptance test class	HI 11.6 2 B		*fluid temperature T:*	20,00	°C

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7
speed n	r.p.m.	1790,5	1781,7	1773,5	1772,5	1770,5	1766,1	1765,4
temperature T	°C	15,9	15,6	15,6	15,8	15,8	15,8	15,9
capacity Q	**gal/min**	**0,00**	**280,47**	**530,17**	**568,16**	**635,54**	**864,35**	**1051,03**
motor input power Pel	hp (electric	9,05	16,51	23,46	24,37	26,04	29,92	30,53
voltage U	V	465,3	462,1	458,4	457,8	456,8	454,1	453,7
current I1	A	19,74	24,07	29,39	30,16	31,58	35,15	35,71
current I2	A	19,74	24,02	29,37	30,16	31,61	35,19	35,76
current I3	A	19,73	24,01	29,28	30,12	31,52	35,12	35,66
cos phi	-	0,424	0,640	0,751	0,761	0,778	0,807	0,812
calculated values								
density ρ	kg/m³	999,0	999,1	999,1	999,0	999,0	999,0	999,0
total head H	**feet**	**106,28**	**96,08**	**90,51**	**89,17**	**88,08**	**78,72**	**67,41**
motor efficiency η mot	%	82,89	87,70	89,04	89,13	89,27	89,47	89,49
pump input power P2	**hp (electric**	**7,50**	**14,48**	**20,89**	**21,72**	**23,25**	**26,76**	**27,32**
pump power P2 ρ ordered	hp (electric	7,49	14,46	20,87	21,70	23,22	26,74	27,30
pump efficiency η	**%**	**0,00**	**47,02**	**58,02**	**58,91**	**60,83**	**64,22**	**65,51**
η total (pump+motor)	%	0,00	41,23	51,67	52,51	54,30	57,46	58,62

Remarks:

P+C/B.Bock QP1909483

test record nr.	20210322-095223
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	22.03.2021

\ DN 080 \ 9974530833_000100_412741

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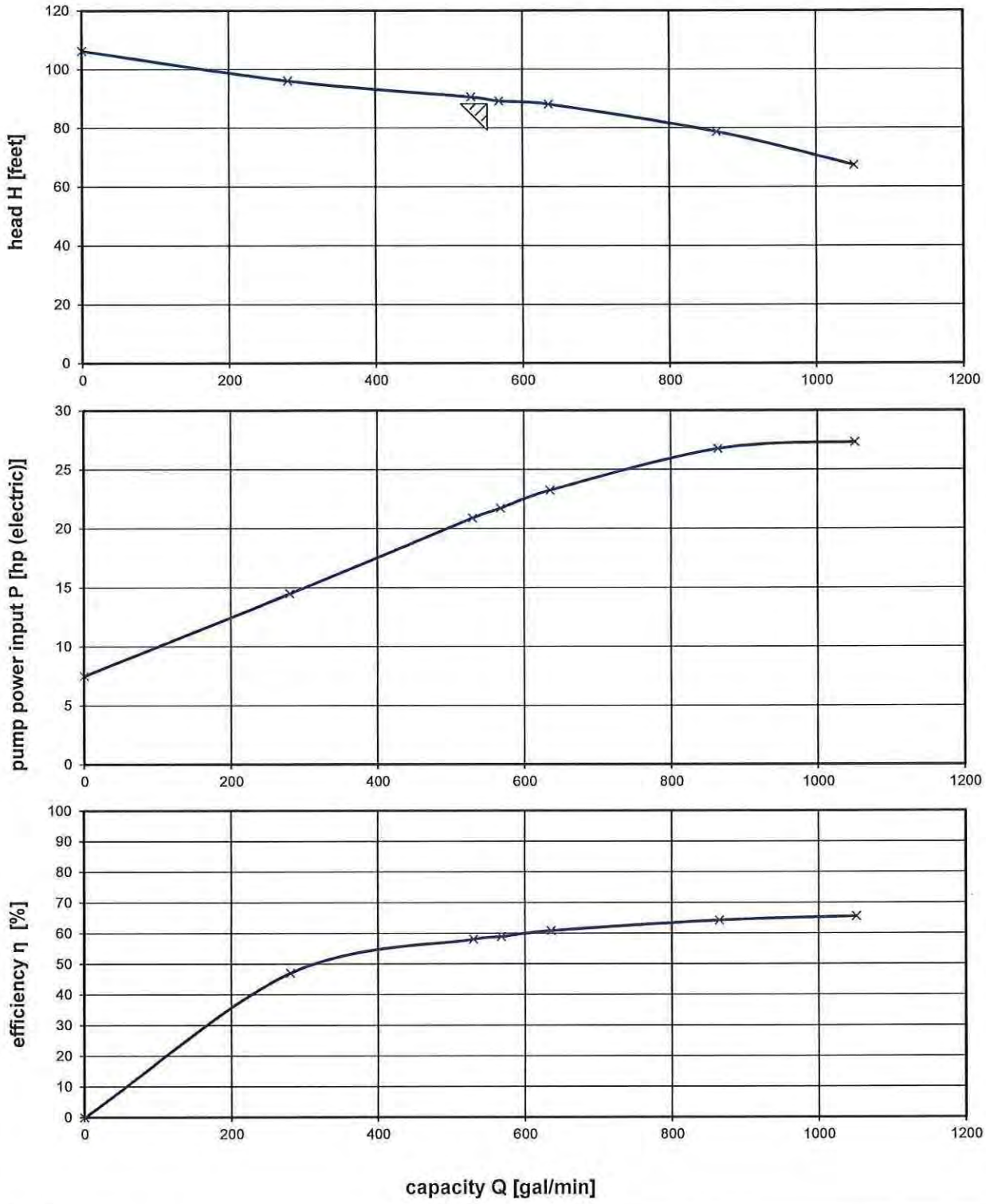
performance curves at operation speed from 1765 to 1790 r.p.m.



KSB	performance curves				client reference				
	\ DN 080 \ 9974530833_000100_412741				order nr. 9974530833_000100			date	22.03.2021
pump data	type	KRTF 80-252/224XEG1-S			D2 [mm]				
report nr.	manufactur.	KSB Halle			260				
20210322-095223	curve no.								
motor data	type	KA16MN04-250		frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur.	KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–
VERTIKAL	serial no.	412741		60	29,998659	1762	460	37,4	0,84
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet	hp (electric)	%	r.p.m.		kg/m³	°C	m²/s
HI 11.6 2 B	552,37	88,12	21,63	56,82	1762		998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

49 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412741**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412741		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	400	gal/min	*head H:*	59 feet
			frequency	49 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	8
frequency	Hz	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0
temperature T	°C	15,9	15,7	15,7	15,7	15,7	15,7	15,7	15,8
capacity Q	**gal/min**	**0,00**	**189,68**	**295,92**	**393,89**	**503,75**	**612,36**	**803,99**	**938,47**
motor input power Pel	hp (electric	5,00	8,32	10,39	12,26	14,18	15,74	17,14	16,93
calculated values									
density ρ	kg/m³	999,0	999,0	999,0	999,0	999,0	999,0	999,0	999,0
total head H	**feet**	**67,00**	**61,61**	**58,54**	**56,81**	**55,84**	**53,59**	**46,02**	**39,45**
η total (pump+motor)	%	0,00	35,49	42,11	46,11	50,12	52,67	54,55	55,25

Remarks:

\ DN 080 \ 9974530833_000100_412741.49Hz

test record nr.	20210322-102129
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	22.03.2021

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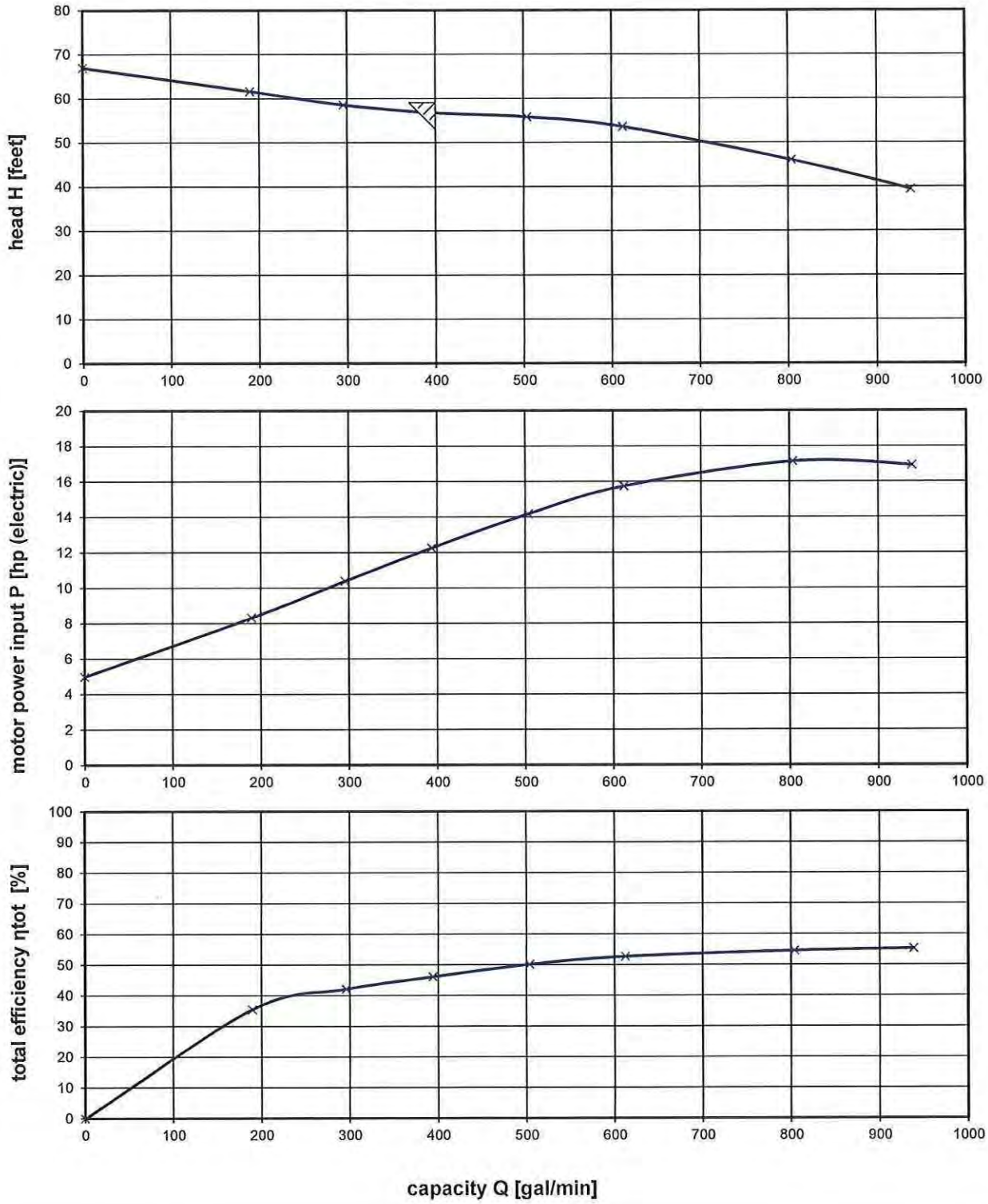
performance curves at operation speed from 49 to 49 Hz



KSB	performance curves \ DN 080 \ 9974530833_000100_412741.49Hz			client reference order nr. 9974530833_000100			date 22.03.2021	
pump data	type KRTF 80-252/224XEG1-S			D2 [mm]				
report nr.	manufactur. KSB Halle			260				
20210322-102129	curve no.							
motor data	type KA16MN04-250		frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur. KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–
VERTIKAL	serial no. 412741		60	29,998659	1762	460	37,4	0,84
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet		%	Hz	m	kg/m³	°C	m²/s
HI 11.6 2 B	400,00	59,00		56,82	49	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

38 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412741**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412741		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	160 gal/min	*head H:*	39 feet
		frequency	38 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	38,0	38,0	38,0	38,0	38,0	38,0	38,0	
temperature T	°C	16,1	16,1	16,0	15,9	15,9	15,9	15,9	
capacity Q	**gal/min**	**0,00**	**105,36**	**150,76**	**288,82**	**454,01**	**605,59**	**733,56**	
motor input power Pel	hp (electric	2,50	3,68	4,18	5,78	7,45	8,24	8,22	
calculated values									
density ρ	kg/m³	999,0	999,0	999,0	999,0	999,0	999,0	998,9	
total head H	**feet**	**38,13**	**35,33**	**34,55**	**32,02**	**30,37**	**26,12**	**21,67**	
η total (pump+motor)	%	0,00	25,58	31,50	40,44	46,74	48,48	48,82	

Remarks:

\ DN 080 \ 9974530833_000100_412741.38Hz

test record nr.	20210322-103704
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	22.03.2021

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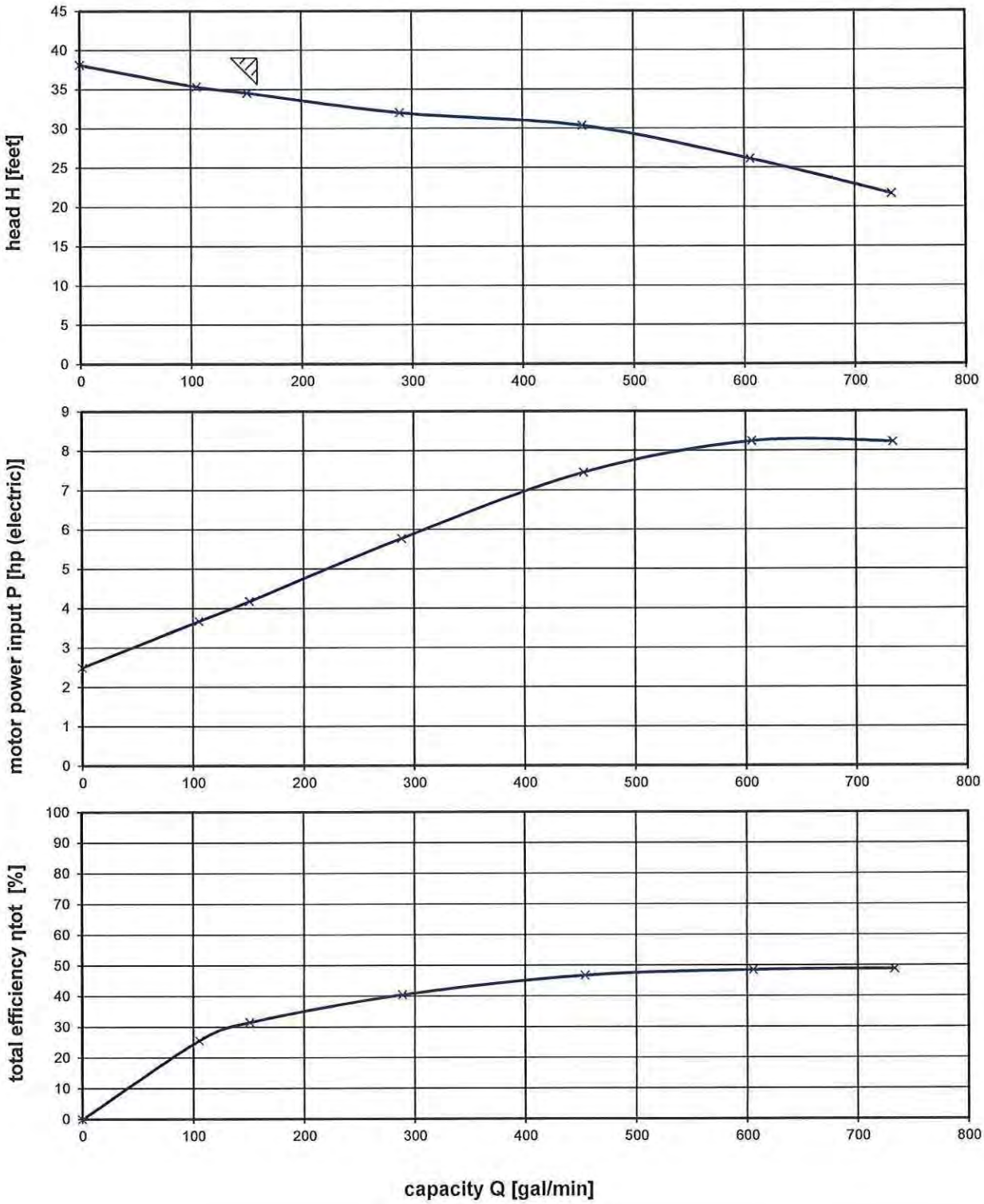
performance curves at operation speed from 38 to 38 r.p.m.



KSB	performance curves \ DN 080 \ 9974530833_000100_412741.38Hz			client reference order nr. 9974530833_000100			date 22.03.2021	
pump data	type KRTF 80-252/224XEG1-S			D2 [mm]				
report nr.	manufactur. KSB Halle			260				
20210322-103704	curve no.							
motor data	type KA16MN04-250		frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur. KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–
VERTIKAL	serial no. 412741		60	29,998659	1762	460	37,4	0,84
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet		%	Hz	m	kg/m³	°C	m²/s
HI 11.6 2 B	160,00	39,00		56,82	38	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

KSB

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412742**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412742		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	552,37	gal/min	*head H:*	88,12	feet
pump input power P:	21,63	hp (electric	*speed n:*	1762	r.p.m.
pump efficiency η:	56,82	%	*density ρ:*	998	kg/m³
			kin. viscosity:	0,000001	m²/s
acceptance test class	HI 11.6 2 B		*fluid temperature T:*	20,00	°C

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7
speed n	r.p.m.	1790,3	1780,9	1773,1	1772,1	1769,9	1765,6	1764,7
temperature T	°C	17,0	16,6	16,7	16,7	16,7	16,7	16,7
capacity Q	**gal/min**	**0,00**	**270,67**	**537,09**	**567,68**	**649,43**	**862,52**	**1052,07**
motor input power Pel	hp (electric	9,18	17,19	23,80	24,69	26,59	30,36	31,13
voltage U	V	468,0	459,0	455,4	454,9	453,6	451,1	450,6
current I1	A	19,90	24,36	29,59	30,36	32,05	35,57	36,30
current I2	A	19,82	24,30	29,58	30,35	32,08	35,63	36,36
current I3	A	19,80	24,20	29,42	30,19	31,87	35,40	36,12
cos phi	-	0,426	0,664	0,762	0,772	0,789	0,816	0,820
calculated values								
density ρ	kg/m³	998,8	998,9	998,9	998,9	998,9	998,9	998,8
total head H	**feet**	**106,91**	**95,05**	**90,71**	**90,10**	**89,01**	**80,35**	**70,99**
motor efficiency η mot	%	83,05	87,90	89,08	89,16	89,31	89,48	89,50
pump input power P2	**hp (electric**	**7,62**	**15,11**	**21,20**	**22,01**	**23,75**	**27,17**	**27,86**
pump power P2 ρ ordered	hp (electric	7,62	15,10	21,18	21,99	23,73	27,14	27,84
pump efficiency η	**%**	**0,00**	**43,01**	**58,05**	**58,69**	**61,48**	**64,44**	**67,71**
η total (pump+motor)	%	0,00	37,81	51,71	52,33	54,90	57,66	60,60

Remarks:

P+C/B.Bock QP1909483

\ DN 080 \ 9974530833_000100_412742

test record nr.	20210322-121724
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	22.03.2021

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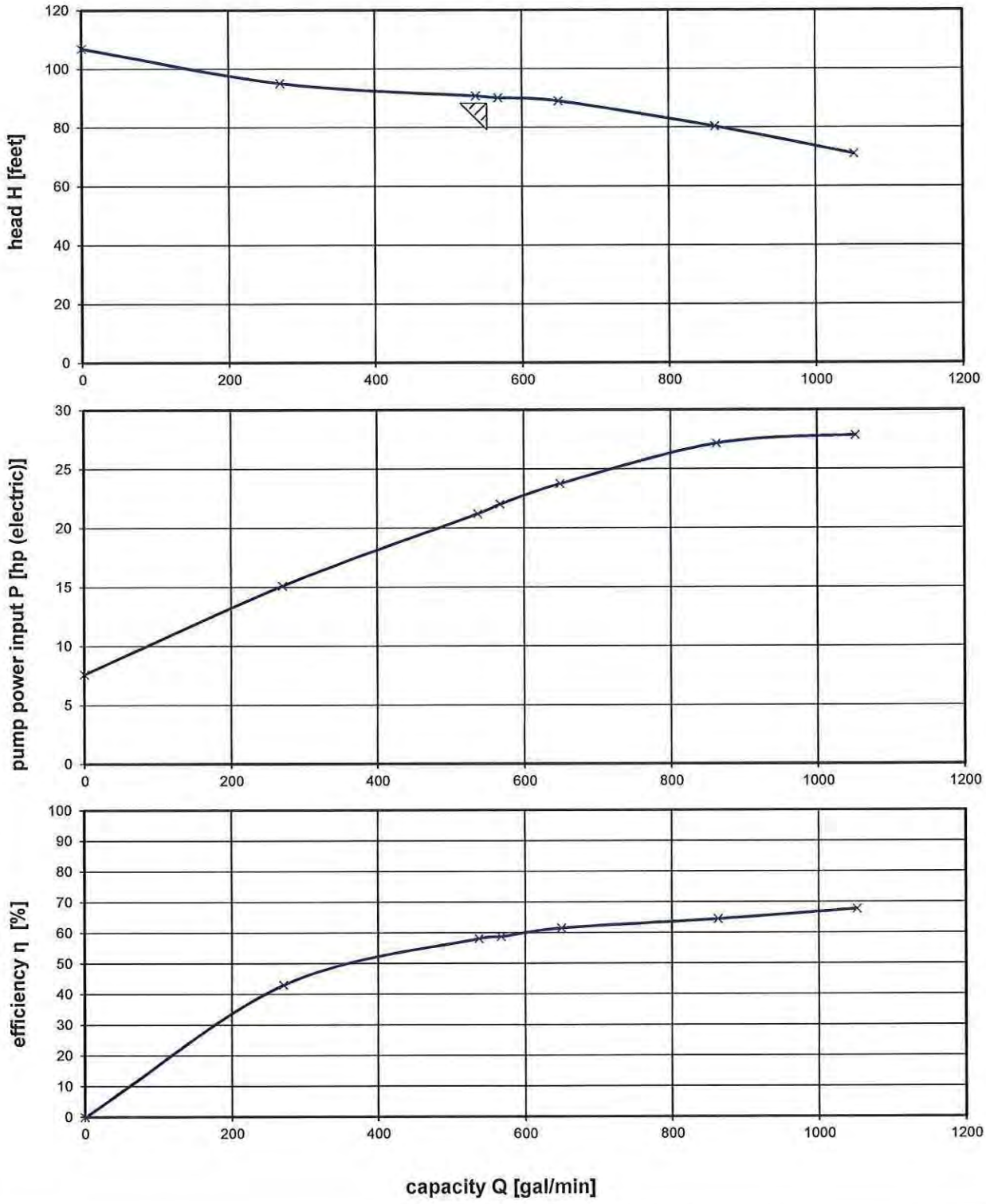
performance curves at operation speed from 1765 to 1790 r.p.m.



KSB	performance curves			client reference					
	\ DN 080 \ 9974530833_000100_412742			order nr. 9974530833_000100			date 22.03.2021		
pump data	type KRTF 80-252/224XEG1-S			D2 [mm]					
report nr.	manufactur. KSB Halle			260					
20210322-121724	curve no.								
motor data	type KA16MN04-250		frequency	P motor	speed n	voltage	current	cos φ	
client motor	manufactur. KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–	
VERTIKAL	serial no. 412742		60	29,998659	1762	460	37,4	0,84	
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet	hp (electric)	%	r.p.m.		kg/m³	°C	m²/s
HI 11.6 2 B	552,37	88,12	21,63	56,82	1762		998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

49 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412742**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle			*motor type:*	KA16MN04-250	
serial no.:	412742			*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp		*speed:*	1762	r.p.m.
voltage:	460	Volt		*current:*	37,4	Ampere
cos φ:	0,84	-		*frequency:*	60	Hz

Guarantee Data

capacity	400	gal/min	*head H:*	59 feet
			frequency	49 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	8
frequency	Hz	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0
temperature T	°C	17,1	16,8	16,9	17,0	17,0	17,0	17,1	17,1
capacity Q	**gal/min**	**0,00**	**198,64**	**300,48**	**397,38**	**498,25**	**589,23**	**795,59**	**936,69**
motor input power Pel	hp (electric	4,97	8,52	10,52	12,35	14,05	15,40	17,14	17,21
calculated values									
density ρ	kg/m³	998,8	998,8	998,8	998,8	998,8	998,8	998,8	998,8
total head H	**feet**	**67,03**	**61,45**	**58,51**	**56,95**	**56,23**	**54,22**	**46,71**	**41,39**
η total (pump+motor)	%	0,00	36,20	42,23	46,29	50,35	52,38	54,77	56,89

Remarks:	*test record nr.*	20210322-124345
	test person	WE
	test bench name	Prüfstand P2 / 5
	test bench type	open
	*quality check *)*	
\ DN 080 \ 9974530833_000100_412742.49Hz	*date*	22.03.2021

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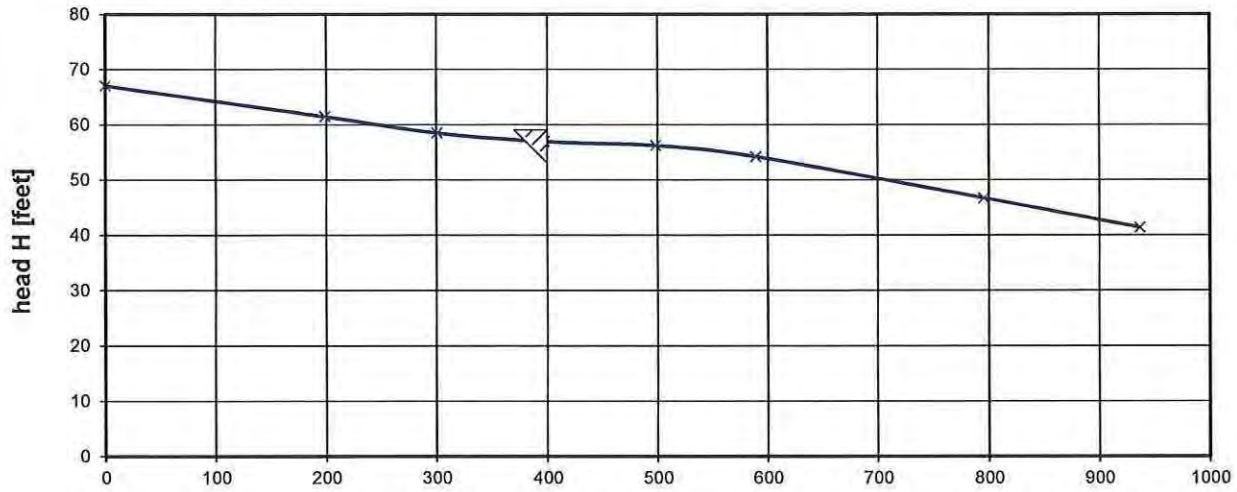
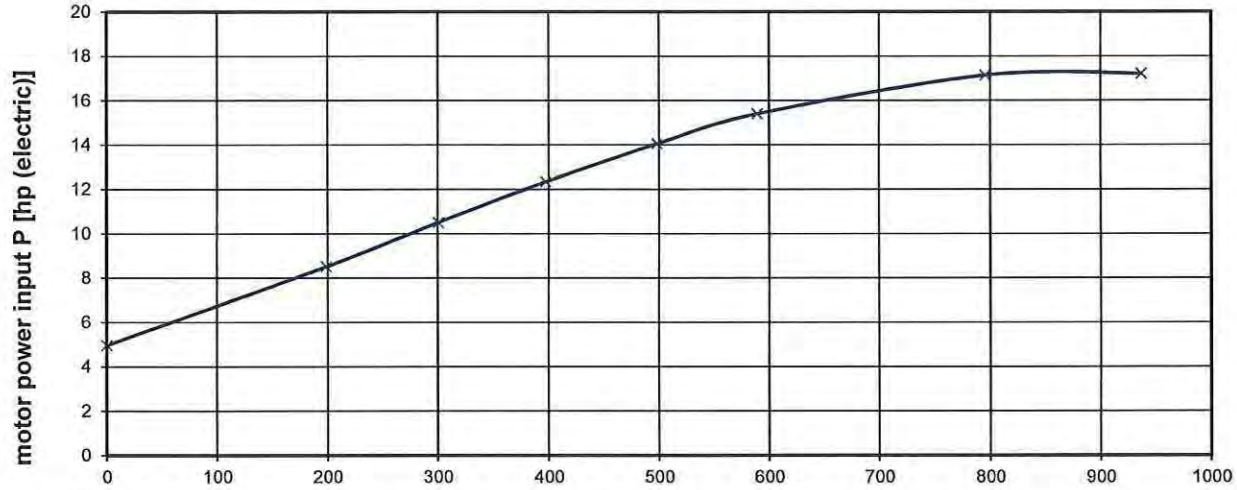
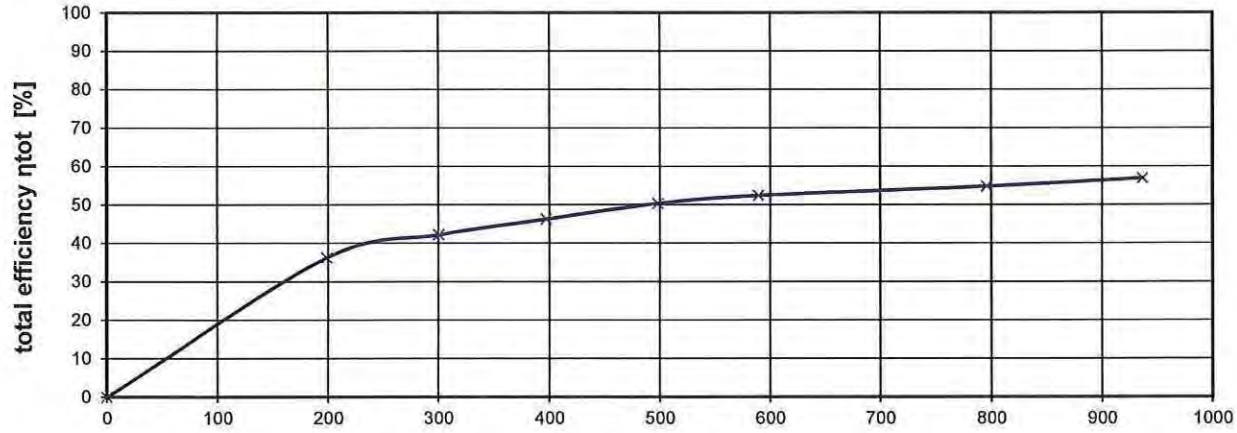
performance curves at operation speed from 49 to 49 r.p.m.







capacity Q [gal/min]

KSB	performance curves			client reference					
	\ DN 080 \ 9974530833_000100_412742.49Hz			order nr.	9974530833_000100		date	22.03.2021	
pump data	type	KRTF 80-252/224XEG1-S		D2 [mm]					
report nr.	manufactur.	KSB Halle		260					
20210322-124345	curve no.								
motor data	type	KA16MN04-250	frequency	P motor	speed n	voltage	current	cos φ	
client motor	manufactur.	KSB Halle	Hz	hp	r.p.m.	Volt	Ampere	–	
VERTIKAL	serial no.	412742	60	29,998659	1762	460	37,4	0,84	
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet		%	Hz	m	kg/m³	°C	m²/s
HI 11.6 2 B	400,00	59,00		56,82	49	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

37 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412742**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412742		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	105	gal/min	*head H:*	38 feet
			frequency	37 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	37,0	37,0	37,0	37,0	37,0	37,0	37,0	
temperature T	°C	17,2	17,1	17,1	17,2	17,2	17,2	17,2	
capacity Q	**gal/min**	**0,00**	**106,99**	**152,28**	**295,26**	**455,52**	**599,43**	**731,26**	
motor input power Pel	hp (electric	2,48	3,65	4,34	5,78	7,36	8,08	8,19	
calculated values									
density ρ	kg/m³	998,8	998,8	998,8	998,8	998,8	998,8	998,7	
total head H	**feet**	**37,29**	**34,63**	**33,14**	**31,58**	**29,77**	**26,03**	**22,16**	
η total (pump+motor)	%	0,00	25,62	29,35	40,76	46,56	48,78	49,96	

Remarks:

test record nr.	20210322-130406
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	22.03.2021

\ DN 080 \ 9974530833_000100_412742.38Hz

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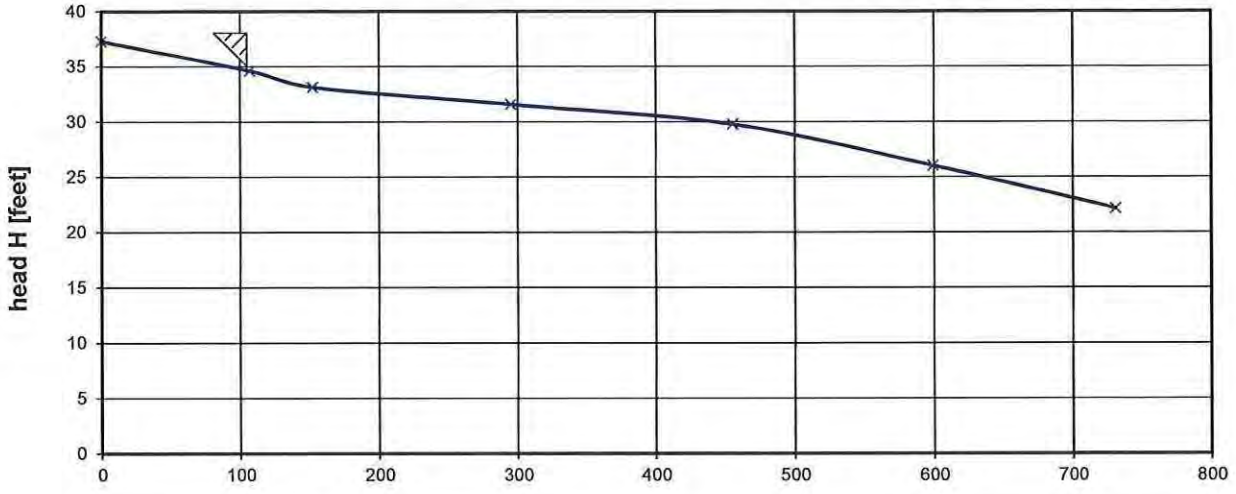
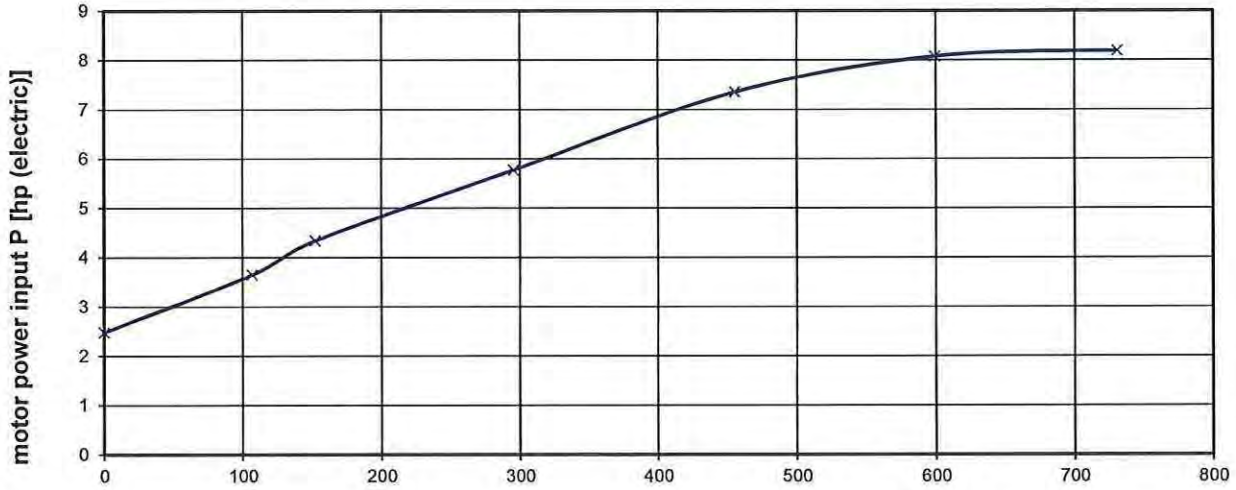
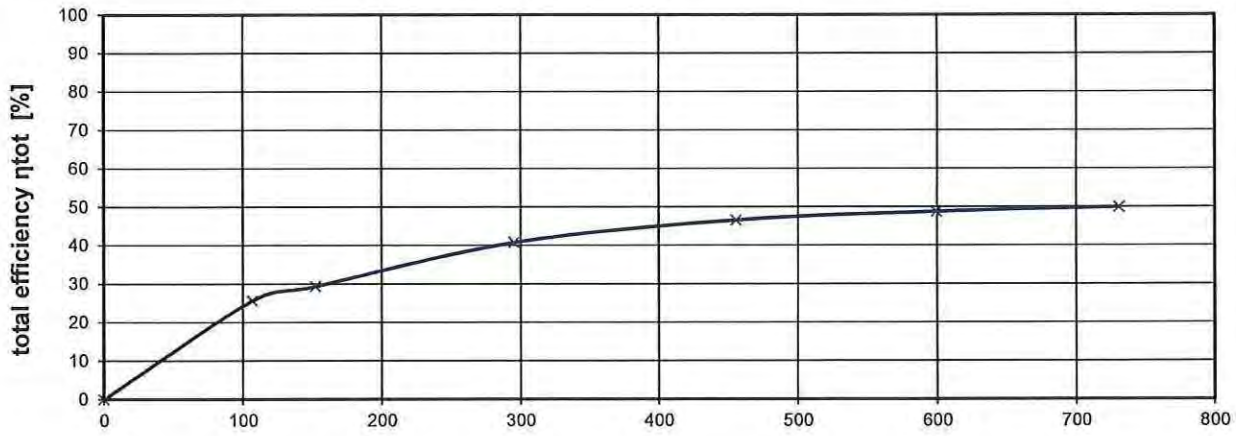
performance curves at operation speed from 37 to 37 Hz







capacity Q [gal/min]

KSB	**performance curves**				client reference				
	\ DN 080 \ 9974530833_000100_412742.38Hz				order nr. 9974530833_000100			date	22.03.2021
pump data	type KRTF 80-252/224XEG1-S				D2 [mm]				
report nr.	manufactur. KSB Halle				260				
20210322-130406	curve no.								
motor data	type KA16MN04-250			frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur. KSB Halle			Hz	hp	r.p.m.	Volt	Ampere	–
VERTIKAL	serial no. 412742			60	29,998659	1762	460	37,4	0,84
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet		%	Hz	m	kg/m³	°C	m²/s
HI 11.6 2 B	105,00	38,00		56,82	37	0,00	998,0	20,0	1,00E-06

This report was created electronically and is valid without signature

KSB SE & Co. KGaA
test field

Test Record 3.1

KSB

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412743**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412743		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	552,37	gal/min	*head H:*	88,12	feet
pump input power P:	21,63	hp (electric	*speed n:*	1762	r.p.m.
pump efficiency η:	56,82	%	*density ρ:*	998	kg/m³
			kin. viscosity:	0,000001	m²/s
acceptance test class	HI 11.6 2 B		*fluid temperature T:*	20,00	°C

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7
speed n	r.p.m.	1789,7	1781,0	1773,2	1771,6	1769,8	1765,9	1765,3
temperature T	°C	20,9	20,7	20,8	20,8	20,8	20,9	20,9
capacity Q	**gal/min**	**0,00**	**280,25**	**524,94**	**578,24**	**644,91**	**864,04**	**1047,06**
motor input power Pel	hp (electric	9,68	17,06	23,76	25,14	26,70	30,11	30,56
voltage U	V	462,5	459,2	455,7	454,9	453,9	451,6	451,3
current I1	A	19,78	24,32	29,60	30,80	32,18	35,33	35,77
current I2	A	19,71	24,25	29,51	30,73	32,09	35,29	35,75
current I3	A	19,68	24,16	29,40	30,60	31,99	35,13	35,57
cos phi	-	0,457	0,660	0,761	0,775	0,790	0,815	0,817
calculated values								
density ρ	kg/m³	998,1	998,1	998,1	998,1	998,1	998,0	998,0
total head H	**feet**	**109,78**	**98,17**	**91,27**	**90,55**	**88,78**	**77,29**	**66,77**
motor efficiency η mot	%	83,63	87,86	89,07	89,20	89,32	89,48	89,49
pump input power P2	**hp (electric**	**8,10**	**14,99**	**21,17**	**22,42**	**23,85**	**26,94**	**27,34**
pump power P2 ρ ordered	hp (electric	8,10	14,99	21,17	22,42	23,85	26,94	27,34
pump efficiency η	**%**	**0,00**	**46,33**	**57,13**	**58,94**	**60,59**	**62,55**	**64,53**
η total (pump+motor)	%	0,00	40,70	50,89	52,57	54,12	55,97	57,75

Remarks:

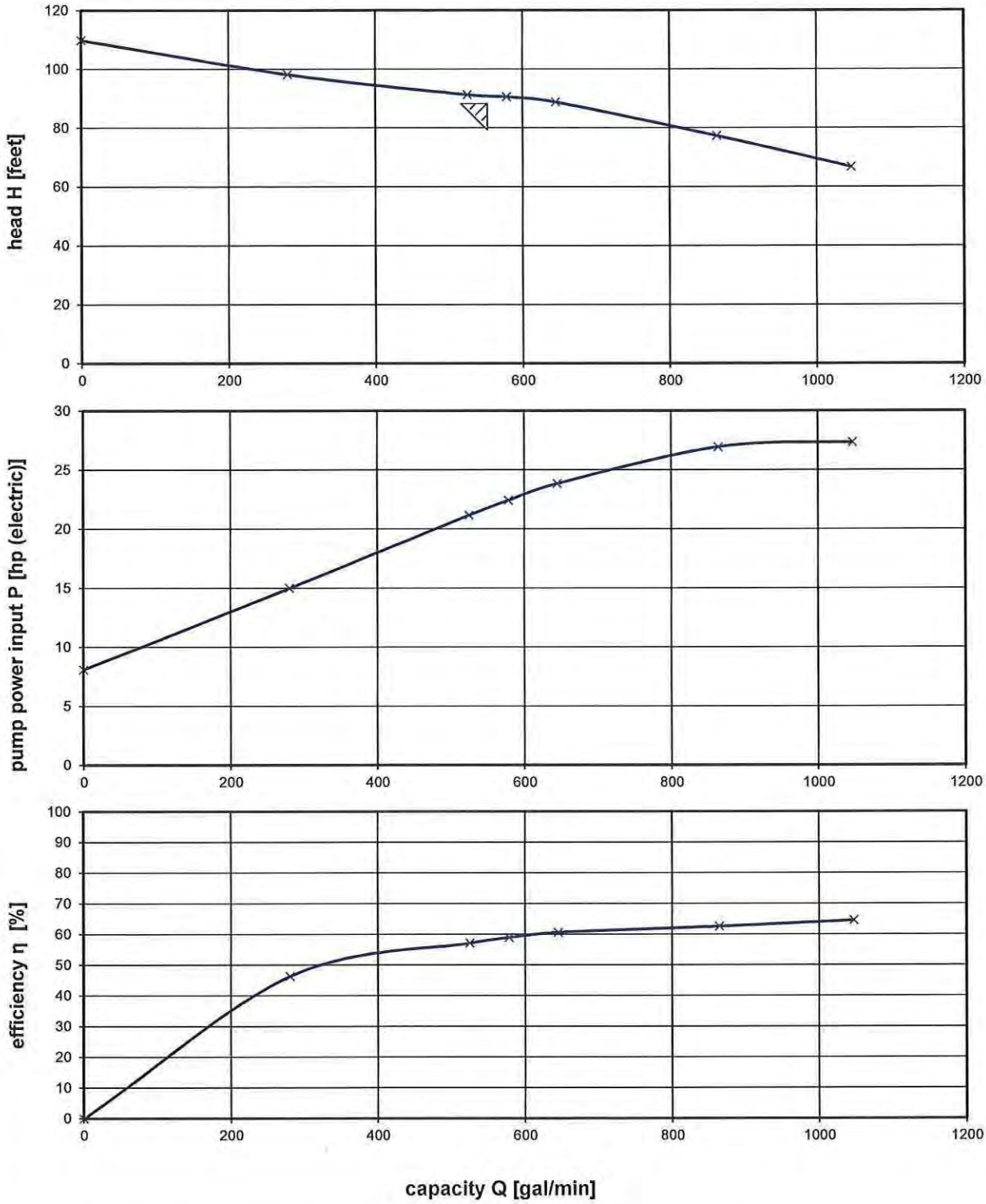
P+C/B.Bock QP1909483

\ DN 080 \ 9974530833_000100_412743

test record nr.	20210318-074709
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	18.03.2021

*) This report was created electronically and is valid without signature

performance curves at operation speed from 1765 to 1790 r.p.m.



KSB	**performance curves** \ DN 080 \ 9974530833_000100_412743				client reference order nr. 9974530833_000100		date 18.03.2021		
pump data	*type* KRTF 80-252/224XEG1-S				*D2 [mm]*				
report nr.	*manufactur.* KSB Halle				260				
20210318-074709	*curve no.*								
motor data	*type* KA16MN04-250			*frequency*	*P motor*	*speed n*	*voltage*	*current*	*cos φ*
client motor	*manufactur.* KSB Halle			*Hz*	*hp*	*r.p.m.*	*Volt*	*Ampere*	–
VERTIKAL	*serial no.* 412743			60	29,998659	1762	460	37,4	0,84
ordered data	*capacity Q*	*head H*	*P pump*	*η pump*	*speed n*	*NPSH*	*density ρ*	*temp. hot*	*kin. visk*
acceptance test class	*gal/min*	*feet*	*hp (electric)*	*%*	*r.p.m.*		*kg/m³*	*°C*	*m²/s*
HI 11.6 2 B	552,37	88,12	21,63	56,82	1762		998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

49 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412743**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412743		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	400 gal/min	*head H:*	59 feet
		frequency	49 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	8
frequency	Hz	49,0	49,0	49,0	49,0	49,0	49,0	49,0	49,0
temperature T	°C	20,9	20,8	21,0	21,0	21,0	21,0	20,9	20,9
capacity Q	**gal/min**	**0,00**	**198,32**	**295,07**	**396,51**	**504,88**	**601,47**	**804,75**	**943,25**
motor input power Pel	hp (electric	5,45	9,11	10,74	12,63	14,47	15,80	17,53	17,54
calculated values									
density ρ	kg/m³	998,1	998,1	998,0	998,0	998,0	998,0	998,0	998,0
total head H	**feet**	**70,60**	**63,97**	**60,22**	**58,39**	**56,69**	**54,06**	**46,43**	**41,50**
η total (pump+motor)	%	0,00	35,16	41,76	46,25	49,92	51,95	53,78	56,31

Remarks:

test record nr.	20210318-090557
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	18.03.2021

\ DN 080 \ 9974530833_000100_412743.49Hz

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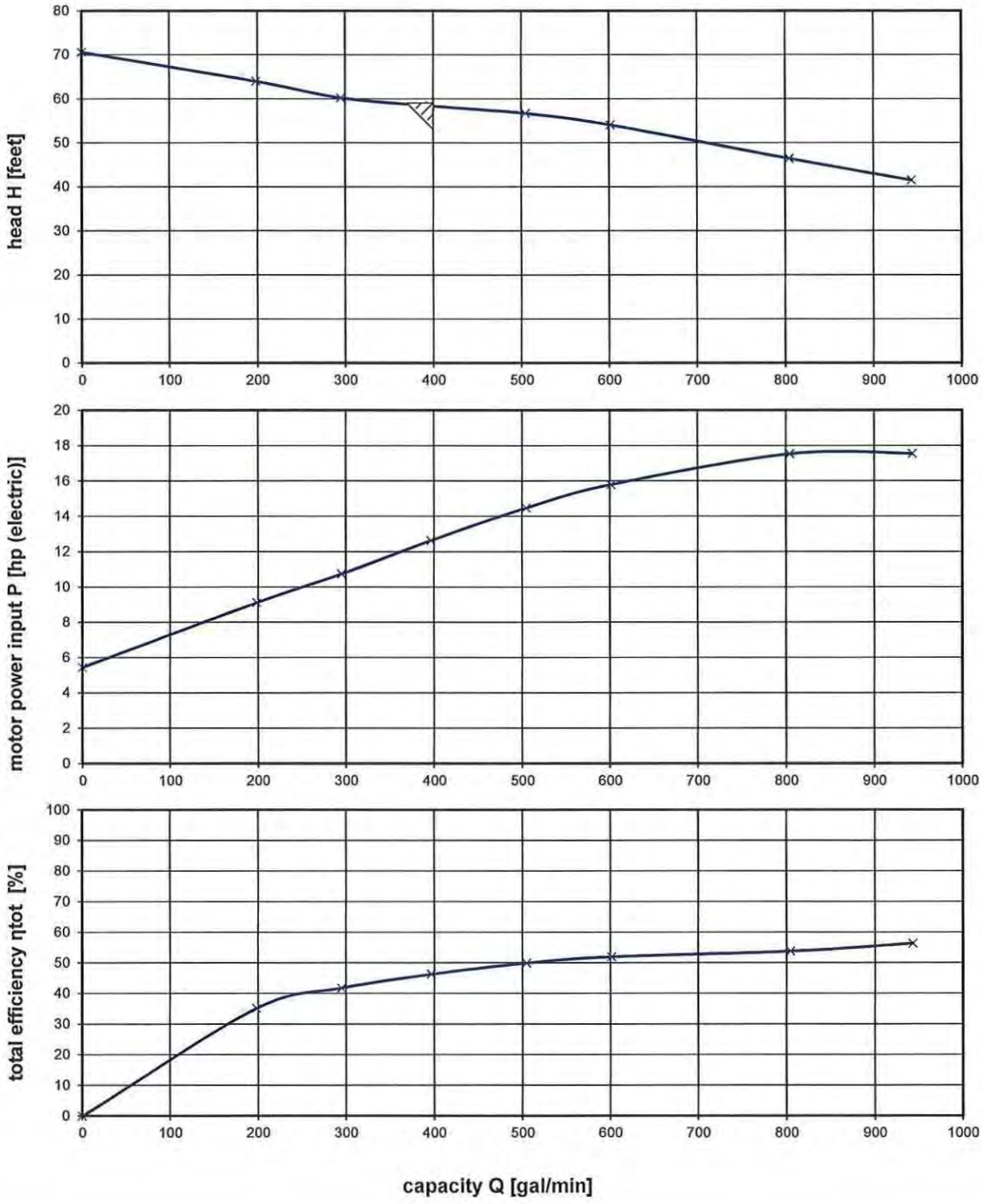
performance curves at operation speed from 49 to 49 Hz



KSB	performance curves			client reference					
	\ DN 080 \ 9974530833_000100_412743.49Hz			order nr. 9974530833_000100			date 18.03.2021		
pump data	type KRTF 80-252/224XEG1-S			D2 [mm]					
report nr.	manufactur. KSB Halle			260					
20210318-090557	curve no.								
motor data	type KA16MN04-250		frequency	P motor	speed n	voltage	current	cos φ	
client motor	manufactur. KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–	
VERTIKAL	serial no. 412743		60	29,998659	1762	460	37,4	0,84	
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet		%	Hz	m	kg/m³	°C	m²/s
HI 11.6 2 B	400,00	59,00		56,82	49	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

38 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000100**	*curve no.:*	
pump type:	KRTF 80-252/224XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**412743**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-250	
serial no.:	412743		*client motor:*	VERTIKAL	
motor rated power:	29,99866	hp	*speed:*	1762	r.p.m.
voltage:	460	Volt	*current:*	37,4	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	160 gal/min	*head H:*	39 feet
		frequency	38 Hz

Measure Instructions

impeller trimming type AN 1528 D2 260 mm

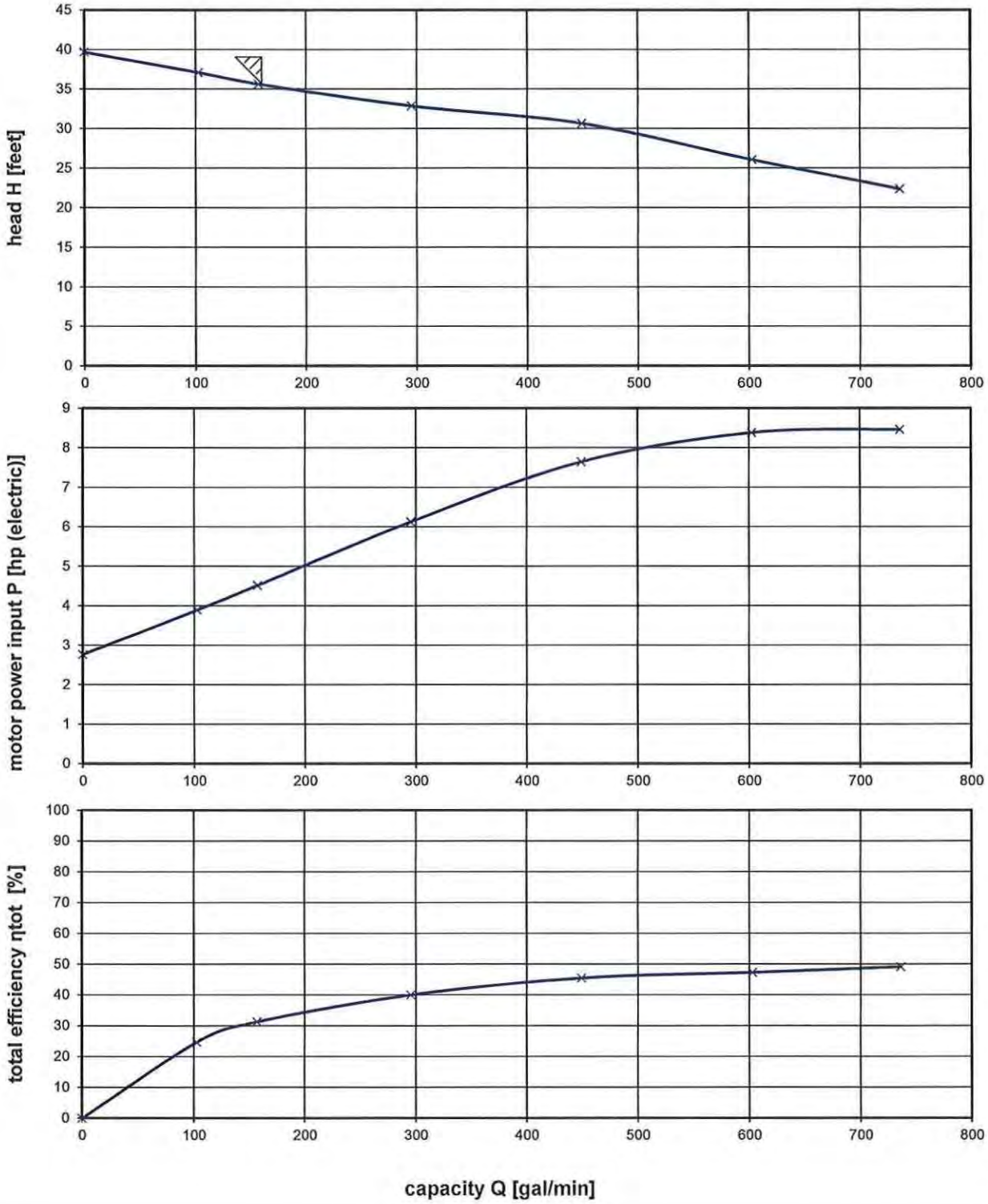
measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	38,0	38,0	38,0	38,0	38,0	38,0	38,0	
temperature T	°C	21,1	21,1	21,1	21,1	21,1	21,1	21,0	
capacity Q	**gal/min**	**0,00**	**102,65**	**156,99**	**295,33**	**449,32**	**602,80**	**736,39**	
motor input power Pel	hp (electric	2,77	3,89	4,51	6,13	7,65	8,38	8,46	
calculated values									
density ρ	kg/m³	998,0	998,0	998,0	998,0	998,0	998,0	998,0	
total head H	**feet**	**39,68**	**37,08**	**35,64**	**32,88**	**30,66**	**26,07**	**22,36**	
η total (pump+motor)	%	0,00	24,68	31,27	40,00	45,47	47,31	49,11	

Remarks:	*test record nr.*	20210318-092757
	test person	WE
	test bench name	Prüfstand P2 / 5
	test bench type	open
	*quality check *)*	
\ DN 080 \ 9974530833_000100_412743.38Hz	*date*	18.03.2021

**) This report was created electronically and is valid without signature*

performance curves at operation speed from 38 Hz to 38 Hz r.p.m.



KSB	performance curves				client reference				
	\ DN 080 \ 9974530833_000100_412743.38Hz				order nr. 9974530833_000100			date	18.03.2021
pump data	type KRTF 80-252/224XEG1-S				D2 [mm]				
report nr.	manufactur. KSB Halle				260				
20210318-092757	curve no.								
motor data	type KA16MN04-250			frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur. KSB Halle			Hz	hp	r.p.m.	Volt	Ampere	–
VERTIKAL	serial no. 412743			60	29,998659	1762	460	37,4	0,84
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet			Hz	m		°C	m²/s
HI 11.6 2 B	160,00	39,00			38	0,00		20,0	1,00E-06

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Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

[X] Druckprobe / hydrostatic test/ Essai de pression

gemäß/according/conforme **KSB-Standard** [X] **spez.** [ ]

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412739**	**KRTF 80-252/224XEG1-S**	**QP 1909483**

Beleg-Nr. Cert.-No.	Bauteil/part/partie	Prüfmedium/medium/agent		Prüfdruck/pressure/ Pression d'essai	Haltedauer/duration/ Durée d'essai
		Wasser Water Eau	Luft Air Air	bar/ psi	min
412739	**Pump complete**	**X**		**5,2 / 75,4**	**10**

Die drucktragenden Teile der Pumpe(n) wurden abgepresst.
The pressure containing parts of the pump(s) were hydrostatically tested.
Les parties de pompe soumises á la pression ont subi une épreuve hydrostatique.

Prüfstempel/Prüfung durchgeführt von AP
Stamp/Test performed by
Poincon de l'expert/Epreuve effectuée par

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité **Quality assurance KSB SE & Co. KGaA** **Qualitätssicherung KSB SE & Co. KGaA**

Datum / date / date : 04.03.2021

KSB SE & Co. KGaA
Qualitätsmanagement

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

[X] Druckprobe / hydrostatic test/ Essai de pression

gemäß/according/conforme **KSB-Standard** [X] **spez.** [ ]

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412740**	**KRTF 80-252/224XEG1-S**	**QP 1909483**

Beleg-Nr. Cert.-No.	Bauteil/part/partie	Prüfmedium/medium/agent		Prüfdruck/pressure/ Pression d'essai	Haltedauer/duration/ Durée d'essai
		Wasser Water Eau	Luft Air Air	bar/ psi	min
412740	**Pump complete**	**X**		**5,2 / 75,4**	**10**

Die drucktragenden Teile der Pumpe(n) wurden abgepresst.
The pressure containing parts of the pump(s) were hydrostatically tested.
Les parties de pompe soumises á la pression ont subi une épreuve hydrostatique.

Prüfstempel/Prüfung durchgeführt von AP
Stamp/Test performed by
Poincon de l'expert/Epreuve effectuée par

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité **Quality assurance KSB SE & Co. KGaA** **Qualitätssicherung KSB SE & Co. KGaA**

Datum / date / date : 04.03.2021

KSB SE & Co. KGaA
Qualitätsmanagement

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

[X] Druckprobe / hydrostatic test/ Essai de pression

gemäß/according/conforme **KSB-Standard** [X] **spez.** [ ]

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412741**	**KRTF 80-252/224XEG1-S**	**QP 1909483**

Beleg-Nr. Cert.-No.	Bauteil/part/partie	Prüfmedium/medium/agent		Prüfdruck/pressure/ Pression d'essai	Haltedauer/duration/ Durée d'essai
		Wasser Water Eau	Luft Air Air	bar/ psi	min
412741	**Pump complete**	**X**		**5,2 / 75,4**	**10**

Die drucktragenden Teile der Pumpe(n) wurden abgepresst.
The pressure containing parts of the pump(s) were hydrostatically tested.
Les parties de pompe soumises á la pression ont subi une épreuve hydrostatique.

Prüfstempel/Prüfung durchgeführt von AP
Stamp/Test performed by
Poincon de l'expert/Epreuve effectuée par

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité **Quality assurance KSB SE & Co. KGaA** **Qualitätssicherung KSB SE & Co. KGaA**

Datum / date / date : 04.03.2021

KSB SE & Co. KGaA
Qualitätsmanagement

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

[X] Druckprobe / hydrostatic test/ Essai de pression

gemäß/according/conforme **KSB-Standard** [X] **spez.** [ ]

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412742**	**KRTF 80-252/224XEG1-S**	**QP 1909483**

Beleg-Nr. Cert.-No.	Bauteil/part/partie	Prüfmedium/medium/agent		Prüfdruck/pressure/ Pression d'essai	Haltedauer/duration/ Durée d'essai
		Wasser Water Eau	Luft Air Air	bar/ psi	min
412742	**Pump complete**	**X**		**5,2 / 75,4**	**10**

Die drucktragenden Teile der Pumpe(n) wurden abgepresst.
The pressure containing parts of the pump(s) were hydrostatically tested.
Les parties de pompe soumises á la pression ont subi une épreuve hydrostatique.

Prüfstempel/Prüfung durchgeführt von AP
Stamp/Test performed by
Poincon de l'expert/Epreuve effectuée par

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité **Quality assurance KSB SE & Co. KGaA** **Qualitätssicherung KSB SE & Co. KGaA**

Datum / date / date : 04.03.2021

KSB SE & Co. KGaA
Qualitätsmanagement

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

[X] Druckprobe / hydrostatic test/ Essai de pression

gemäß/according/conforme **KSB-Standard** [X] **spez.** [ ]

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412743**	**KRTF 80-252/224XEG1-S**	**QP 1909483**

Beleg-Nr. Cert.-No.	Bauteil/part/partie	Prüfmedium/medium/agent		Prüfdruck/pressure/ Pression d'essai	Haltedauer/duration/ Durée d'essai
		Wasser Water Eau	Luft Air Air	bar/ psi	min
412743	**Pump complete**	**X**		**5,2 / 75,4**	**10**

Die drucktragenden Teile der Pumpe(n) wurden abgepresst.
The pressure containing parts of the pump(s) were hydrostatically tested.
Les parties de pompe soumises á la pression ont subi une épreuve hydrostatique.

Prüfstempel/Prüfung durchgeführt von AP
Stamp/Test performed by
Poincon de l'expert/Epreuve effectuée par

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité **Quality assurance KSB SE & Co. KGaA** **Qualitätssicherung KSB SE & Co. KGaA**

Datum / date / date : 04.03.2021

KSB SE & Co. KGaA
Qualitätsmanagement

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
		X	

Elektrische Prüfung Motor / motor electric test / examen moteur electrique DIN EN 60034-1

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412739**	**KA16 MN04-250 WA 3356-15**	**QP 1909483**

Kabel/cable/câble	ohne without sans	mit with avec	Länge length [m] longueur	Querschnitt cross area [mm²] surface	Temperatur temperatur [°C] température
	X				**20**

Schaltung/Connection/Couplage	offen/open/ouvert	X	verschalten/connected/conjoint	

32

Widerstand zwischen	$U - V / T_1 - T_2$		$U_1 - U_2 / T_1 - T_4$	**0,4298**	20-21	**0,883**
Resistance between	$V - W / T_2 - T_3$		$V_1 - V_2 / T_2 - T_5$	**0,4336**	21-22	**191,7**
Résistance entre	$U - W / T_1 - T_3$		$W_1 - W_2 / T_3 - T_6$	**0,4324**	**21-22**	**369,9**

Temp Test Results

Isolationsmessung Insulation megger test Mesure d' isolement	Testspannung Testing voltage Voltage d' essai	**2888**	Prüfung bestanden Proved successful Essai avec succès	**X**

Isolationswiderstand bei 500 V Insulation resistance with 500 V Résistance d' isolement avec 500 V	Wicklung Winding Bobinage	**>1000 MOhm**	Feuchtschutzelektrode Moisture protection Sonde d' humidité	**882,1 MOhm**

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité

Quality assurance KSB SE & Co. KGaA / Qualitätssicherung KSB SE & Co. KGaA

KSB SE & Co. KGaA
Qualitätsmanagement

Datum / date / date : 04.03.2021

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

Elektrische Prüfung Motor / motor electric test / examen moteur electrique DIN EN 60034-1

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412740**	**KA16 MN04-250 WA 3356-15**	**QP 1909483**

Kabel/cable/câble	ohne without sans	mit with avec	Länge length [m] longueur	Querschnitt cross area [mm²] surface	Temperatur temperatur [°C] température
	X				**20**

Schaltung/Connection/Couplage	offen/open/ouvert	X	verschalten/connected/conjoint	

32

Widerstand zwischen	U - V / T_1 - T_2		U_1 - U_2 / T_1 - T_4	**0,4380**	20-21	**0,875**
Resistance between	V - W / T_2 - T_3		V_1 - V_2 / T_2 - T_5	**0,4407**	21-22	**231,9**
Résistance entre	U - W / T_1 - T_3		W_1 - W_2 / T_3 - T_6	**0,4401**	**21-22**	**391,6**

Isolationsmessung Insulation megger test Mesure d' isolement	Testspannung Testing voltage Voltage d' essai	**2869**	Prüfung bestanden Proved successful Essai avec succès	**X**

Isolationswiderstand bei 500 V Insulation resistance with 500 V Résistance d' isolement avec 500 V	Wicklung Winding Bobinage	**>1000 MOhm**	Feuchtschutzelektrode Moisture protection Sonde d' humidité	**882,1 MOhm**

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité

Quality assurance KSB SE & Co. KGaA / Qualitätssicherung KSB SE & Co. KGaA

KSB SE & Co. KGaA
Qualitätsmanagement

Datum / date / date : 04.03.2021

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

Elektrische Prüfung Motor / motor electric test / examen moteur electrique DIN EN 60034-1

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412741**	**KA16 MN04-250 WA 3356-15**	**QP 1909483**

Kabel/cable/câble	ohne without sans	mit with avec	Länge length [m] longueur	Querschnitt cross area [mm²] surface	Temperatur temperatur [°C] température
	X				**20**

Schaltung/Connection/Couplage	offen/open/ouvert	X	verschalten/connected/conjoint	

32

Widerstand zwischen	$U - V / T_1 - T_2$		$U_1 - U_2 / T_1 - T_4$	**0,4369**	20-21	**0,878**
Resistance between	$V - W / T_2 - T_3$		$V_1 - V_2 / T_2 - T_5$	**0,4409**	21-22	**195,5**
Résistance entre	$U - W / T_1 - T_3$		$W_1 - W_2 / T_3 - T_6$	**0,4393**	21-22	**379,4**

Isolationsmessung Insulation megger test Mesure d' isolement	Testspannung Testing voltage Voltage d' essai	**2823**	Prüfung bestanden Proved successful Essai avec succès	**X**

Isolationswiderstand bei 500 V Insulation resistance with 500 V Résistance d' isolement avec 500 V	Wicklung Winding Bobinage	**>1000 MOhm**	Feuchtschutzelektrode Moisture protection Sonde d' humidité	**834,8 MOhm**

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité

Quality assurance KSB SE & Co. KGaA / Qualitätssicherung KSB SE & Co. KGaA

KSB SE & Co. KGaA
Qualitätsmanagement

Datum / date / date : 04.03.2021

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

Elektrische Prüfung Motor / motor electric test / examen moteur electrique DIN EN 60034-1

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos100	**412742**	**KA16 MN04-250 WA 3356-15**	**QP 1909483**

Kabel/cable/câble	ohne without sans	mit with avec	Länge length [m] longueur	Querschnitt cross area [mm²] surface	Temperatur temperatur [°C] température
	X				**20**

Schaltung/Connection/Couplage	offen/open/ouvert	X	verschalten/connected/conjoint	

32

Widerstand zwischen	U - V / T_1 - T_2		U_1 - U_2 / T_1 - T_4	**0,4296**	20-21	**0,869**
Resistance between	V - W / T_2 - T_3		V_1 - V_2 / T_2 - T_5	**0,4333**	21-22	**222,0**
Résistance entre	U - W / T_1 - T_3		W_1 - W_2 / T_3 - T_6	**0,4330**	**21-22**	**412,1**

Isolationsmessung Insulation megger test Mesure d' isolement	Testspannung Testing voltage Voltage d' essai	**2853**	Prüfung bestanden Proved successful Essai avec succès	**X**

Isolationswiderstand bei 500 V Insulation resistance with 500 V Résistance d' isolement avec 500 V	Wicklung Winding Bobinage	**>1000 MOhm**	Feuchtschutzelektrode Moisture protection Sonde d' humidité	**>1000 MOhm**

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité

Quality assurance KSB SE & Co. KGaA / Qualitätssicherung KSB SE & Co. KGaA

KSB SE & Co. KGaA
Qualitätsmanagement

Datum / date / date : 04.03.2021

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

Elektrische Prüfung Motor / motor electric test / examen moteur electrique DIN EN 60034-1

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/POs100	**412743**	**KA16 MN04-250 WA 3356-15**	**QP 1909483**

Kabel/cable/câble	ohne without sans	mit with avec	Länge length [m] longueur	Querschnitt cross area [mm²] surface	Temperatur temperatur [°C] température
	X				**20**

Schaltung/Connection/Couplage	offen/open/ouvert	X	verschalten/connected/conjoint	

32

Widerstand zwischen	$U - V / T_1 - T_2$		$U_1 - U_2 / T_1 - T_4$	**0,4383**	20-21	**0,859**
Resistance between	$V - W / T_2 - T_3$		$V_1 - V_2 / T_2 - T_5$	**0,4392**	21-22	**230,7**
Résistance entre	$U - W / T_1 - T_3$		$W_1 - W_2 / T_3 - T_6$	**0,4421**	**21 –22**	**360,3**

Isolationsmessung Insulation megger test Mesure d' isolement	Testspannung Testing voltage Voltage d' essai	**2856**	Prüfung bestanden Proved successful Essai avec succès	**X**

Isolationswiderstand bei 500 V Insulation resistance with 500 V Résistance d' isolement avec 500 V	Wicklung Winding Bobinage	**>1000 MOhm**	Feuchtschutzelektrode Moisture protection Sonde d' humidité	**>1000 MOhm**

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité

Quality assurance KSB SE & Co. KGaA / Qualitätssicherung KSB SE & Co. KGaA

Datum / date / date : 04.03.2021

PS3 Pumps

KSB SE & Co. KGaA
test field

Test Record 3.1

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000200**	*curve no.:*	
pump type:	KRTF 80-252/154XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**413055**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-170	
serial no.:	413055		*client motor:*	VERTIKAL	
motor rated power:	19,99464	hp	*speed:*	1763	r.p.m.
voltage:	460	Volt	*current:*	25,3	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	317,76	gal/min	*head H:*	81,41	feet
pump input power P:	12,34	hp (electric	*speed n:*	1763	r.p.m.
pump efficiency η:	52,8	%	*density ρ:*	998	kg/m³
			kin. viscosity:	0,000001	m²/s
acceptance test class	ISO 9906 P < 10 kW		*fluid temperature T:*	20,00	°C

Measure Instructions

impeller trimming type AN 1528 D2 249 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
speed n	r.p.m.	1789,1	1782,6	1776,9	1775,6	1769,7	1764,9	1764,4	
temperature T	°C	20,5	20,3	20,3	20,3	20,5	20,5	20,5	
capacity Q	**gal/min**	**0,00**	**162,26**	**300,47**	**335,08**	**508,26**	**700,07**	**872,72**	
calculated values									
density ρ	kg/m³	998,2	998,2	998,2	998,2	998,1	998,1	998,1	
total head H	**feet**	**99,18**	**92,82**	**86,50**	**85,25**	**77,22**	**70,90**	**59,58**	
pump input power P2	**hp (electric**	**5,91**	**9,41**	**12,50**	**13,19**	**16,34**	**18,95**	**19,20**	
pump power P2 ρ ordered	hp (electric	5,90	9,41	12,50	13,19	16,34	18,94	19,20	
pump efficiency η	**%**	**0,00**	**40,39**	**52,49**	**54,65**	**60,60**	**66,13**	**68,34**	

Remarks:

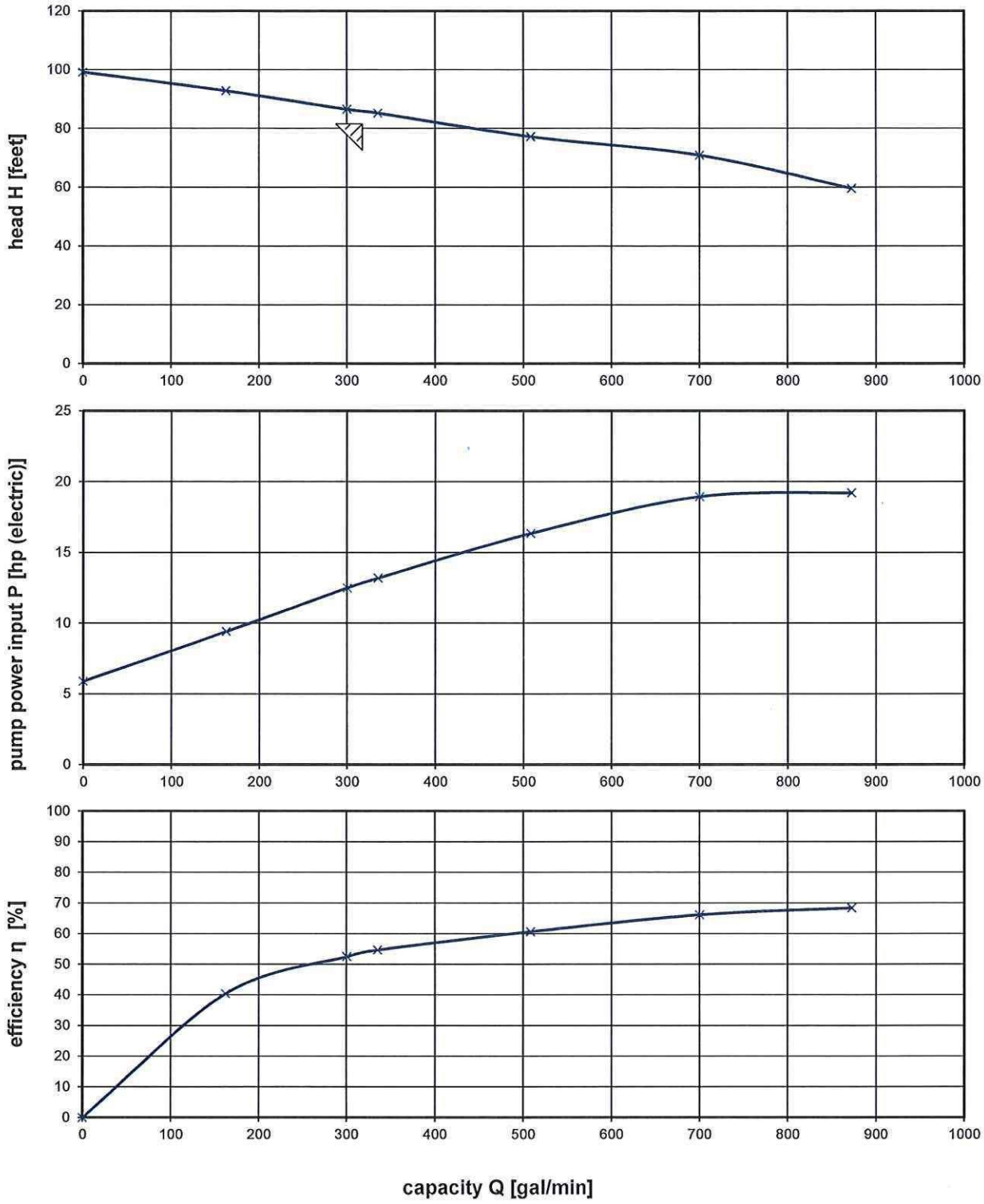
P+C/B.Bock QP1909495

\ DN 080 \ 9974530833_000200_413055

test record nr.	20210324-093137
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	24.03.2021

**) This report was created electronically and is valid without signature*

performance curves at operation speed from 1764 to 1789 r.p.m.



KSB	performance curves				client reference				
	\ DN 080 \ 9974530833_000200_413055				order nr. 9974530833_000200			date	24.03.2021
pump data	type	KRTF 80-252/154XEG1-S			D2 [mm]				
report nr.	manufactur.	KSB Halle			249				
20210324-093137	curve no.								
motor data	type	KA16MN04-170		frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur.	KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–
VERTIKAL	serial no.	413055		60	19,994636	1763	460	25,3	0,84
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet	hp (electric)	%	r.p.m.		kg/m³	°C	m²/s
ISO 9906 P < 10 kW	317,76	81,41	12,34	52,80	1763		998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000200**	*curve no.:*	
pump type:	KRTF 80-252/154XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**413056**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-170	
serial no.:	413056		*client motor:*	VERTIKAL	
motor rated power:	19,99464	hp	*speed:*	1763	r.p.m.
voltage:	460	Volt	*current:*	25,3	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	317,76	gal/min	*head H:*	81,41	feet
pump input power P:	12,34	hp (electric	*speed n:*	1763	r.p.m.
pump efficiency η:	52,8	%	*density ρ:*	998	kg/m³
			kin. viscosity:	0,000001	m²/s
acceptance test class	ISO 9906 P < 10 kW		*fluid temperature T:*	20,00	°C

Measure Instructions

impeller trimming type AN 1528 D2 249 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
speed n	r.p.m.	1788,9	1782,1	1776,7	1775,3	1769,3	1764,6	1764,3	
temperature T	°C	20,9	20,7	20,8	20,8	20,8	20,9	20,9	
capacity Q	**gal/min**	**0,00**	**167,21**	**299,28**	**333,69**	**504,72**	**701,98**	**869,37**	
calculated values									
density ρ	kg/m³	998,1	998,1	998,1	998,1	998,1	998,1	998,0	
total head H	**feet**	**99,09**	**92,70**	**86,88**	**85,24**	**77,60**	**69,94**	**58,84**	
pump input power P2	**hp (electric**	**5,99**	**9,64**	**12,60**	**13,32**	**16,57**	**19,13**	**19,28**	
pump power P2 ρ ordered	hp (electric	5,99	9,64	12,60	13,32	16,57	19,13	19,28	
pump efficiency η	**%**	**0,00**	**40,57**	**52,08**	**53,90**	**59,66**	**64,76**	**66,98**	

Remarks:	*test record nr.*	20210324-112418
	test person	WE
	test bench name	Prüfstand P2 / 5
	test bench type	open
	*quality check *)*	
\ DN 080 \ 9974530833_000200_413056	*date*	24.03.2021

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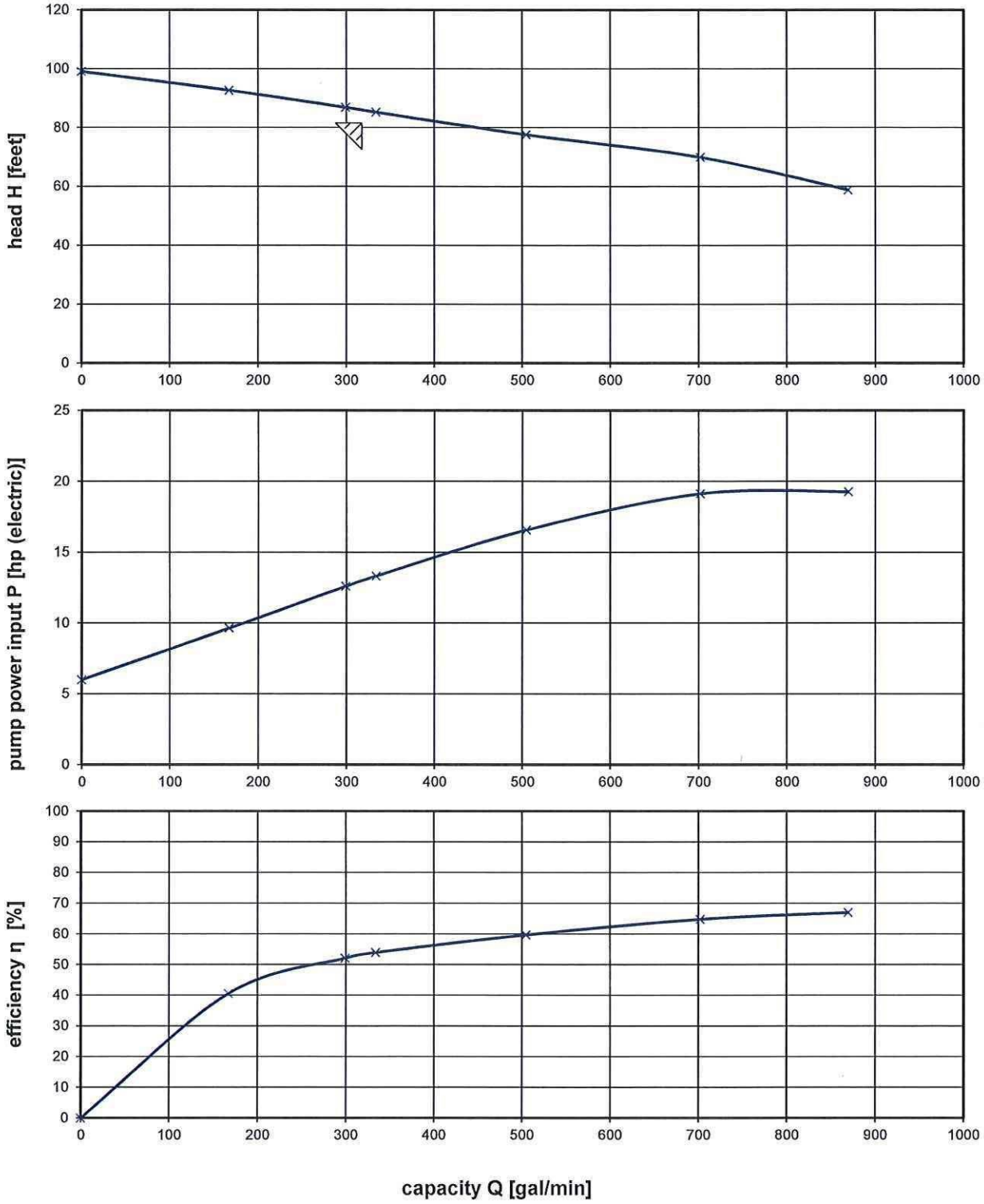
performance curves at operation speed from 1764 to 1789 r.p.m.



KSB	**performance curves** \ DN 080 \ 9974530833_000200_413056				client reference order nr. 9974530833_000200			date 24.03.2021	
pump data	*type* KRTF 80-252/154XEG1-S				*D2 [mm]*				
report nr.	*manufactur.* KSB Halle				249				
20210324-112418	*curve no.*								
motor data	*type* KA16MN04-170			*frequency*	*P motor*	*speed n*	*voltage*	*current*	*cos φ*
client motor	*manufactur.* KSB Halle			*Hz*	*hp*	*r.p.m.*	*Volt*	*Ampere*	–
VERTIKAL	*serial no.* 413056			60	19,994636	1763	460	25,3	0,84
ordered data	*capacity Q*	*head H*	*P pump*	*η pump*	*speed n*	*NPSH*	*density ρ*	*temp. hot*	*kin. visk*
acceptance test class	*gal/min*	*feet*	*hp (electric)*	*%*	*r.p.m.*		*kg/m³*	*°C*	*m²/s*
ISO 9906 P < 10 kW	317,76	81,41	12,34	52,80	1763		998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

53 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000200**	*curve no.:*	
pump type:	KRTF 80-252/154XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**413055**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-170	
serial no.:	413055		*client motor:*	VERTIKAL	
motor rated power:	19,99464	hp	*speed:*	1763	r.p.m.
voltage:	460	Volt	*current:*	25,3	Ampere
cos φ:	0,84	-	*frequency:*	60	Hz

Guarantee Data

capacity	250 gal/min	*head H:*	60 feet
		frequency	53 Hz

Measure Instructions

impeller trimming type AN 1528 D2 249 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	53,0	53,0	53,0	53,0	53,0	53,0	53,0	
temperature T	°C	20,5	20,3	20,4	20,4	20,5	20,5	20,5	
capacity Q	**gal/min**	**0,00**	**130,38**	**239,13**	**263,43**	**397,10**	**543,27**	**651,22**	
motor input power Pel	hp (electric	5,07	7,58	9,69	10,17	12,53	14,72	15,34	
calculated values									
density ρ	kg/m³	998,2	998,2	998,2	998,2	998,1	998,1	998,1	
total head H	**feet**	**76,86**	**72,29**	**68,21**	**67,31**	**62,20**	**58,88**	**52,95**	
η total (pump+motor)	%	0,00	31,39	42,50	44,02	49,74	54,85	56,74	

Remarks:

\ DN 080 \ 9974530833_000200_413055.53Hz

test record nr.	20210324-103705
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	24.03.2021

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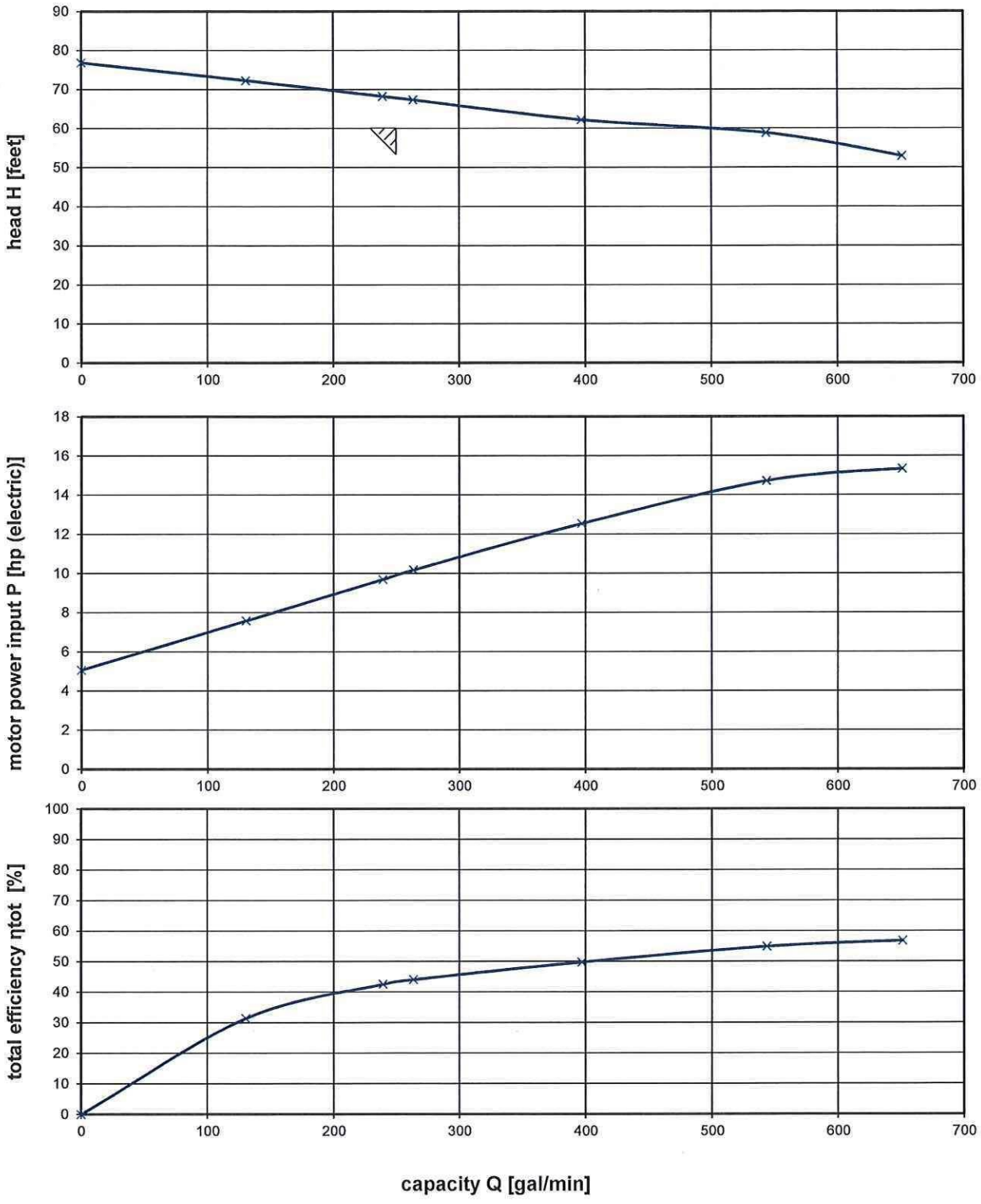
performance curves at operation speed from 53 to 53 Hz



KSB	**performance curves** \ DN 080 \ 9974530833_000200_413055.53Hz				*client reference* order nr. 9974530833_000200			date 24.03.2021	
pump data	*type* KRTF 80-252/154XEG1-S				*D2 [mm]*				
report nr.	*manufactur.* KSB Halle				249				
20210324-103705	*curve no.*								
motor data	*type* KA16MN04-170			*frequency*	*P motor*	*speed n*	*voltage*	*current*	*cos φ*
client motor	*manufactur.* KSB Halle			*Hz*	*hp*	*r.p.m.*	*Volt*	*Ampere*	–
VERTIKAL	*serial no.* 413055			60	19,994636	1763	460	25,3	0,84
ordered data	*capacity Q*	*head H*	*P pump*	*η pump*	*speed n*	*NPSH*	*density ρ*	*temp. hot*	*kin. visk*
acceptance test class	*gal/min*	*feet*		*%*	*Hz*	*m*	*kg/m³*	*°C*	*m²/s*
ISO 9906 P < 10 kW	250,00	60,00		52,80	53	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

53 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000200**	*curve no.:*	
pump type:	KRTF 80-252/154XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**413056**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle		*motor type:*	KA16MN04-170		
serial no.:	413056		*client motor:*	VERTIKAL		
motor rated power:	19,99464	hp	*speed:*	1763	r.p.m.	
voltage:	460	Volt	*current:*	25,3	Ampere	
cos φ:	0,84	-	*frequency:*	60	Hz	

Guarantee Data

capacity	250 gal/min	*head H:*	60 feet
		frequency	53 Hz

Measure Instructions

impeller trimming type AN 1528 D2 249 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	53,0	53,0	53,0	53,0	53,0	53,0	53,0	
temperature T	°C	20,7	20,6	20,6	20,6	20,7	20,7	20,7	
capacity Q	**gal/min**	**0,00**	**129,98**	**239,03**	**263,07**	**394,44**	**543,27**	**645,71**	
motor input power Pel	hp (electric	5,02	7,47	9,61	10,09	12,40	14,56	15,17	
calculated values									
density ρ	kg/m³	998,1	998,1	998,1	998,1	998,1	998,1	998,1	
total head H	**feet**	**76,14**	**71,66**	**67,95**	**67,08**	**62,17**	**58,01**	**52,05**	
η total (pump+motor)	%	0,00	31,47	42,65	44,12	49,93	54,62	55,93	

Remarks:

\ DN 080 \ 9974530833_000200_413056.53Hz

test record nr.	20210324-113717
test person	WE
test bench name	Prüfstand P2 / 5
test bench type	open
*quality check *)*	
date	24.03.2021

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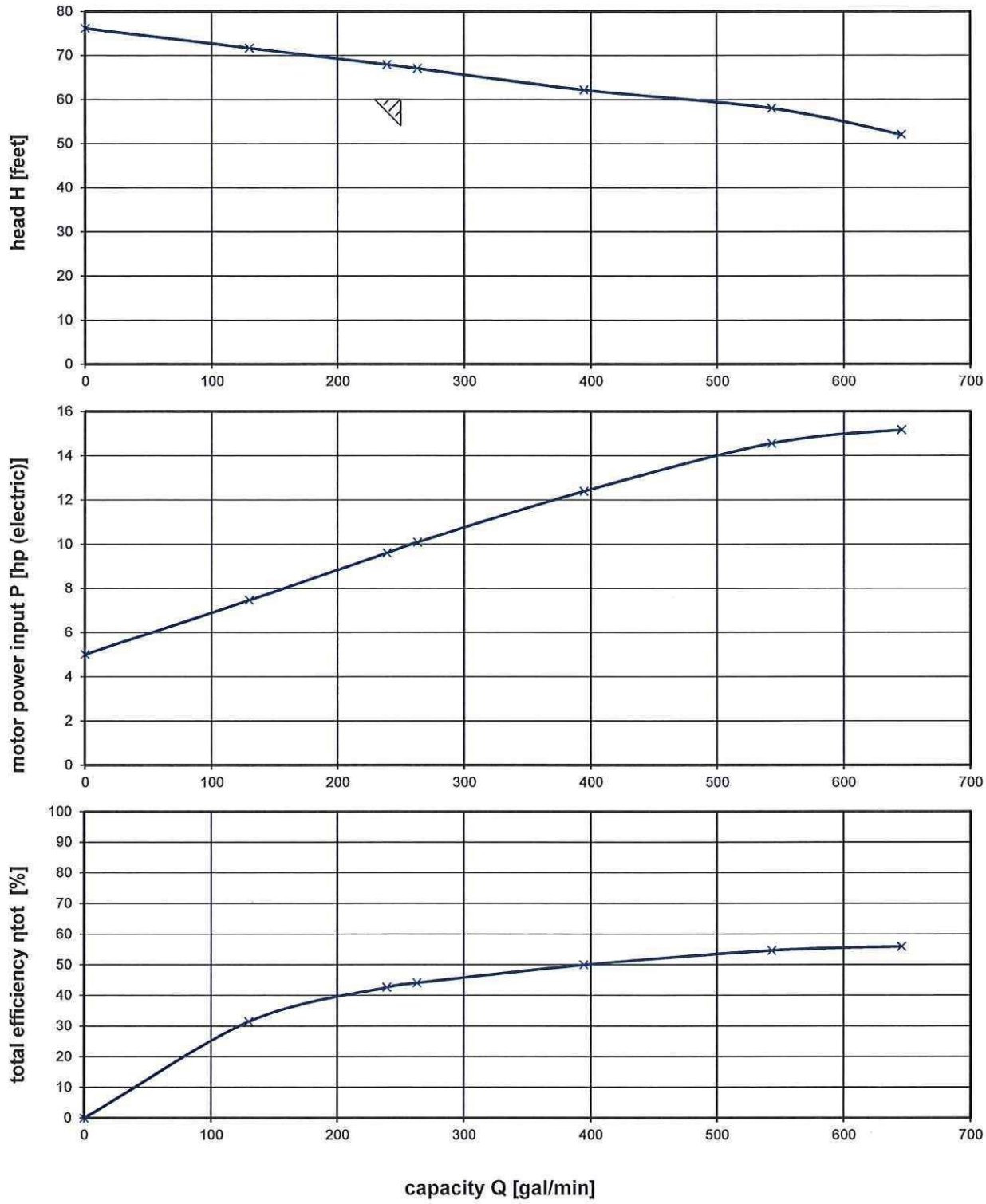
performance curves at operation speed from 53 to 53 Hz



KSB	performance curves			client reference				
	\ DN 080 \ 9974530833_000200_413056.53Hz			order nr. 9974530833_000200			date	24.03.2021
pump data	type KRTF 80-252/154XEG1-S			D2 [mm]				
report nr.	manufactur. KSB Halle			249				
20210324-113717	curve no.							
motor data	type KA16MN04-170		frequency	P motor	speed n	voltage	current	cos φ
client motor	manufactur. KSB Halle		Hz	hp	r.p.m.	Volt	Ampere	–
VERTIKAL	serial no. 413056		60	19,994636	1763	460	25,3	0,84
ordered data	capacity Q	head H	P pump	η pump	speed n	NPSH	density ρ	temp. hot	kin. visk
acceptance test class	gal/min	feet		%	Hz	m	kg/m³	°C	m²/s
ISO 9906 P < 10 kW	250,00	60,00		52,80	53	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

46 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000200**	*curve no.:*	
pump type:	KRTF 80-252/154XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**413055**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle			*motor type:*	KA16MN04-170	
serial no.:	413055			*client motor:*	VERTIKAL	
motor rated power:	19,99464	hp		*speed:*	1763	r.p.m.
voltage:	460	Volt		*current:*	25,3	Ampere
cos φ:	0,84	-		*frequency:*	60	Hz

Guarantee Data

capacity	50	gal/min	*head H:*	52 feet
			frequency	46 Hz

Measure Instructions

impeller trimming type AN 1528 D2 249 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	46,0	46,0	46,0	46,0	46,0	46,0	46,0	
temperature T	°C	20,6	20,5	20,5	20,5	20,5	20,5	20,4	
capacity Q	**gal/min**	**0,00**	**27,03**	**45,67**	**54,22**	**252,75**	**426,47**	**565,90**	
motor input power Pel	hp (electric	3,45	3,81	4,08	4,20	7,13	9,28	10,16	
calculated values									
density ρ	kg/m³	998,1	998,1	998,1	998,1	998,1	998,1	998,1	
total head H	**feet**	**57,84**	**56,61**	**56,10**	**55,72**	**49,90**	**44,93**	**39,66**	
η total (pump+motor)	%	0,00	10,13	15,87	18,14	44,62	52,12	55,78	

Remarks:	*test record nr.*	20210324-105807
	test person	WE
	test bench name	Prüfstand P2 / 5
	test bench type	open
	*quality check *)*	
\ DN 080 \ 9974530833_000200_413055.46Hz	*date*	24.03.2021

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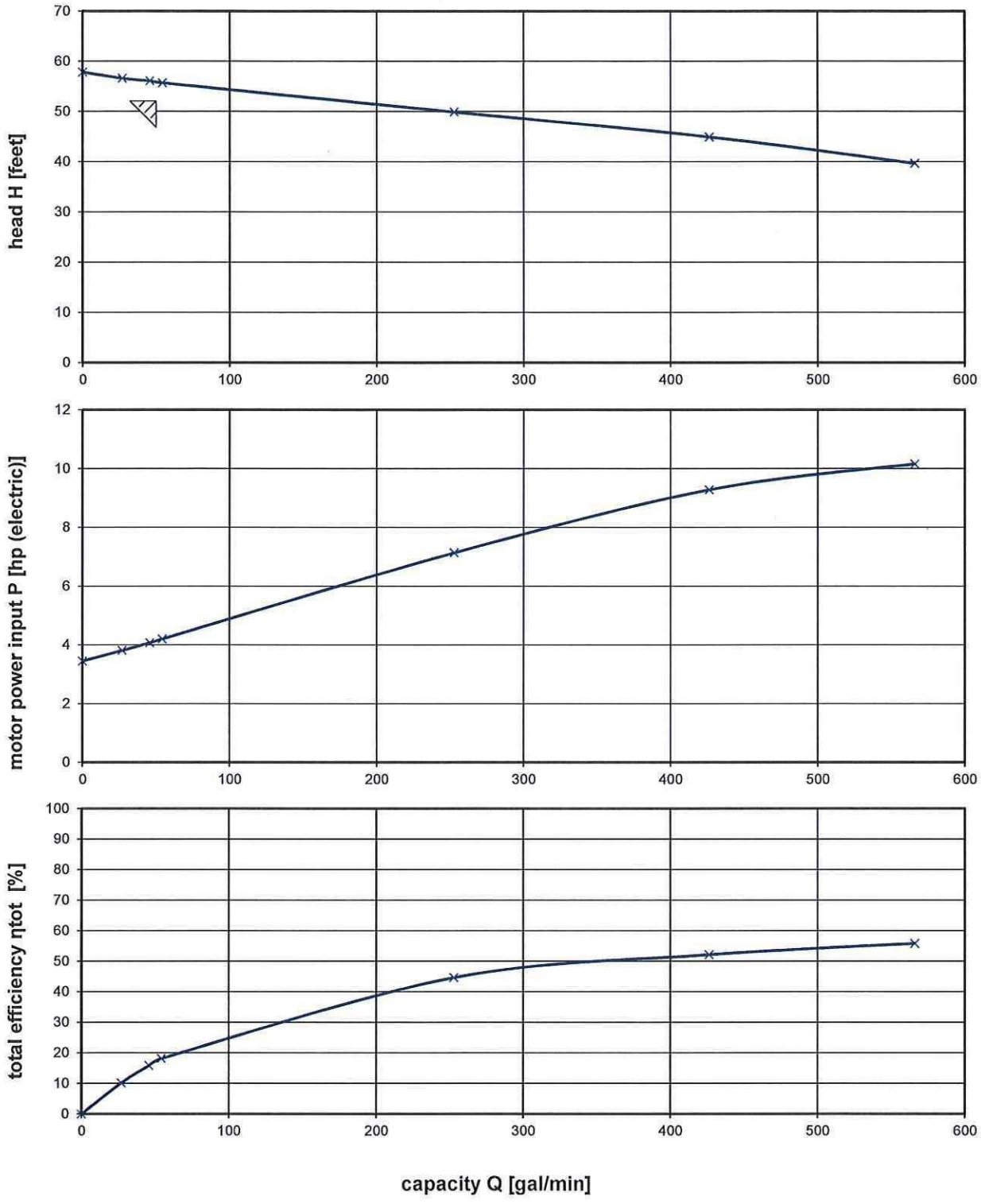
performance curves at operation speed from 46 to 46 Hz



KSB	performance curves				client reference				
	\ DN 080 \ 9974530833_000200_413055.46Hz				order nr. 9974530833_000200			date	24.03.2021
pump data	*type*	KRTF 80-252/154XEG1-S			*D2 [mm]*				
report nr.	*manufactur.*	KSB Halle			249				
20210324-105807	*curve no.*								
motor data	*type*	KA16MN04-170		*frequency*	*P motor*	*speed n*	*voltage*	*current*	*cos φ*
client motor	*manufactur.*	KSB Halle		*Hz*	*hp*	*r.p.m.*	*Volt*	*Ampere*	–
VERTIKAL	*serial no.*	413055		60	19,994636	1763	460	25,3	0,84
ordered data	*capacity Q*	*head H*	*P pump*	*η pump*	*speed n*	*NPSH*	*density ρ*	*temp. hot*	*kin. visk*
acceptance test class	*gal/min*	*feet*		*%*	*Hz*	*m*	*kg/m³*	*°C*	*m²/s*
ISO 9906 P < 10 kW	50,00	52,00		52,80	46	0,00	998,0	20,0	1,00E-06

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KSB SE & Co. KGaA
test field

Test Record 3.1

46 Hz

Ordered Data

client:		*client reference:*	
order no.:	**9974530833_000200**	*curve no.:*	
pump type:	KRTF 80-252/154XEG1-S	*manufacturer:*	KSB Halle
serial no.:	**413056**	*KSB location:*	HA
construction:	S	*no. of stages:*	1

Motor Data

manufacturer:	KSB Halle			*motor type:*	KA16MN04-170		
serial no.:	413056			*client motor:*	VERTIKAL		
motor rated power:		19,99464	hp	*speed:*		1763	r.p.m.
voltage:		460	Volt	*current:*		25,3	Ampere
cos φ:		0,84	-	*frequency:*		60	Hz

Guarantee Data

capacity	50 gal/min	*head H:*	52 feet
		frequency	46 Hz

Measure Instructions

impeller trimming type AN 1528 D2 249 mm

measured data

measured values	dimension	1	2	3	4	5	6	7	
frequency	Hz	46,0	46,0	46,0	46,0	46,0	46,0	46,0	
temperature T	°C	20,7	20,7	20,7	20,7	20,7	20,7	20,7	
capacity Q	**gal/min**	**0,00**	**26,92**	**46,47**	**53,70**	**253,86**	**421,78**	**565,50**	
motor input power Pel	hp (electric	3,44	3,80	4,10	4,20	7,15	9,22	10,15	
calculated values									
density ρ	kg/m³	998,1	998,1	998,1	998,1	998,1	998,1	998,1	
total head H	**feet**	**57,88**	**56,63**	**55,90**	**55,77**	**49,79**	**45,03**	**39,57**	
η total (pump+motor)	%	0,00	10,12	16,00	17,98	44,60	51,97	55,65	

Remarks:	*test record nr.*	20210324-114244
	test person	WE
	test bench name	Prüfstand P2 / 5
	test bench type	open
	*quality check *)*	
\ DN 080 \ 9974530833_000200_413056.46Hz	*date*	24.03.2021

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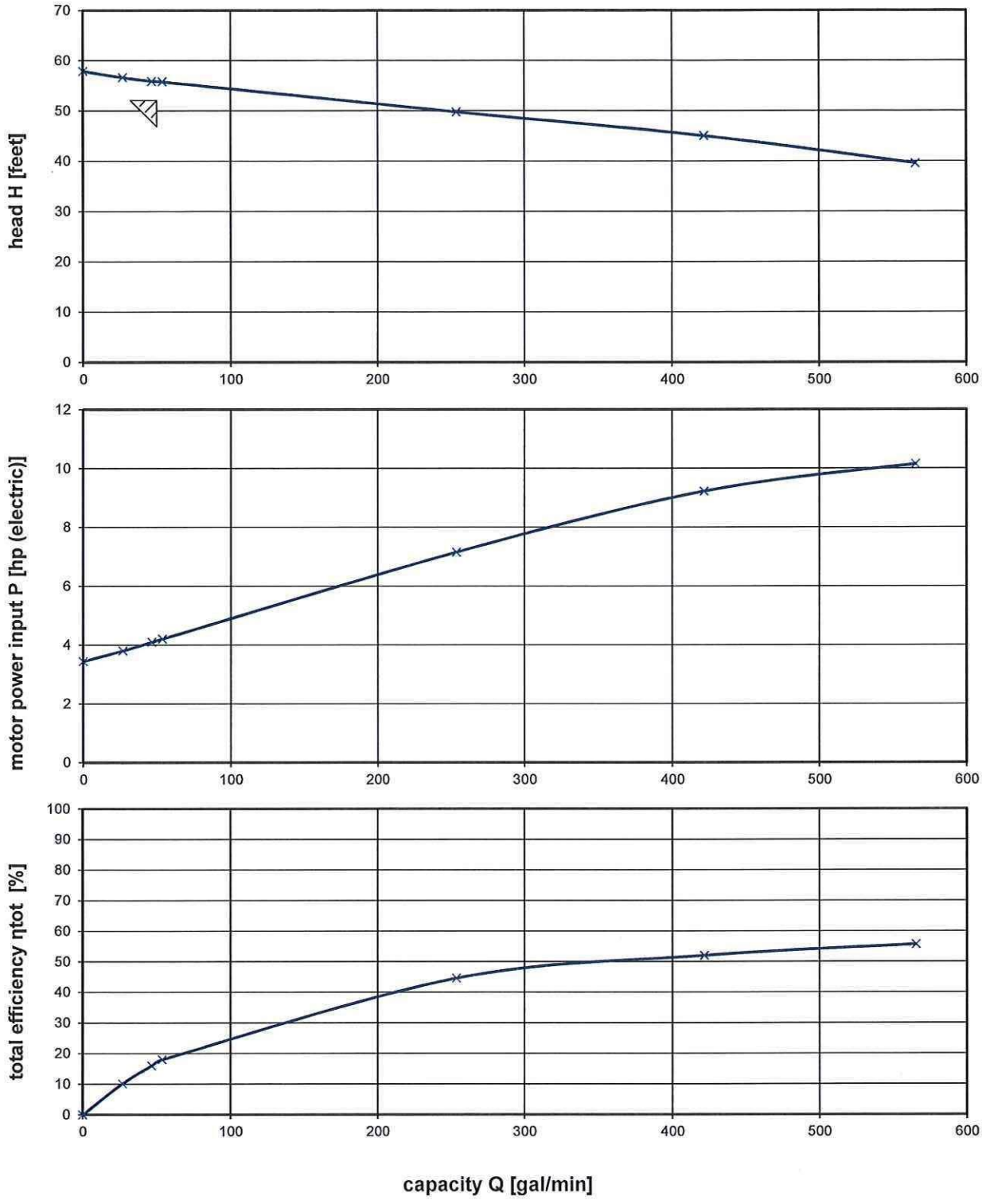
performance curves at operation speed from 46 to 46 Hz



KSB	**performance curves**				client reference				
	\ DN 080 \ 9974530833_000200_413056.46Hz				order nr. 9974530833_000200			date	24.03.2021
pump data	*type* KRTF 80-252/154XEG1-S				*D2 [mm]*				
report nr.	*manufactur.* KSB Halle				249				
20210324-114244	*curve no.*								
motor data	*type* KA16MN04-170			*frequency*	*P motor*	*speed n*	*voltage*	*current*	*cos φ*
client motor	*manufactur.* KSB Halle			*Hz*	*hp*	*r.p.m.*	*Volt*	*Ampere*	–
VERTIKAL	*serial no.* 413056			60	19,994636	1763	460	25,3	0,84
ordered data	*capacity Q*	*head H*	*P pump*	*η pump*	*speed n*	*NPSH*	*density ρ*	*temp. hot*	*kin. visk*
acceptance test class	*gal/min*	*feet*		*%*	*Hz*	*m*	*kg/m³*	*°C*	*m²/s*
ISO 9906 P < 10 kW	50,00	52,00		52,80	46	0,00	998,0	20,0	1,00E-06

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Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

[X] Druckprobe / hydrostatic test/ Essai de pression

gemäß/according/conforme **KSB-Standard** [X] **spez.** [ ]

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos200	**413055**	**KRTF 80-252/154XEG1-S**	**QP 1909495**

Beleg-Nr. Cert.-No.	Bauteil/part/partie	Prüfmedium/medium/agent		Prüfdruck/pressure/ Pression d'essai	Haltedauer/duration/ Durée d'essai
		Wasser Water Eau	Luft Air Air	bar/ psi	min
413055	**Pump complete**	**X**		**5,2 / 75,4**	**10**

Die drucktragenden Teile der Pumpe(n) wurden abgepresst.
The pressure containing parts of the pump(s) were hydrostatically tested.
Les parties de pompe soumises á la pression ont subi une épreuve hydrostatique.

Prüfstempel/Prüfung durchgeführt von AP
Stamp/Test performed by
Poincon de l'expert/Epreuve effectuée par

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité **Quality assurance KSB SE & Co. KGaA** **Qualitätssicherung KSB SE & Co. KGaA**

Datum / date / date : 09.03.2021

KSB SE & Co. KGaA
Qualitätsmanagement

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

[X] Druckprobe / hydrostatic test/ Essai de pression

gemäß/according/conforme **KSB-Standard** [X] **spez.** [ ]

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos200	**413056**	**KRTF 80-252/154XEG1-S**	**QP 1909495**

Beleg-Nr. Cert.-No.	Bauteil/part/partie	Prüfmedium/medium/agent		Prüfdruck/pressure/ Pression d'essai	Haltedauer/duration/ Durée d'essai
		Wasser Water Eau	Luft Air Air	bar/ psi	min
413056	**Pump complete**	**X**		**5,2 / 75,4**	**10**

Die drucktragenden Teile der Pumpe(n) wurden abgepresst.
The pressure containing parts of the pump(s) were hydrostatically tested.
Les parties de pompe soumises á la pression ont subi une épreuve hydrostatique.

Prüfstempel/Prüfung durchgeführt von AP
Stamp/Test performed by
Poincon de l'expert/Epreuve effectuée par

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité **Quality assurance KSB SE & Co. KGaA** **Qualitätssicherung KSB SE & Co. KGaA**

Datum / date / date : 09.03.2021

KSB SE & Co. KGaA
Qualitätsmanagement

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

Elektrische Prüfung Motor / motor electric test / examen moteur electrique DIN EN 60034-1

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos200	**413055**	**KA16 MN04-170 WA 3374-15**	**QP 1909483**

Kabel/cable/câble	ohne without sans	mit with avec	Länge length [m] longueur	Querschnitt cross area [mm²] surface	Temperatur temperatur [°C] température
	X				**20**

Schaltung/Connection/Couplage	offen/open/ouvert	X	verschalten/connected/conjoint	

32

Widerstand zwischen	$U - V / T_1 - T_2$		$U_1 - U_2 / T_1 - T_4$	**0,7773**	20-21	**0,865**
Resistance between	$V - W / T_2 - T_3$		$V_1 - V_2 / T_2 - T_5$	**0,7814**	21-22	**196,5**
Résistance entre	$U - W / T_1 - T_3$		$W_1 - W_2 / T_3 - T_6$	**0,7824**	**21-22**	**359,1**

Isolationsmessung Insulation megger test Mesure d' isolement	Testspannung Testing voltage Voltage d' essai	**2891**	Prüfung bestanden Proved successful Essai avec succès	**X**

Isolationswiderstand bei 500 V Insulation resistance with 500 V Résistance d' isolement avec 500 V	Wicklung Winding Bobinage	**>1000 MOhm**	Feuchtschutzelektrode Moisture protection Sonde d' humidité	**>1000 MOhm**

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité

Quality assurance KSB SE & Co. KGaA / Qualitätssicherung KSB SE & Co. KGaA

KSB SE & Co. KGaA
Qualitätsmanagement

Datum / date / date : 09.03.2021

Werksbescheinigung	Werkszeugnis	Abnahmeprüfzeugnis 3.1	Abnahmeprüfzeugnis 3.2
Declaration of compliance with the order Attestation de conformité à la commande	Test report Relevé de contrôle	Inspection certificate 3.1 Certificat de reception 3.1	Inspection certificate 3.2 Certificat de reception 3.2
EN 10204 – 2.1	**EN 10204 – 2.2**	**EN 10204 – 3.1**	**EN 10204 – 3.2**
[ ]	[ ]	[X]	[ ]

Elektrische Prüfung Motor / motor electric test / examen moteur electrique DIN EN 60034-1

Besteller/Customer/Client	Anlage/Project/Projet	Bestell-Nr./Purchase order No./ Commande No.	Pos.-Nr./Item-No./Repère-No.
Auftr.-Nr./Order No./No.d'ordre	**Werk-Nr./Serial-No./No.de fabrication**	**Typ/Type/Type**	**Techn. Bed./Techn. requirements/ Exigences techniques**
9974530833/Pos200	**413056**	**KA16 MN04-170 WA 3374-15**	**QP 1909483**

Kabel/cable/câble	ohne without sans	mit with avec	Länge length [m] longueur	Querschnitt cross area [mm²] surface	Temperatur temperatur [°C] température
	X				**20**

Schaltung/Connection/Couplage	offen/open/ouvert	X	verschalten/connected/conjoint	

32

Widerstand zwischen	U - V / T_1 - T_2		U_1 - U_2 / T_1 - T_4	**0,7800**	20-21	**0,877**
Resistance between	V - W / T_2 - T_3		V_1 - V_2 / T_2 - T_5	**0,7827**	21-22	**215,0**
Résistance entre	U - W / T_1 - T_3		W_1 - W_2 / T_3 - T_6	**0,7829**	**21-22**	**361,8**

Isolationsmessung Insulation megger test Mesure d' isolement	Testspannung Testing voltage Voltage d' essai	**2845**	Prüfung bestanden Proved successful Essai avec succès	**X**

Isolationswiderstand bei 500 V Insulation resistance with 500 V Résistance d' isolement avec 500 V	Wicklung Winding Bobinage	**>1000 MOhm**	Feuchtschutzelektrode Moisture protection Sonde d' humidité	**>1000 MOhm**

Die gestellten Anforderungen sind erfüllt./The requirements are fulfilled./Les exigences demandées ont été réalisées.

Kunde Customer Client	Abnahmebeauftragter des Bestellers Purchasers authorized inspection representative L'inspecteur autorisé	Zugelassene Abnahmegesellschaft Authorized Inspection Agency	Prüfaufsicht/Qualitätssicherung The Expert/Quality Assurance L'expert Assurance de qualité

Quality assurance KSB SE & Co. KGaA / Qualitätssicherung KSB SE & Co. KGaA

KSB SE & Co. KGaA
Qualitätsmanagement

Datum / date / date : 09.03.2021

Five Year or 10,000 Hour KRT Pump Warranty And Ten Year Guide Cable Warranty for Permanent Municipal Installations

KSB, Inc. warrants to the Original End Purchaser that its Pump(s) will be free from defects in workmanship and materials covering parts and labor for a period of five (5) years or ten thousand (10,000) hours of operation, and that its Guide Cable will be free from defects in workmanship and materials covering parts and labor for a period of ten (10) years of operation when pumping abrasive-free, non-corrosive liquids used in Permanent Municipal Installations. This warranty commences on the date KSB, Inc ships the pump(s).

KSB Pump(s) are warranted for five (5) years for use in Sewage Collection systems or intermittent duty cycle pumping. KSB Pump(s) are warranted for 10,000 hours of operation for use in Sewage Treatment Processing or for continuous duty cycle pumping. For the purpose of this clause, continuous duty cycle is defined as twelve (12) hours per day average operation time, or greater.

In the event that defects in workmanship or materials appear during the term of the warranty, the Purchaser shall deliver written claim of Warranty to the Company within ninety (90) days of discovery. The obligation of KSB, Inc. under the warranty shall be limited to replacement of defective part(s) and/or labor whichever KSB, Inc., in its sole discretion, chooses to elect. The Original End Purchaser shall be entitled to this warranty provided that the terms of payment have been complied with and the pump(s) with cable(s) attached or faulty part(s) thereof have been returned freight prepaid to KSB, Inc. or to an authorized KSB Service Facility and the defect has been acknowledged in writing by KSB, Inc. to be caused by faulty workmanship or defective material. Normal wear and tear is specifically excluded from warranty coverage.

This warranty does not apply to KSB Grinder Pumps or pumps used in industrial or portable applications. The warranty shall be void if the pump(s) or its part(s) have not been used and maintained in accordance with the printed instructions of KSB, Inc., or have been damaged wholly or in part by misuse, accident, neglect, faulty electrical system, or any other cause beyond the control of KSB, Inc.

Unless otherwise specified by KSB, Inc., the warranty period shall be computed from the original shipping date to the date the pump(s) and/or part(s) are returned to KSB, Inc. or, if repairs are made on site, the warranty period shall be computed to the date notice of defects is received by KSB, Inc.

Pump(s) or part(s) repaired or replaced will be returned at the cost of the Original End Purchaser. Repairs or replacement parts are warranted free from defects in workmanship and materials for the longer of the un-expired term of this warranty or ninety (90) days from the date KSB, Inc. ships such repaired or replaced items, and all other terms and conditions of this warranty shall apply. The extent of the Original End Purchaser's share in the repair or replacement cost detailed below shall be paid prior to shipment by KSB, Inc.

Electrical system schematics (including bills of material) may be required to support any warranty claims at the request of KSB, Inc. This documentation will normally be required in the case of pumps or 20 horsepower and larger.

KSB, Inc. will bear the cost for such repair or replacement as follows:

Item	Categories	I	II	III
A. Pumps	Months after Shipment	0-18	19-39	40-60
	Hours of Operation	0-2,999	3,000-6,499	6,500-10,000
	KSB Share of Cost	100%	50%	25%
B. Guide Cables	Months after Shipment	0-120	-	-
	KSB Share of Cost	100%	-	-

KSB, INC. WILL NOT BE RESPONSIBLE FOR TRAVEL EXPENSES, RENTED EQUIPMENT, OUTSIDE CONTRACTORS' FEES, UNAUTHORIZED REPAIR, SHOP EXPENSES OR FOR PUMPS PURCHASED OR USED WITHOUT KSB SUPPLIED POWER CABLE(S).

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No sales agent or sales representative or any other person is authorized to modify, extend, or enlarge this Warranty. Any modification, extension, or enlargement of this Warranty shall not bind KSB, Inc.

Revised 9/2014
Supersedes all previously published warranties

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

9.2 - Instrumentation and Controls

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

Operation & Maintenance Manual

Downtown Area Collection System and Pump Station
Town of Orleans, MA

United Concrete Products Inc.

173 Church St,
Wallingford, CT 06492

AECOM Technical Services

1 Federal St,
Boston, MA 02110

R.E. Erickson Co., Inc.

Instruments & Controls
595 Providence Highway
Walpole, MA 02081
Office: (508) 668-9330 Fax: (508) 660-2032

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Downtown Area Collection System and Pump Station No 2 ISR Panel 3.02

Downtown Area Collection System and Pump Station No 3 ISR Panel 3.03

Tab - 2.01

KPSI 700

- Submersible level transducer
- ±1.00% FS static accuracy
- Custom built in two days
- Two year warranty

The KPSI 700 is a submersible hydrostatic level transducer specifically designed to meet the rigorous environments encountered in liquid level measurement and control. It can be configured to perform to specifications under most adverse, reactive conditions.

Every KPSI Transducer utilizes a highly accurate pressure sensor assembly specifically designed for hostile fluids and gases. The assembly is integrated with supporting electronics in a durable waterproof housing constructed of 316 stainless steel or titanium. The attached electrical cable is custom manufactured and includes para-aramid synthetic fiber members to prevent errors due to cable elongation, and a unique water block feature that self-seals in the event of accidental cuts to the cable. Each vented reference transducer is shipped with a SuperDry Vent Filter that prevents moisture from entering the vent tube for at least one year without maintenance, even in the most humid environments.

Features

- Custom polyurethane or ETFE cable lengths
- Welded 316SS or titanium body
- Custom level ranges up to 700 ft. (210 m) H_2O
- Multiple analog output
- Multiple nose piece styles
- Optional lifetime lightning protection
- Long life vent filter or aneroid bellows
- Available molded cable seal

Applications

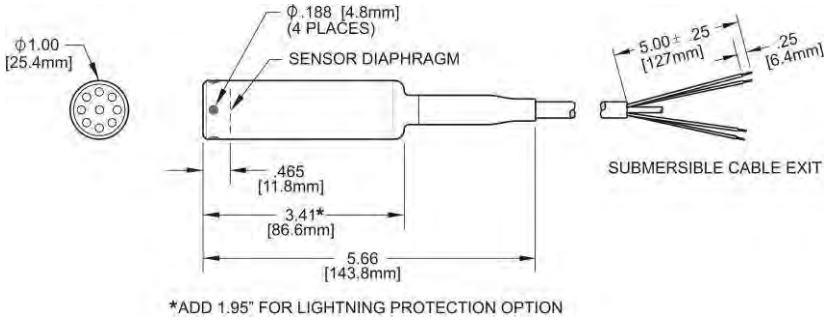
- Lift stations
- Pump control
- Level control
- Surface water monitoring
- Landfill leachate
- Well monitoring
- Groundwater monitoring

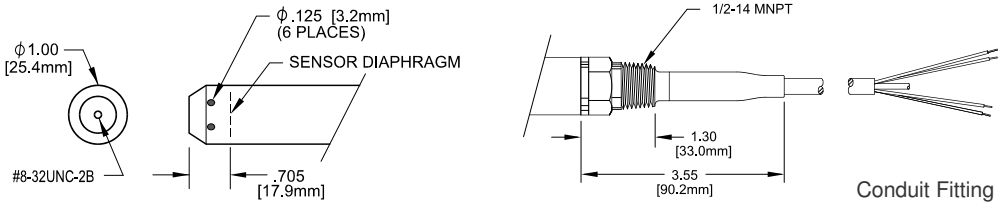
Specifications

PARAMETER		COMMENT
LEVEL RANGES		
Full Scale Level Ranges (Intermediate level ranges are available)	2.3 thru 700 ft. H_2O (0.70 thru 210 m H_2O)	Vented Gage Reference
	10 thru 700 ft. H_2O (3 thru 210 m H_2O)	Sealed Gage Reference
	35 thru 700 ft. H_2O (10 thru 210 m H_2O)	Absolute Gage Reference
Proof Pressure	1.5 x FS	
Burst Pressure	2.0 x FS	

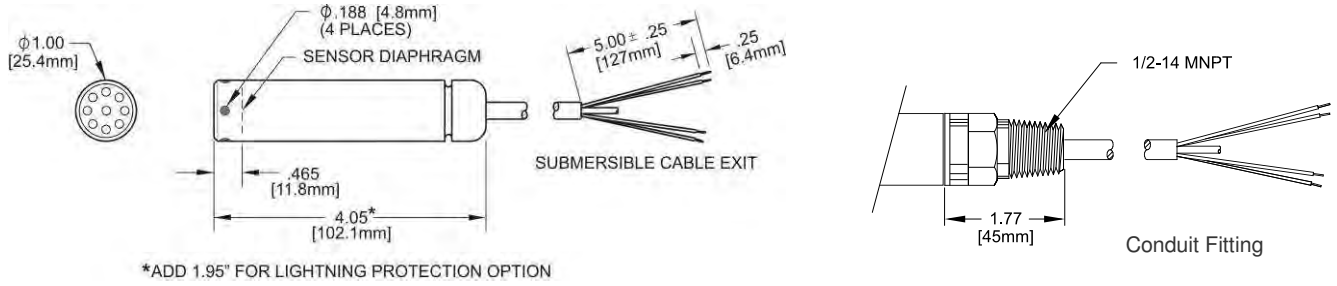
STATIC PERFORMANCE		
Static Accuracy (combined effects of non-linearity, hysteresis and repeatability, best fit straight line method)	±1.00% FSO	BFSL method
Resolution	+0.0001% FS	
ENVIRONMENTAL		
Wetted Materials	316 SS or Titanium; POM; FKM; Polyurethane or ETFE	
Compensated Temp Range	0 to 50ºC	
Thermal Error (maximum allowable deviation from the Best Fit Straight Line due to a change in temperature)	±0.05% FSO/ºC ±0.1% FSO/ºC	Worse case over compensated temperature range for ranges < 12 ft. (4 m) H_2O
Operating Temp Range	-20 to 60 ºC	When attached to polyurethane cable
Protection Rating	IP 68, NEMA 6P	
ELECTRICAL		
Excitation	9-28V – VDC output 9-28V – mA output 15-28V – VDC output 10-28V – VDC output	0-5 V, 0-2.5 V, 0-4 V 4-20 0-10 V 1.5-7.5 V
Input Current	20 mA max., 3.5 mA max.	For mA output, for VDC output
Output	4-20 mA, 0-5 VDC, 0-2.5 VDC, 0-4 VDC, 0-10 VDC, 1.5-7.5 VDC	For ranges < 5 ft. (1.5m) H_2O, only 4-20mA output is available
Zero Offset	±0.25 mA for mA output < 0.25 VDC for VDC output	
Output Impedance	See loop diagram for mA output 20 ohm for VDC output	
Insulation Resistance	100 mega ohm at 50 VDC	
Circuit Protection	Polarity, surge/shorted output	
CERTIFICATIONS		
	CE compliant	EN 61326-1:2013 and 61326-2-3:2013
	UL, CUL and FM	Class I, II, III, Div. 1, Groups A,B,C,D,E,F&G
	WEEE/RoHS	Waste from Electrical and Electronic Equipment (WEEE) and Restrictions on the use of Hazardous Substances (RoHS)
PHYSICAL		
Approximate Weight	0.44 lbs. (198 g) transducer 0.05 lbs./ft. (79 g/m) cable	
Cable Jacket Material	Polyurethane (Standard), ETFE (Optional)	
Cable Pull Strength	200 lbs (90 kg)	Polyurethane
Cable Number of Conductors	4 max.	
Cable Conductor Size	22 AWG	
Cable Seal	Molded Polyurethane FKM Gland	For polyurethane cable For ETFE cable
TEMPERATURE OUTPUT OPTION (Not Intrinsically safety approved)		
Temperature Range	-20 to 60ºC	Available for 4-20 mA output versions only
Output Signal	4-20 mA	
Temperature Measurement Accuracy	±4ºC	±1ºC with single point calibration
LIGHTNING PROTECTION (Power supply needs to be limited to 150mA to avoid lock up of the gas tube after a suppression event)		
Life Expectancy	>1,000 Operations	
Peak Clamping Voltage	36 Volts	
Response Time	<10 nsecs	
Shunts	20,000 Amperes	

Dimensions





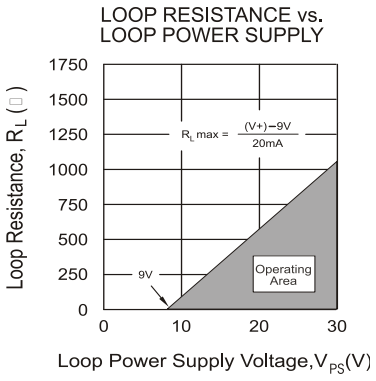
Molded Cable Seal Configuration for Polyurethane Cable



Gland Cable Seal Configuration for ETFE Cable

Electrical Termination / Loop Resistance

ELECTRICAL TERMINATION		
22AWG CONDUCTORS IN A SHIELDED CABLE WITH VENT TUBE		
4-20 mA	RED BLACK	+ EXCITATION - EXCITATION
0-5 VDC	RED BLACK WHITE	+ EXCITATION - EXCITATION + SIGNAL
ALL	DRAIN WIRE	SHIELD



Ordering Information

MODEL	SUBMERSIBLE LEVEL TRANSDUCER
7 0 0	±1.00% FSO Static Accuracy
	MATERIAL
	S Stainless Steel
	T Titanium
	REFERENCE FORMAT
	1 Vented gage
	3 Sealed gage
	4 Absolute
	OUTPUT
	3 0-5 VDC
	F 0-2.5 V
	G 0-4 V
	H 0-10 V
	J 1-5 7-5V
	4 4-20mA
	6 4-20mA temperature measurement option
	PRESSURE CONNECTION
	A Open-face nose cap
	B Ported nose cap
	E Piezometer nose cap
	2 1/4" - 18 NPT male fitting
	7 1/2" - 14 NPT male fitting
	ELECTRICAL CONNECTION
	0 Molded cable seal
	4 1/2" - 14 NPT male conduit fitting with molded cable seal
	A Gland cable seal
	B 1/2" - 14 NPT male conduit fitting with gland cable seal
	LIGHTNING PROTECTION
	A None
	B Full Lightning Protection
	LEVEL RANGE (at MAX output)[1]
	# # # . # # #
	LEVEL RANGE (at MIN output)[1]
	# # # . # # #
	MOISTURE PROTECTION
	A None (sealed/absolute only)
	B Vent Filter
	C Aneroid Bellows
	D Stainless Steel Vent Filter
	CABLE TYPE
	1 Polyurethane
	2 ETFE (Electrical Connection "A" or "B" Only)
	CABLE LENGTH
	# # # # (in feet)
	LABEL[2]
	A psi
	B ft H_2O
	C m H_2O
7 0 0	

Notes:

1 The part number requires two level range limits, corresponding to the maximum and minimum analog outputs of the transducer, to be specified in **pounds per square inch (psi)** to three decimal places. The lower level range is typically 000.000 unless otherwise required. For reverse output requirements, enter the lower level range for the maximum output signal and the upper range for the minimum output. Use the following conversion factors: **Ft. H_2O / 2.3073 = psi // m H_2O / 0.703265 = psi**
Examples: 10 ft. H_2O / 2.3073 = 4.334 psi (Enter 004.334 in the part number), 10 m H_2O / 0.703265 = 14.219 psi (Enter 014.219 in the part number)
For sealed gage reference add local atmosphere when converting to psi. Contact PSI for assistance.
Example:10 ft. H_2O / 2.3073 +14.7 = 19.034 psi (Enter 019.034 in the part number)

2 Units of measure on standard MEAS label. Contact Measurement Specialties if private labeling is required.

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PD8-765 Explosion-Proof Process & Temperature Meter

Instruction Manual

Tab - 2.02

ProtEX™ MAX

FM APPROVED

IECEx

- Explosion-Proof Process & Temperature Meter
- 4-20 mA, ± 10 V, TC & RTD Field Selectable Inputs
- Full 4-Digit Display, 1.20" (30.5 mm)
- SafeTouch Through-Glass Button Programming
- Display Mountable at 0°, 90°, 180°, & 270°
- Isolated 24 VDC @ 200 mA Transmitter Power Supply Option (AC powered meters only)
- 2 Relays + Isolated 4-20 mA Output Option
- Free PC-Based MeterView Programming & Monitoring Software
- Sunlight Readable Display
- Operating Temperature Range: -40 to 65°C (-40 to 149°F)
- FM Approved as Explosion-Proof / Dust-Ignition-Proof / Flame-Proof
- CSA Certified as Explosion-Proof / Dust-Ignition-Proof / Flame-Proof
- ATEX and IECEx Certified as Flame-Proof
- Input Power Options: 85-265 VAC / 90-265 VDC or 12-36 VDC / 12-24 VAC
- Duplex Pump Controller with Alternation Capability
- External Contacts for Remote Button Operation
- On-Board RS-485 Serial Communications
- Modbus® RTU Communication Protocol Standard
- Copy Meter Settings to Other PD8-765 Meters
- Password Protection
- Max/Min Display
- High & Low Alarms with Multiple Reset Actions
- Flanges for Wall or Pipe Mounting
- Explosion-Proof, IP68, NEMA 4X Die-Cast Aluminum Enclosure
- Four 3/4" NPT Threaded Conduit Openings (Two Plugs Installed)
- Pipe Mounting Kits
- Stainless Steel Tag Available
- 3-Year Warranty

PRECISION DIGITAL CORPORATION
233 South Street • Hopkinton MA 01748 USA
Tel (800) 343-1001 • Fax (508) 655-8990
www.predig.com

PRECISION DIGITAL

The Complete ProtEX™ MAX Series

FM APPROVED SP Ex CE IECEx

PD8-154
4-Point Alarm Annunciator

PD8-158
8-Point Alarm Annunciator

PD8-765
Process & Temperature Meter

PD8-6000
Process Meter

PD8-6001
Feet & Inches Level Meter

PD8-6060
Dual-Input Process Meter

PD8-6080
Modbus® Scanner with Dual Analog Input

PD8-6081
Feet & Inches Modbus® Scanner

PD8-6100
Strain Gauge Meter

PD8-6200
Analog Input Flow Rate/Totalizer

PD8-6210
Analog Input Batch Controller

PD8-6262
Analog Dual-Input Flow Rate/Totalizer

PD8-6300
Pulse Input Flow Rate/Totalizer

PD8-6310
Pulse Input Batch Controller

PD8-6363
Pulse Dual-Input Flow Rate/Totalizer

PD8-7000
Temperature Meter

Go to PREDIG.COM for details on the entire ProtEX-MAX Series Meters

Disclaimer

The information contained in this document is subject to change without notice. Precision Digital makes no representations or warranties with respect to the contents hereof and specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. See Warranty Information and Terms & Conditions on www.predig.com for complete details.

⚠ CAUTION

- Read complete instructions prior to installation and operation of the meter.

⚠ WARNINGS

- Risk of electric shock or personal injury.
- This product is not recommended for life support applications or applications where malfunctioning could result in personal injury or property loss. Anyone using this product for such applications does so at his/her own risk. Precision Digital Corporation shall not be held liable for damages resulting from such improper use.
- Failure to follow installation guidelines could result in death or serious injury. Make sure only qualified personnel perform the installation.
- Never remove the meter cover in explosive environments when the circuit is live.
- Cover must be fully engaged to meet explosion-proof/dust-ignition-proof/flame-proof requirements.

⚠ WARNING

Cancer and Reproductive Harm - www.P65Warnings.ca.gov

Limited Warranty

Precision Digital Corporation warrants this product against defects in material or workmanship for the specified period under "Specifications" from the date of shipment from the factory. Precision Digital's liability under this limited warranty shall not exceed the purchase value, repair, or replacement of the defective unit. See Warranty Information and Terms & Conditions on www.predig.com for complete details.

Registered Trademarks

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FREE MeterView Programming Software

Note: PD8-765 meter is not powered from USB connection and requires external power to be programmed.

The PD8-765 is easily setup and programmed without removing the cover by using the four through-glass SafeTouch buttons or by removing the cover and using the front panel push buttons. The meter can also be programmed using a PC and Precision Digital's free MeterView software or "cloned" with the Copy function. Programming the PD8-765 with MeterView software requires removing the front cover and connecting to the electronics module to the PC via the PDA8006 Trident USB serial adapter.

MeterView programming software is intuitive, and most customers can get their meter programmed as they like without even looking in the manual.

Watch MeterView Software Video at
http://www.predig.com/meterview

In addition to programming, the software, with the use of additional devices, may be used for:

- Monitoring
- Datalogging using your PC
- Generating and saving programming files for later use

Once your meter is programmed the way you want it, you can wire it up for your application per the instructions in this manual and install it. If you find that you need to make adjustments to the programming after the meter is installed, you can use the programming buttons and the instructions in this manual to do so.

⚠ WARNING

- The meter should only be connected to a computer while it is located in a safe area.

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Introduction

The ProtEX-MAX PD8-765 explosion-proof, large-display, process and temperature meter offers all the functionality of the PD765 Trident as a fully FM, CSA, ATEX, and IECEx approved explosion-proof product. PD8-765's huge 1.2" (30.5 mm) sunlight readable display is visible from over 30 feet away. This explosion-proof indicator can be field programmed to accept process voltage (0-5 V, 1-5 V, etc.) and current (4-20 mA) inputs, 100 Ohm RTDs, and the four most common thermocouples.

The intensity of the display can be adjusted to compensate for various lighting conditions, including direct sunlight. The meter can be programmed and operated without opening the housing by using the built-in SafeTouch through-glass buttons or the RS-485 serial communication port with free Modbus® protocol. Options for the PD8-765 process and temperature indicator include 2 relays, a 4-20 mA output, and a 24 V transmitter power supply.

SafeTouch Buttons

To make it possible to program and operate the ProtEX-MAX in a hazardous area, the programming buttons that are located behind the glass window can be operated without removing the cover by using the SafeTouch through-glass buttons. The operator puts their finger on the glass over the button and the button is actuated.

To learn more about SafeTouch buttons, see this video:

predig.com/videos/Safetouch_Buttons

Ordering Information

85-265 VAC Models

Model	Options Installed
PD8-765-6X0-10	24 VDC Transmitter Supply
PD8-765-6X3-20	4-20 mA Out Dual 24 VDC Transmitter Supplies
PD8-765-6X5-10	2 Relays 4-20 mA Output 24 VDC Transmitter Supply

12-36 VDC Models

Model	Options Installed
PD8-765-7X0-00	No options
PD8-765-7X5-00	2 relays 4-20 mA output

Accessories

Model	Description
PDA7420	PD8-765 Copy Cable, 7' (2.1 m)
PDA8006*	USB Serial Adapter for Programming Meter with MeterView Software
PDAPLUG75	3/4" Metal Conduit/Stopping Plug
PDA-SSTAG	Custom Stainless Steel Tag (see website for convenient ordering form)
PDA6848	2" U-Bolt Kit Zinc Plated Steel
PDA6848-SS	2" U-Bolt Kit Stainless Steel

*See Free 8006 to receive PDA8006 at no charge.

Notes:

1. 24 VDC transmitter supply available only on AC powered meters.
2. RS-485 Communications is standard on all products

Helpful Videos

There are several videos that will help you get a better understating of the features and functionality of the ProtEX-MAX products. Since the PD8-765 meters have the same general features and functionality of the PD765 Trident meters, appropriate videos for the PD765 Trident meter are also included.

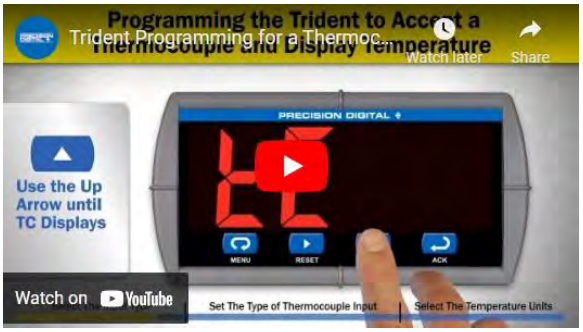
ProtEX-MAX Products Overview

Learn about the complete line of ProtEX-MAX products.

predig.com/videos/ProtEXMAX_Overview

Programming a Thermocouple Input

This video details how to program a thermocouple input on a PD765 Trident Series meter.



predig.com/Program_Trident_Thermocouple

PD765 Trident Display Advantages

The PD765 Trident digital panel meter's 1.2" LED display makes it the ideal choice when upgrading your panels. Watch this video and see real examples of the PD765 Trident improving existing panels with its huge display!

predig.com/videos/Trident_X2_Display_Advantages

PD765 Trident Demonstration

Watch this live demonstration of the PD765 Trident digital panel meter and see how it can improve your process. This video will show you the advantage of the large 1.2" display and simulate a level application.

predig.com/videos/Trident_X2_Live_Demo

MeterView Serial Communications

The PD765 Trident series is one of Precision Digital's most trusted and proven meters ever, and it now has new serial communications capabilities to make it easier to use than ever before. Watch this short video for more information.

predig.com/MV_Serial_Comm_PDA8006

Use ProtEX-MAX for Pump Control

Learn how to use the PD765 Trident (ProtEX-MAX) meter as an explosion-proof pump controller. See how two relays can be used to control two pumps with alternation capability.

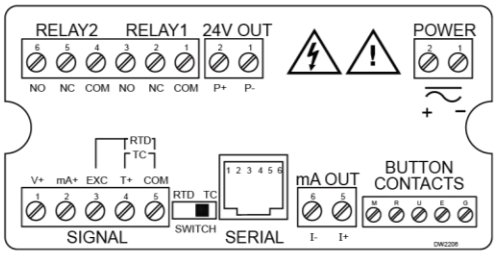
predig.com/videos/Pump_Controller_Key_Features

Key Features

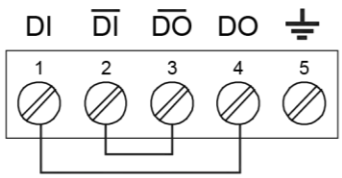
FRONT

CONNECTIONS

PD8-765-6X5-10



Two SPDT relays;
24 V transmitter power (AC powered units only);
TC, RTD, 4-20mA or 0-10 VDC inputs;
4-20 mA output; four external button contacts



The ProtEX-MAX PD8-765 has a 5-position terminal block for connecting RS-485 serial devices.

The Only Explosion-Proof Process & Temperature Meter You Will Ever Need

The PD8-765 ProtEX-MAX is an explosion-proof version of the popular PD765 Trident process and temperature meter. It can satisfy a wide variety of process applications. The PD8-765 can be field programmed to accept process voltage (0-5V, 1-5V, etc.) and current (4-20 mA) inputs, 100 Ohm RTDs, and the four most common thermocouples. It is housed in an IP68 NEMA 4X rated explosion-proof die cast aluminum enclosure and is a fully approved product carrying FM, CSA, ATEX, and IECEx approvals.

There are two power options for the ProtEX-MAX: 85 to 265 VAC or 12-36 VDC and the AC powered versions can provide 24 VDC to power the transmitter if needed. Programming and setup can be performed with the four SafeTouch through-glass buttons, free MeterView software, or using the Copy function.

The relays and isolated 4-20 mA output option increases the utility of the PD8-765. The relays can be used for alarm or control applications. The 4-20 mA output provides an isolated retransmission of the input signal; especially useful for temperature inputs like thermocouples and RTDs. Now you can have an explosion-proof temperature transmitter with a huge, bright display!

The PD8-765 ProtEX-MAX display height is an astounding 1.2" (30.5 mm). It can be read easily from distances of up to 30 feet away! The display intensity function allows the selection of eight levels of intensity for various lighting conditions, including direct sunlight.

Easy Programming Methods

The PD8-765 is easily setup and programmed without removing the cover by using the four through-glass SafeTouch buttons or by removing the cover and using the front panel push buttons. The meter can also be programmed using a PC and Precision Digital's free MeterView software or "cloned" with the Copy function. Programming the PD8-765 with MeterView software requires removing the front cover and connecting to the electronics module to the PC via the PDA8006 Trident USB serial adapter.

MeterView software allows all PD8-765 setup parameters to be programmed from a PC and to save the configuration settings to a file for reporting or programming other meters. For programming purposes, MeterView software connects to the PD8-765 meter via the low-cost PDA8006 USB serial adapter pictured above. We will even send you a PDA8006 USB adapter, normally sold for $43.00, at no cost if you register your meter at http://www.predig.com/free8006 (limit one per customer). You can program the PD8-765 you just bought with the front panel buttons and have the PDA8006 on hand for programming future meters.

Advanced Display Features

Super-Bright Display

The ProtEX-MAX comes standard with a super-bright display, with LEDs that are visible even in direct sunlight. The display also has up to eight levels of adjustable intensity for optimum visibility in any lighting condition.

Four Full Digits

The display on the PD8-765 is four full digits which means it can display numbers up to 9999. Many digital devices have displays of only 3½ digits which means they can display only to 1999. In practical terms, this means the PD8-765 can display type K thermocouples to 2300ºF and 4-20 mA signals up to 9,999.

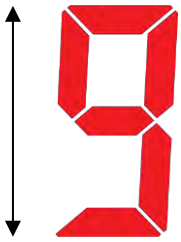
Front Panel LEDs

The meter is supplied with two alarm points that include front panel LEDs to indicate alarm conditions. This standard feature is particularly useful for alarm applications that require visual-only indication.

Large Display Size

The display height on the ProtEX-MAX PD8-765 is an astounding 1.2" (30.5 mm). It can be easily read from distances of up to 30 feet!

ProtEX-MAX PD8-765
Actual Size Digit
1.2"
(30.5 mm)



Meter Copy

The Copy function is used to copy (or clone) all the settings from one PD8-765 meter to other PD8-765 meters in less than 10 seconds. The Copy feature does not require a serial communication adapter, it only requires the optional cable assembly (PDA7420).

Note: The PD8-765 modules must be removed from the enclosures to connect the copy cable.

Display & Toggle Max / Min Reading

The main function of the front panel buttons during operation is to display the maximum and minimum readings reached by the process or temperature inputs. The PD8-765 allows you to toggle between the maximum and minimum readings of the process values. To display the maximum and minimum readings since the last reset/power-up, use the Up arrow/Max button.

Display & Toggle Maximum Value

Display & Toggle Minimum Value

Physical Features

The ProtEX-MAX is designed for ease-of-use in safe and hazardous applications. The ProtEX-MAX is housed in a rugged NEMA 4X explosion-proof enclosure, can operate over a wide temperature range, includes removable screw terminal connectors, has worldwide approvals for use in hazardous areas, and features through-glass buttons for easy meter operation without the need to remove the cover. All of these features are backed by a 3-year warranty.

Super-Bright LED Display

The ProtEX-MAX features a 4-digit display with super-bright LEDs, our brightest ever. These allow the display to be read in any lighting condition, even in direct sunlight.

SafeTouch Through-Glass Buttons

The ProtEX-MAX is equipped with four sensors that operate as through-glass buttons so that it can be programmed and operated without removing the cover (and exposing the electronics) in a hazardous area. These buttons can be disabled for security by selecting the DISABLE setting on the NO-CONTACT BUTTONS switch located on the back of the electronics module, inside the enclosure.

Rugged, Heavy-Duty Enclosure

The ProtEX-MAX is housed in a rugged NEMA 4X, 7, & 9, IP68 die-cast aluminum enclosure, designed to withstand harsh environments in safe and hazardous areas over a wide temperature range.

Wide Viewing Angle

Customers can't always look at the display from straight on, so the window and display module have been optimized to provide a wide viewing angle of approximately ± 40°; nearly twice that of the competition.

Built-In Mounting Flanges

The ProtEX-MAX is equipped with four slotted flanges for wall mounting or NPS 1½" to 2½" or DN 40 to 65 mm pipe mounting.

Flexible Mounting & Wiring

The ProtEX-MAX features four ¾" NPT threaded conduit openings so that wiring can be routed to the most convenient conduit connection(s). Two ¾" NPT metal conduit plugs with 12 mm hex key fitting come installed.

Rotatable Display

The ProtEX-MAX rotatable display, along with four available conduit connections, provide for numerous installation options. The display can be rotated in 90° increments. Rotate it 90° for horizontal mounting.

Vertical Mounting **Horizontal Mounting**

Perfect & Secure Fit Every Time

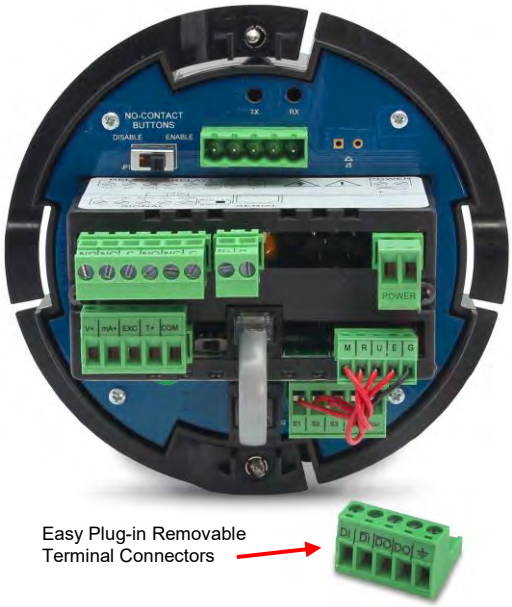
The internal cast rails ensure the ProtEX-MAX assembles together perfectly, quickly and securely; and everything lines up for optimal viewing every time. There are no standoffs to worry about breaking or getting out of alignment. Two spring-loaded, self-retaining, thumbscrews make the assembly a snap, while pressing the display as close to the glass as possible to improve wide angle viewing.

Stainless Steel Tags

PDA-SSTAG is a laser etched stainless steel tag accessory for any of your Precision Digital meters. The tag features custom text for equipment identification, instruction, or whatever else is needed in your facility. Each tag comes with a stainless steel wire and lead seal for easy mounting wherever you need it.

Removable Screw Terminals

Industrial applications require screw terminal connections for easy field wiring and the ProtEX-MAX goes one step further in convenience by also making them removable.



Note: The terminals on the External Contacts connector are wired to the connector on the electronics module to enable the SafeTouch buttons so the meter can be programmed without removing the cover.

Program Meter from USB Port

Hazardous Area Approvals

The ProtEX-MAX's approvals allow it to be used in hazardous areas around the world. These include: FM Approved as Explosion-Proof / Dust-Ignition-Proof / Flame-Proof, CSA Certified as Explosion-Proof / Dust-Ignition-Proof, and ATEX and IECEx Certified as Flame-Proof.

Wide Operating Temperature Range

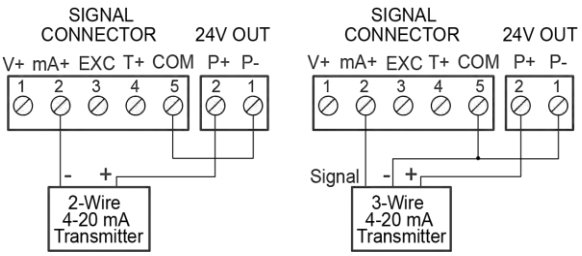
The ProtEX-MAX can operate from -40 to 60°C (-40 to 140°F) meaning it can be installed in a wide variety of indoor and outdoor industrial applications.

Transmitter Power Supplies

Meter Powers Transmitter

One of the most useful features of AC powered PD8-765s is their built-in, isolated, 24 V @ 200 mA power supply to power the transmitter. This feature saves money by eliminating an external power supply and also simplifies wiring.

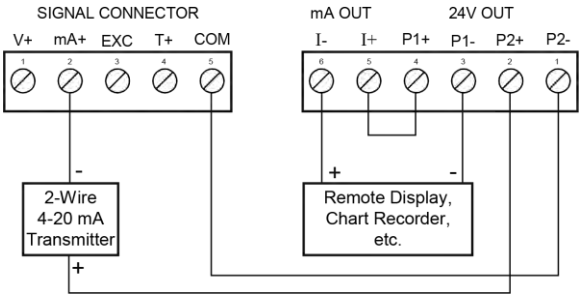
The following diagrams illustrate how to wire an AC powered PD8-765 so it will power the transmitter:



Connections for PD8-765-6X0-10 & PD8-765-6X5-10

Meter Powers 4-20 mA Output

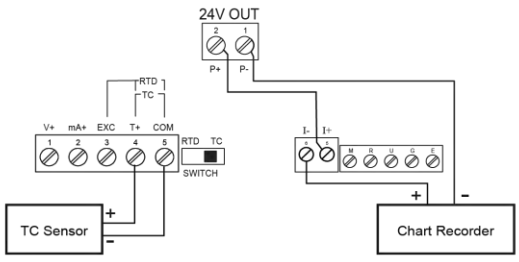
Not only can the AC powered PD8-765 power the 4-20 mA input signal, but an additional power supply of 24 V @ 40 mA is available to power the 4-20 mA output.



Connections for PD8-765-6X3-20

Isolated Transmitter Output

The PD8-765's isolated 4-20 mA output option converts the meter into a transmitter / loop isolator with a digital display; perfect for temperature applications!

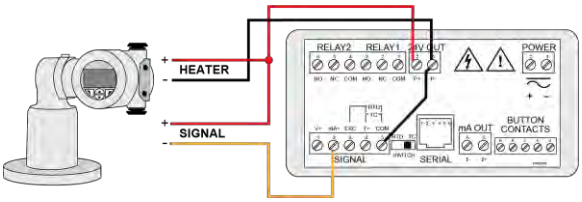


Fuse Prevents Current Overload

Another very useful aspect of the PD8-765 is that the current input is protected against current overload by a resettable fuse. The fuse limits the current to a safe level when it detects a fault condition, and automatically resets itself when the fault condition is removed.

Other Uses for Power Supplies

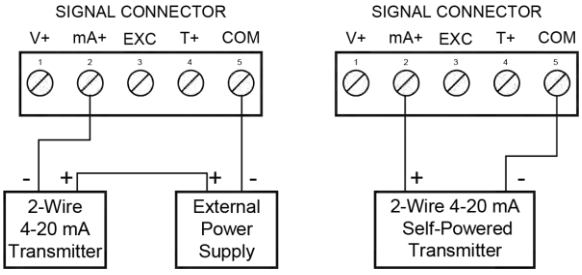
The most common use for these two power supplies is for the 200 mA transmitter power supply to power the field transmitter and 40 mA power supply to power the 4-20 mA output from the meter. However, these two power supplies can be used in other ways. For instance, some level transmitters require the use of a heated lens. The PD8-765's 200 mA power supply could be used to power both the heated lens and the 4-20 mA signal from the transmitter.



PD8-765-6X5-10 Powers Both the Heater and 4-20 mA Input Signal

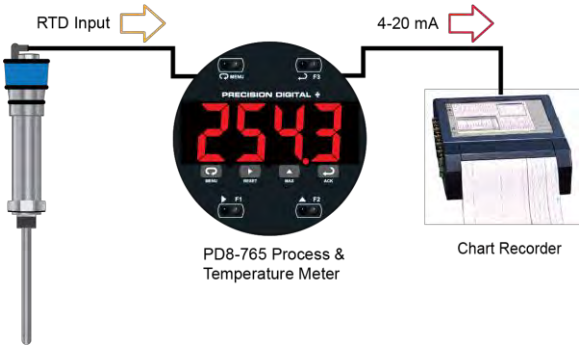
External Power Supply for Loop

For applications that require an external transmitter power supply, the same PD8-765 is used and merely wired in a different fashion as the following diagrams illustrate:



Exp-Proof Temperature Transmitter with Big Display

The PD8-765, with an optional 4-20 mA output, can be used as an isolated temperature transmitter with a big display by converting the thermocouple or RTD input into an isolated 4-20 mA output.

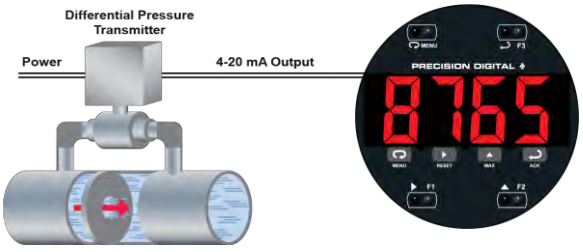


Input Signal Conditioning

To satisfy applications that require scaling in ways other than the usual 2-point linear method, the ProtEX-MAX can also be scaled for square root (DP flow).

Square Root Linearization

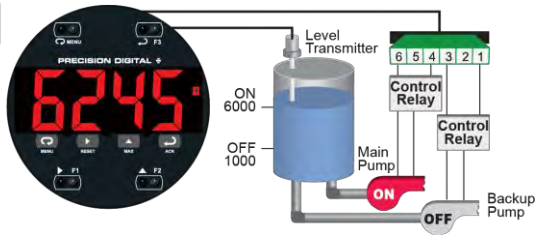
The square root function can be used to linearize the signal from a differential pressure transmitter and display flow rate in engineering units.



Exp-Proof Dual-Pump Alternation

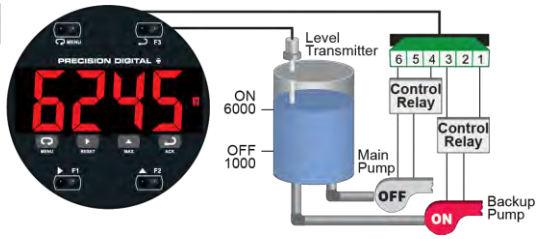
The ProtEX-MAX can be used as an explosion-proof pump controller when combined with a continuous level transmitter. The most common pump control application is shown below: controlling and alternating two pumps. In addition, the ProtEX-MAX provides the 24 V to power the transmitter.

1



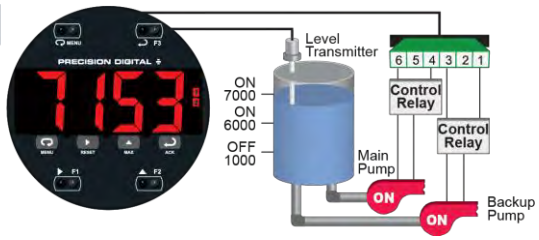
Relay #1 turns the main pump on at 6000 gallons and turns it off at 1000 gallons.

2



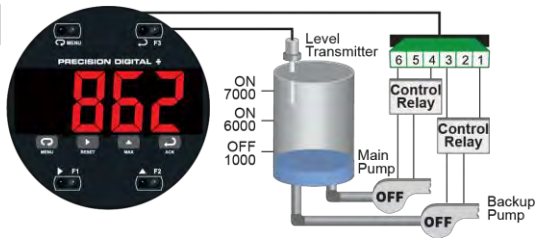
With the Pump Alternation feature activated, the next time the level reaches 6000 gallons, relay #2 starts the backup pump.

3



If the active pump is not able to keep up, and the level reaches 7000 gallons, the other relay will start the inactive pump as well.

4



When the level falls below 1000 gallons, both pumps will turn off.

Learn how to use the PD765 Trident (ProtEX-MAX) meter as an explosion-proof pump controller. See how the four relays can be used to alternate two pumps and provide high and low alarms.

predig.com/videos/PumpControl

Useful Tools

PD9501 Multi-Function Calibrator

This PD9501 Multi-Function Calibrator has a variety of signal measurement and output functions, including voltage, current, thermocouple, and RTD.

PD9502 Low-Cost Signal Generator

The PD9502 is a low-cost, compact, simple to use 4-20 mA or 0-10 VDC signal generator. It can easily be set for 0-20 mA, 4-20 mA, 0-10 V or 2-10 V ranges. Signal adjustment is made with a one-turn knob. A 15-27 VDC wall plug is provided with the instrument. Optional USB power bank is available.

Specifications

Except where noted all specifications apply to operation at +25°C.

General

Display	1.20" (31 mm), red LED, Four digits (-1999 to 9999), automatic lead zero blanking.
Display Intensity	Eight user selectable intensity levels. Default intensity is six.
Display Update Rate	Process/RTD: 3.7-5/second Thermocouple: 1.8-2.5/second
LED Status Indicators	See ***LED Status Indicators*** on page *35* for details.
Overrange	Display flashes 9999
Underrange	Display flashes - 1999
Programming Methods	Four SafeTouch through-glass buttons when cover is installed. Mechanical buttons can be used with the cover removed. Cloning with Copy feature. Free PC-based USB MeterView programming software, and Modbus® registers.
Noise Filter	Programmable from 2 to 199 (0 will disable filter)
Filter Bypass	Programmable from 0.1 to 99.9% of calibrated span
Recalibration	All ranges are calibrated at the factory. Recalibration is recommended at least every 12 months.
Max/Min Display	Max/min readings reached by the process are stored until reset by the user or until power to the meter is turned off.
Password	Restricts modification of programmed settings
Non-Volatile Memory	All programmed settings are stored in non-volatile memory for a minimum of ten years if power is lost.
Power Options	85-265 VAC, 50/60 Hz; 90-265 VDC, 20 W max or 12-36 VDC; 12-24 VAC, 6 W max
Fuse	Required external fuse: UL Recognized, 5 A max, slow blow; up to 6 meters may share one 5 A fuse
Normal Mode Rejection	64 dB at 50/60 Hz
Isolation	4 kV input/output-to-power line 500 V input-to-output or output-to-P+ supply 6X5 models only: 100 V output-to-24 VDC supply
Overvoltage Category	Installation Overvoltage Category II: Local level with smaller transient overvoltages than Installation Overvoltage Category III
Environmental	T6 Class operating temperature range Ta = -40 to 60°C T5 Class operating temperature range Ta = -40 to 65°C Storage temperature range: -40 to 85°C (-40 to 185°F) Relative humidity: 0 to 90% non-condensing
Connections	Power, signal, relays, mA out: Removable screw terminal blocks accept 12 to 22 AWG wire RS-485: Removable screw terminal block accepts 16 to 30 AWG wire
Enclosure	Explosion-proof die cast aluminum with glass window, corrosion resistant epoxy coating, color: blue NEMA 4X, 7, & 9, IP68 Default conduit connections: Four ¾" NPT threaded conduit openings and two ¾" NPT metal conduit plugs with 12 mm hex key fitting installed. Additional conduit opening configurations may be available; verify quantity and sizes on specific device labeling during installation.
Mounting	Wall Mounting: Four (4) mounting holes provided for mounting meter to wall. See *Wall Mounting Instructions* on page *21* for additional details. Pipe Mounting: Optional pipe mounting kit (PDA6848) allows for pipe mounting. Sold separately. See *Pipe Mounting Instructions* on page *22* for additional details.
Tightening Torque	Screw terminal connectors: 5 lb-in (0.56 Nm)
Overall Dimensions	6.42" x 7.97" x 8.47" (W X H X D) (163 mm x 202 mm x 215 mm)
Weight	16.0 lbs (7.26 kg)
Warranty	3 years parts & labor. See Warranty Information and Terms & Conditions on www.predig.com for complete details.

Process Inputs

Inputs	0-20 mA, 4-20 mA, 1-5 V, ±10 V	
Transmitter Supply	Isolated, one or two transmitter supplies P1: 24 VDC ±10% @ 200 mA max (-10 option) P1 & P2: 24 VDC ±10% @ 200 mA & 40 mA max (-20 option)	
Accuracy	±0.05% FS ±1 count; ±0.1% FS ±2 counts for square root	
Function	Linear or square root	
Low-Flow Cutoff	0 to 9999 (0 disables cutoff function) Point below at which display always shows zero	
Decimal Point	Up to 3 decimals	
Calibration	Scale without signal or calibrate with signal source	
Calibration Range	User programmable over entire range of meter	
Input Impedance	Voltage range: greater than 1 MΩ, Current range: 50-100 Ω, varies with resettable fuse impedance	
Input Overload	Protected by automatically resettable fuse	
HART Transparency	The meter does not interfere with existing HART communications; it displays the 4-20 mA primary variable and it allows the HART communications to pass through without interruption. The meter is not affected if a HART communicator is connected to the loop. The meter does not display secondary HART variables.	
Temperature Drift	**0 to 65°C ambient**	**-40 to 0°C ambient**
	Current: ±0.20% FS (50 PPM/°C) **Voltage:** ±0.02% FS (1.7 PPM/°C)	**Current:** ±0.80% FS **Voltage:** ±0.06% FS

Temperature Inputs

Inputs	Factory calibrated, field selectable: type J, K, T, or E thermocouples and 100 Ω platinum RTD (0.00385 or 0.00392 curve)
Resolution	1°; type T TC & RTD: 1° or 0.1°
Cold Junction Reference	Automatic
Temperature Drift	±2°C maximum
Offset Adjustment	Programmable to ±19.9°. This parameter allows the user to apply an offset value to the temperature being displayed.
Input Impedance	Greater than 100 kΩ

Accuracy

Input Type	Range	Accuracy (0 - 65 C)	Accuracy (-40 - 0 C)	Resolution
J	-58 to 1382°F -50 to 750°C	±2°F ±1°C	±5°F ±3°C	1°
K	-58 to 2300°F -50 to 1260°C	±2°F ±1°C	±4°F ±2°C	1°
T	-292 to 700°F -180 to 371°C	±2°F ±1°C	±13°F ±7°C	1° or 0.1°
E	-58 to 1700ºF -50 to 927ºC	±2°F ±1°C	±11°F ±6°C	1°
RTD	-328 to 1382°F -200 to 750°C	±1°F ±1°C	±5°F ±3°C	1° or 0.1°

Relays Option

Rating	2 Form C (SPDT); rated 3 A @ 30 VDC or 3 A @ 250 VAC resistive load; 1/14 HP (≈ 50 watts) @ 125/250 VAC for inductive loads such as contactors, solenoids, etc.
Deadband	0-100% FS, user selectable
Electrical Noise Suppression	A snubber should be connected to each relay contact switching inductive loads to prevent disruption to the microprocessor's operation. Recommended snubber value: 0.01 µF/470 Ω, 250 VAC (PDX6901).
High or Low Alarm	User may program any alarm for high or low
Relay Operation	• Automatic (non-latching) and/or manual reset • Latching (requires manual acknowledge) with/without clear • Pump alternation control • Off (disable unused relays)
Relay Reset	Front panel button, terminal at back of meter or through serial communications
Time Delay	0 to 199 seconds, on and off delays; programmable
Sensor Break Relay Operation	The sensor break relay condition may be programmed for each relay as On (alarm) or Off (non-alarm). The relays will enter these states when a sensor break is detected for RTD or thermocouple inputs. These settings have no effect when current or voltage inputs are selected.
Fail-Safe Operation	Programmable, independent for each relay. Relay coils are energized in non-alarm condition. In case of power failure, relays will go to alarm state.
Auto Initialization	When power is applied to the meter, relays will reflect the state of the input to the meter.

External Button Contacts

Number	Four
Function	Remote operation of front-panel buttons: programming, reset relays or view/reset max/min readings
Open State	+5 VDC open contact on button input terminals
Closed State	Closed contact button input terminal to common/ground, active low 0 to 0.4 VDC

Isolated 4-20 mA Transmitter Output Option

Scaling Range	1.00 to 23.00 mA; reverse scaling allowed		
Calibration	Factory calibrated for 4-20 mA		
Accuracy	±0.1% FS ±0.004 mA		
Temperature Drift	50 PPM/°C ***Note:*** *Analog output drift is separate from input drift.*		
Isolation	500 V input-to-output or output-to-24 VDC supplies 4 kV output-to-power line For -6X5 models only: 100 V output-to-24 VDC supply		
External Power	35 VDC maximum		
Output Loop Resistance	Power supply	Minimum	Maximum
	24 VDC	10 Ω	700 Ω
	35 VDC (external)	100 Ω	1200 Ω

RS-485 Serial Communications

Compatibility	EIA-485
Connectors	Removable screw terminal connector
Max Distance	3,937' (1,200 m) max
Status Indication	Separate LEDs for Transmit (TX) and Receive (RX)

Modbus® RTU Serial Communications

Slave Id	1 – 247 (Meter address)
Baud Rate	300 – 19,200 bps
Transmit Time Delay	Programmable between 0 and 199 ms
Data	8 bit (1 start bit, 1 stop bit)
Parity	None (1 or 2 stop bits), even, or odd (Modbus® only; PDC protocol does not use parity)
Byte-To-Byte Timeout	0.01 – 2.54 second
Turn Around Delay	Less than 2 ms (fixed)

Note: *Refer to the ProtEX-MAX Modbus® Register Tables located at www.predig.com for details.*

Compliance Information

Electromagnetic Compatibility

Emissions	EN 55011 Group 1 Class A ISM emissions requirements
Radiated Emissions	Class A
AC Mains Conducted Emissions	Class A
Immunity	EN 61326-1 Measurement, control, and laboratory equipment EN 61000-6-2 EMC heavy industrial generic immunity standard
RFI - Amplitude Modulated	80 -1000 MHz 10 V/m 80% AM (1 kHz) 1.4 - 2.0 GHz 3 V/m 80% AM (1 kHz) 2.0 - 2.7 GHz 1 V/m 80% AM (1 kHz)
Electrical Fast Transients	±2kV AC mains, ±1kV other
Electrostatic Discharge	±4kV contact, ±8kV air
RFI - Conducted	10V, 0.15-80 MHz, 1kHz 80% AM
AC Surge	±2kV Common, ±1kV Differential
Surge	1KV (CM)
Power-Frequency Magnetic Field	30 A/m 70%V for 0.5 period
Voltage Dips	40%V for 5 & 50 periods 70%V for 25 periods
Voltage Interruptions	<5%V for 250 periods

Product Ratings and Approvals

FM	Enclosure: Type 4X; IP66 Class I, Division 1, Groups B, C, D Class II, Division 1, Groups E, F, G Class III, Division 1, T5/T6 Class I, Zone 1, AEx d, IIC Gb T5/T6 Zone 21, AEx tb IIIC T90°C; Ta -40°C to +65°C T6 Ta = -40°C to +60°C; T5 Ta = -40°C to +65°C Certificate Number: 3047283
CSA	Class I, Division 1, Groups B, C, D Class II, Division 1, Groups E, F, G Class III, Division 1 Class I Zone 1 Ex d IIC Zone 21 Ex tb IIIC T90°C -40°C < Tamb. < +60° C; Temperature Code T6 -40°C < Tamb. < +65° C; Temperature Code T5 Enclosure Type 4X & IP66 Certificate Number: 2531731
ATEX	II 2 G D Ex d IIC T* Gb Ex tb IIIC T90°C Db IP68 Ta = -40°C to +*°C *T6 = -40°C to +60°C *T5 = -40°C to +65°C Certificate number: Sira 12ATEX1182
IECEx	Ex d IIC T* Gb Ex tb IIIC T90°C Db IP68 Ta = -40°C to +*°C *T6 = -40°C to +60°C *T5 = -40°C to +65°C Certificate Number: IECEx SIR 12.0073

Special Conditions for Safe Use:
Use suitably certified and dimensioned cable entry device and/or plug. The equipment shall be installed such that the supply cable is protected from mechanical damage. The cable shall not be subjected to tension or torque. If the cable is to be terminated within an explosive atmosphere, then appropriate protection of the free end of the cable shall be provided. Cable must be suitable for 90°C.

Year of Construction
This information is contained within the serial number with the first four digits representing the year and month in the YYMM format.

For European Community: The ProtEX-MAX must be installed in accordance with the ATEX directive 94/9/EC, and the product certificate Sira 12ATEX1182.

EU Declaration of Conformity

EU Declaration of Conformity is available in the Documentation CD provided with the product under the **EU DoC** menu.

Safety Information

⚠ CAUTION

- Read complete instructions prior to installation and operation of the meter.

⚠ WARNINGS

- Risk of electric shock or personal injury.
- Hazardous voltages exist within enclosure. Installation and service should be performed only by trained service personnel.

Installation

Install in accordance with applicable local and national regulations (e.g. NEC).

For Installation in USA
The ProtEX-MAX must be installed in accordance with the National Electrical Code (NEC) NFPA 70.

For Installation in Canada
The ProtEX-MAX must be installed in accordance with the Canadian Electrical Code CSA 22.1. All power supplies below 36 V and input circuits must be derived from a CSA Approved Class 2 source.

For European Community
The ProtEX-MAX must be installed in accordance with the ATEX directive 94/9/EC and the product certificate Sira 12ATEX1182.

⚠ WARNINGS

- Disconnect from supply before opening enclosure.
- Keep cover tight while circuits are live.
- Conduit seals must be installed within 18" (450mm) of the enclosure or within 2" (50mm) for Zone installations.

Wiring connectors are accessed by opening the enclosure. To access electrical connectors, remove the 2 captive screws and then remove the electronics module. Connectors are on the rear of the electronics module.

Unpacking

Remove the meter from box. Inspect the packaging and contents for damage. Report damages, if any, to the carrier.

If any part is missing or the meter malfunctions, please contact your supplier or the factory for assistance.

Pre-Installed Conduit Plugs

The ProtEX-MAX is supplied with two pre-installed conduit plugs for installations that do not require the use of all four conduit entries. The conduit/stopping plugs include an internal hexagonal socket recess for removal. The conduit plugs and their factory installation are included in all hazardous area approvals of this product.

⚠ WARNING

- In hazardous areas, conduit and conduit/stopping plugs require the application of non-setting (solvent free) thread sealant. It is critical that all relevant hazardous area guidelines be followed for the installation or replacement of conduit or plugs.

Cover Jam Screw

The cover jam screw should be properly installed once the meter has been wired and tested in a safe environment. The cover jam screw is intended to prevent the removal of the meter cover in a hazardous environment without the use of tools. Using a M2 hex wrench, turn the screw clockwise until the screw contacts the meter. Turn the screw an additional 1/4 to 1/2 turn to secure the cover.

⚠ CAUTION

- Excess torque may damage the threads and/or wrench.

Mounting

The ProtEX-MAX has four slotted mounting flanges that may be used for pipe mounting or wall mounting. Refer to *Figure 1* and *Figure 2* below.

⚠ WARNING

- Do not attempt to loosen or remove flange bolts while the meter is in service.

Mounting Dimensions

All units: inches (mm)

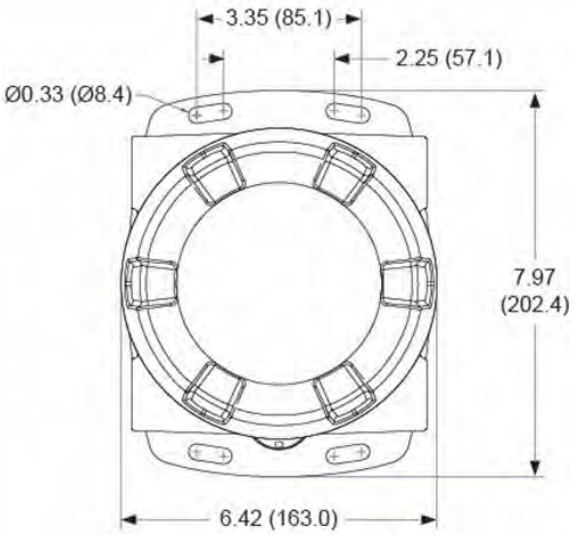


Figure 1. Enclosure Dimensions – Front View

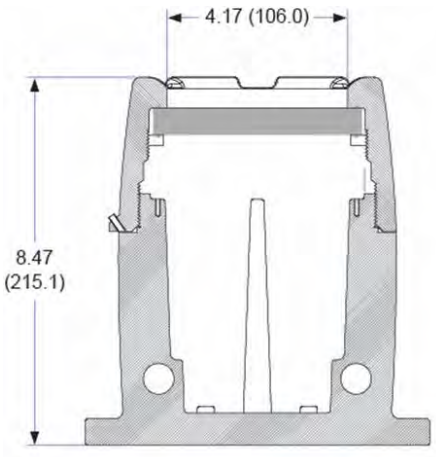


Figure 2. Enclosure Dimensions – Side Cross Section View

ENCLOSURE CAD DIMENSIONAL DRAWINGS
Download free 3-D CAD files of these instruments to simplify your drawings!
predig.com/documentation-cad

Wall Mounting Instructions

The meter can be mounted to any wall or flat surface using the four provided mounting holes located in the cast-in flanges. In addition, the internal electronic assembly can be rotated to allow the enclosure to be mounted in any position. To mount the meter to a wall, follow these instructions:

- Prepare a section of wall approximately 7" x 8.5" (178 mm x 216 mm) for meter mounting by marking with a pencil the mounting holes (shown in *Figure 1*) on the wall.
- Select the appropriate mounting screws for the mounting surface to be used. The mounting holes diameter is shown on *Figure 1*.
  Note: *Mounting screws are not included.*
- Using a drill bit slightly smaller than the girth of the mounting screws, pre-drill holes at the mounting locations previously marked.
- Insert mounting screws into the four mounting holes and screw them into the pre-drilled holes.

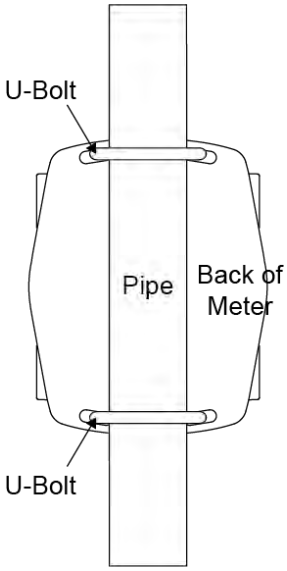
Pipe Mounting Instructions

The meter can also be mounted to a pipe using an optional U-Bolt kit. This kit includes two U-bolts, the necessary hardware, and is available in zinc plated steel (PDA6848) and 316 stainless steel (PDA6848-SS).

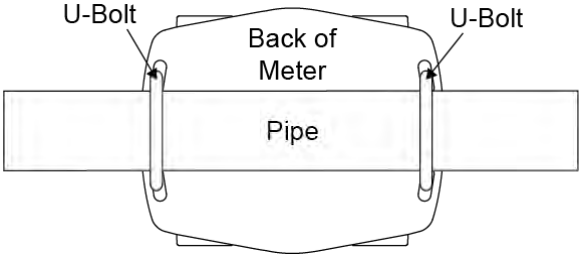
To mount the meter using a U-Bolt kit, follow these instructions:

- Orient the groove on the back of the instrument with the pipe and secure it to the pipe with the two U-bolts and hardware provided.

Vertical Pipe Mounting



Horizontal Pipe Mounting



MeterView Software

The easiest and quickest way to program your PD8-765 is to use the FREE MeterView software. We will even send you a PDA8006 USB adapter, normally sold for $43.00, at no cost if you register your meter at http://www.predig.com/free8006 (limit one per customer). You can program the PD8-765 you just bought with the front panel buttons and have the PDA8006 on hand for programming future meters.

Remote Programming

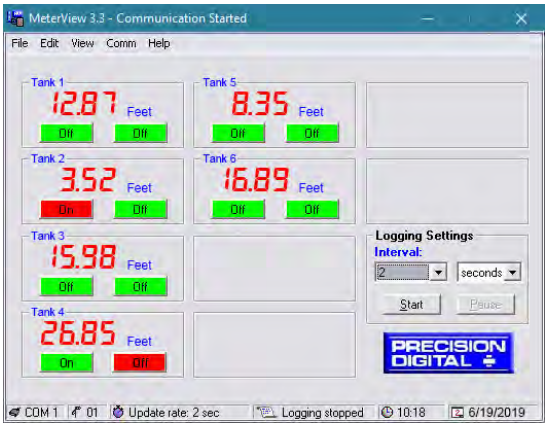
MeterView software allows all setup parameters to be programmed remotely from a PC and saved to a file for reporting or programming other meters.

Data Acquisition

MeterView software provides a convenient way to collect the data generated by the PD8-765 serial output. The user can select the logging time interval. Data can be written to a file, which can then be imported into a spreadsheet or other application.

Monitoring

MeterView software can be used to monitor up to 100 PD8-765s on a PC. The user can set a custom meter identification, such as Tank 1 to display on the screen as well as engineering units, such as feet. The screen shot below shows MeterView software monitoring level in six storage tanks:



Monitoring System Parts

The following table illustrates the parts needed to monitor 10 PD8-765s:

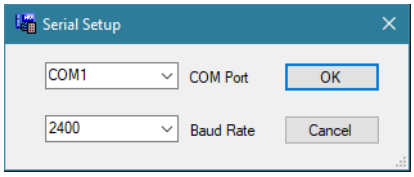
Quantity	Model	Description
10	PDA7422	Trident RS-485 Serial Adapter
1	PDA8485-I	USB to RS-485 Isolated Converter

MeterView Installation

1. Go to www.predig.com/meterview
2. Read instructions & copy serial # of desired MeterView version
3. Download Installation file to computer
4. Double-click installation file to open it
5. Double-click **Setup.exe** to begin installation
6. Follow on-screen instructions

Running MeterView the First Time

The first time MeterView is run it is necessary to set up the serial communication settings of the program. Select the communication port and the baud rate of the meter(s) connected.



Note: *The selected baud rate in MeterView and the meter(s) baud rate must be the same. Otherwise a communication error will occur.*

WARNINGS

- Only one meter may be connected at a time. Attaching multiple meters will cause a conflict with the meter software.
- The meter should only be connected to a computer while it is located in a safe area.
- DO NOT unplug the meter while the new installation files are being written to it. The meter will display ـدر ـEE during the process and you will receive an on-screen notification once the process is complete.

Enable Meter and Select Meter Address

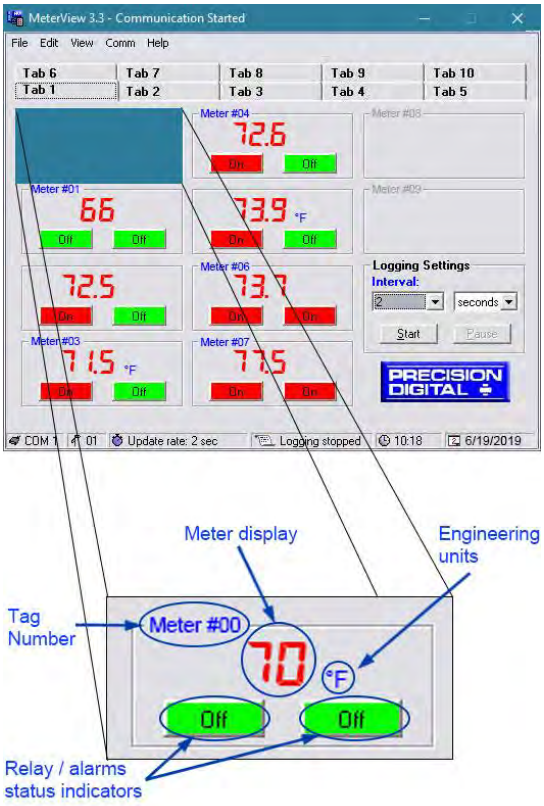
The actual meter address is set up at the meter using the front panel buttons. The location where a meter is displayed is selected on MeterView Main window.

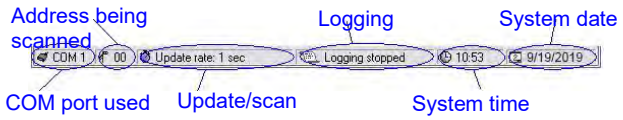
To enable or select a meter with a different serial address:

1. Right-click on the screen location of meter.
2. Click on **Enabled**, if meter is not yet enabled.
3. Click on **Change Address**.
4. Select meter address to display in this location.

MeterView Main Window

The main MeterView window shows the present reading(s), relays/alarm status, tag number(s) and selected engineering units, along with other information for each meter. The graphic below indicates the different parts of the main MeterView window.





Main Window Menus

The MeterView main window contains the following menus:

- File menu
- Edit menu
- View menu
- Comm Menu
- Help Menu

File Menu

The following options are available from this menu:

1. **Exit** to close the MeterView program.

Edit Menu

The following options are available from this menu:

1. **Serial Settings** to edit the serial communication settings.
2. **Number of Meters** to automatically populate the Main Window with a single meter, 10 meters, or 100 meters.

View Menu

The following options are available from this menu:

1. **Event Log** to view the MeterView event log window where all internal program events and errors are logged.
2. **Show Relay Alerts** select whether or not MeterView should alert the user of a change in the relay status (ON → OFF or vice versa) with a pop-up message.

Comm Menu

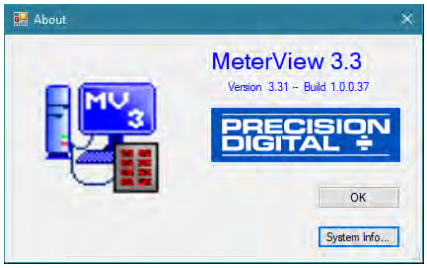
The following options are available from this menu:

1. **Stop** to halt the automatic meter scanning. This allows quicker access to menu items, functions, and windows.
2. **Start** to resume the automatic meter scanning.

Help Menu

The following options are available from this menu:

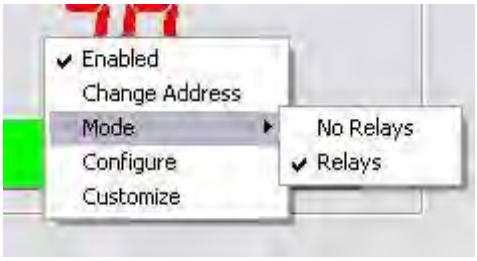
1. **Online Resources** links to Predig.com for help and product documentation.
2. **About Meterview 3.3** for version number and build information.



Right Click Menu

By right clicking on a meter on the screen a menu will appear with the following options:

Menu Item	Function/Submenus
Enabled	Enable or disable a meter on the screen
Change Address	Change a meter's serial address in MeterView
Mode	Show relays
Configure	Access the configuration window for a meter
Customize	Customize how a meter looks on the screen



Notes:

- *Accessing menus or other windows could disrupt communication with the meter(s).*
- *Use left mouse button or tab key on the keyboard to navigate within a window.*
- *Parameters not available within a window appear grayed-out.*
- *An arrow next to a box indicates a drop-down menu. Click on arrow to display the drop-down menu.*

Configuration Window

Click on **Configure** in the right click menu to open a meter's configuration window. The following settings can be programmed from this window:

1. Input type (4-20 mA, 0-10 V, RTD, or TC).
2. Decimal point for process inputs (dd.dd).
3. Units (F or C) and sensor type for temperature inputs.
4. Values for scaling process inputs, values for scaling analog output, Password, Adjust (temperature only), Filter, Bypass, Cutoff (process inputs only), Transmit Delay, Function type, and Cut-off.
5. Relay settings.
6. After the last change has been made, click the **Write to Meter** button or press Enter on the keyboard to send the new settings to the meter, or click on **Exit** to abandon changes. Before sending the new settings, MeterView will ask to confirm that the meter's current settings should be overwritten. Click **Yes** to overwrite the settings, or **No** to abort the operation and return to the configuration window.

The configuration window contains the following menus:

- File menu
- Tools menu
- Password menu

Note: *Accessing menus or other windows could disrupt communication with the other meter(s).*

File Menu

The following options are available from the File menu:

1. **Save Configuration** to save the present settings to a file.
2. **Load Configuration** to load settings from a file.
3. **Export to HTML** to save the present settings to a HTML file.
4. **Import from HTML** to load settings from a HTML file.
5. **Print Configuration**

Tools Menu

The following options are available from the Tools menu:

1. **Load Defaults** to load the factory default settings.

It is recommended to save a configuration file before changing any setting and before any calibration operation.

Password Menu

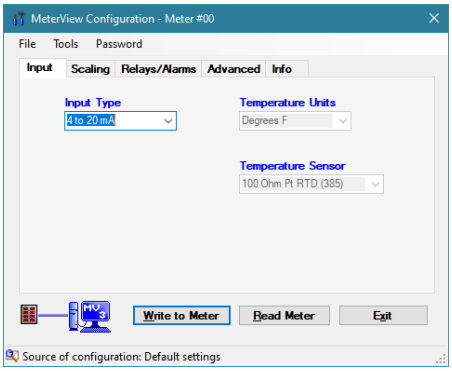
The following options are available from the Password menu:

1. **Lock Meter** to lock the meter and prevent unauthorized changes.
2. **Unlock Meter** to unlock the meter and allow changes to be made.
3. **Change Password** to change the unlock password of the meter.

The password must be a four-digit number; "0000" is the unlocked password setting.

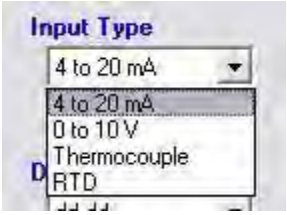
Input Tab

In the configuration window, click on the **Input** tab to view the input options.



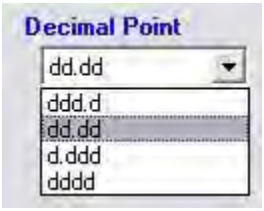
Set Up Input Type

Click on the arrow next to the *4 to 20 mA* box and then click on the desired input type.



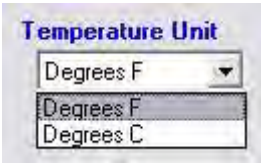
Set Up Decimal Point

Click on the arrow next to the *dd.dd* box and then click on the desired decimal point position. Decimal point selection is available for 4-20 mA and 0-10 V inputs only. The display scale and relay set/reset points are adjusted according to the decimal point selection.



Set Up Temperature Unit

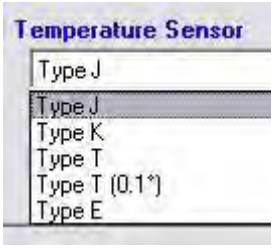
Click on the arrow next to the *Degrees F* box and then click on the desired temperature unit. Temperature unit selection is available for Thermocouple and RTD inputs only.



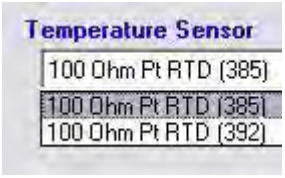
Set Up Temperature Sensor

Click on the arrow next to the *Type J* box and then click on the desired temperature sensor. Temperature sensor selection is available for Thermocouple and RTD inputs only.

Thermocouple Sensors

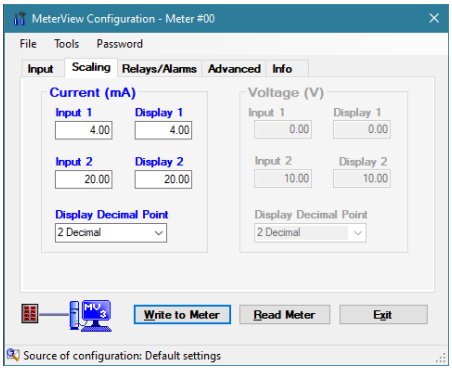


RTD Sensors



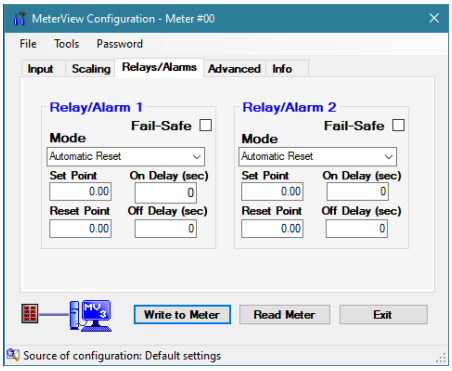
Scaling Tab

In the configuration window, click on the **Scaling** tab to view the scaling settings for process inputs (current and voltage).



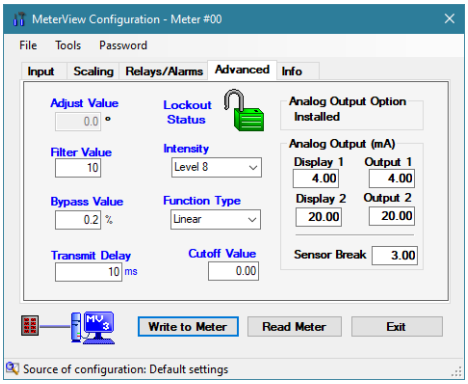
Relays/Alarms Tab

In the configuration window, click on the **Relays/Alarms** tab to view the settings for the relays/alarms.



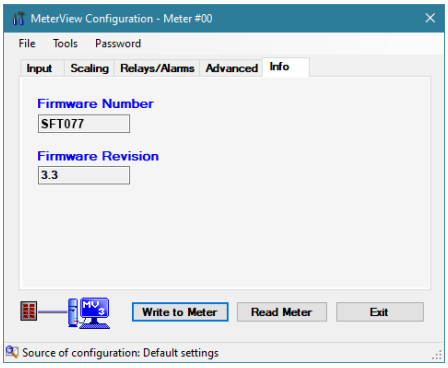
Advanced Tab

In the configuration window, click on the **Advanced** tab to view the advanced settings. Consult the meter manual for further details.



Info Tab

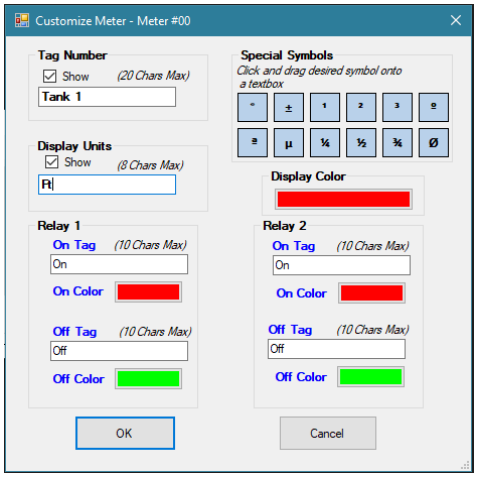
In the configuration window, click on the **info** tab to view the firmware number and version.



Customize Window

Click on **Customize** in the right click menu to open a meter's customize window. The following settings can be programmed from this window:

1. **Tag Number** to identify a meter and optionally display it on the meter. Pre-selected special characters may be used in this field by simply dragging the desired symbol into it.
2. **Display Units** to identify the engineering units of the value being read and optionally display it on the meter. Pre-selected special characters may be used in this field by simply dragging the desired symbol into it.
3. **Display Color** to change the color of the meter display on the screen.
4. **Relay Tag** to change the text label of the Relay Status indicator(s).
5. **Relay Color** to change the color of the Relay Status indicator(s).



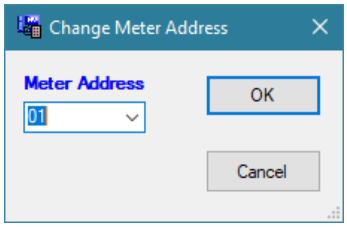
Note: *These settings are **NOT** saved to the meter.*

Serial Communication Setup

Addresses for PD8-765 and MeterView are set to 00 at the factory.

1. From the main window, click on **Edit** → **Serial Settings** menu to access the Serial Communication Setup.
2. Select correct communication port used for Serial Adapter.
3. If timeout error is received, try another serial port selection or check meter's address.

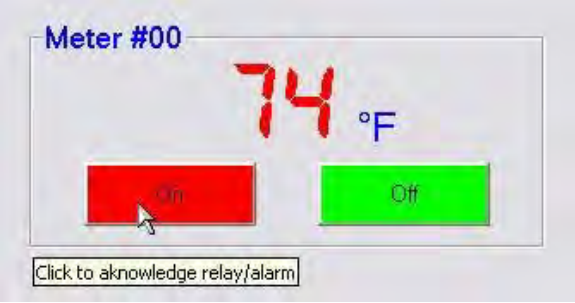
To change the serial address of a meter, simply click on **Change Address** in the right-click menu. This setting is on a per-meter basis.



Note: *Baud rate is set up for 2400 bps at the factory.*

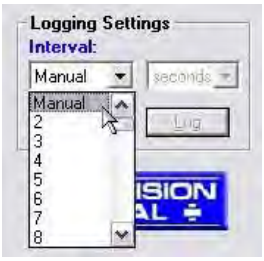
Relays/Alarms Status

Each meter enabled in the main MeterView window can display the current status of its relays/alarms (if the meter **Mode** in the right-click menu is set to **Relays**) and can allow the user to remotely acknowledge the relays/alarms (if applicable). The text labels and colors for the status indicators may be customized through the **Customize** window.



Logging Meter Data to File

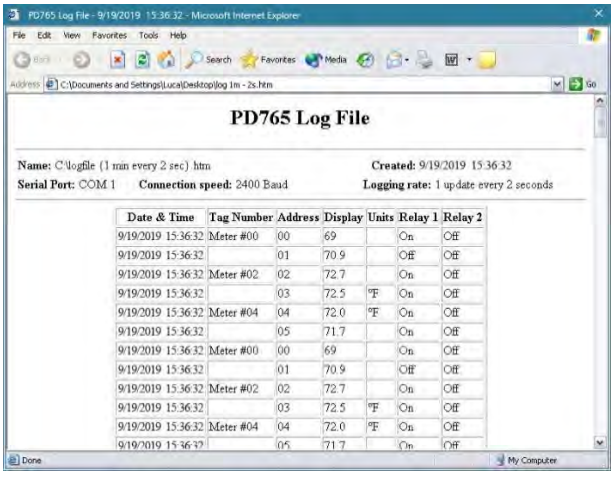
1. Click on the arrow next to the Interval box to select an interval from 2 to 60 or select manual to log the data only when the **Log** button is clicked (**Log** button is only visible when manual is selected).
2. Select seconds, minutes, or hours.
3. Click the **Start** button.
4. Select file location and enter a file name. Click **OK**. MeterView will begin logging data to the file.



Logging may be paused or stopped at any time. MeterView will indicate logging and paused status with corresponding message flashing in the main window status bar. When logging, all other MeterView functions and windows are not accessible.

Log File Sample

The HTML log file format contains pertinent information related to the meter and logging selections. Each log entry includes date and time, tag number, serial address, display value, units and relays/alarms status.



PD765 Log File

Name: C:\logfile (1 min every 2 sec).htm Created: 9/19/2019 15:36:32
Serial Port: COM 1 Connection speed: 2400 Baud Logging rate: 1 update every 2 seconds

Date & Time	Tag Number	Address	Display	Units	Relay 1	Relay 2
9/19/2019 15:36:32	Meter #00	00	69		On	Off
9/19/2019 15:36:32		01	70.9		Off	Off
9/19/2019 15:36:32	Meter #02	02	72.7		On	Off
9/19/2019 15:36:32		03	72.5	°F	On	Off
9/19/2019 15:36:32	Meter #04	04	72.0	°F	On	Off
9/19/2019 15:36:32		05	71.7		On	Off
9/19/2019 15:36:32	Meter #00	00	69		On	Off
9/19/2019 15:36:32		01	70.9		Off	Off
9/19/2019 15:36:32	Meter #02	02	72.7		On	Off
9/19/2019 15:36:32		03	72.5	°F	On	Off
9/19/2019 15:36:32	Meter #04	04	72.0	°F	On	Off
9/19/2019 15:36:32		05	71.7		On	Off

Connections

All connections are made to removable screw terminal connectors located at the rear of the meter.

⚠ CAUTION

- Use copper wire with 60°C or 60/75°C insulation for all line voltage connections. Observe all safety regulations. Electrical wiring should be performed in accordance with all applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety.

⚠ WARNINGS

- Observe all safety regulations. Electrical wiring should be performed in accordance with all agency requirements and applicable national, state, and local codes to prevent damage to the meter and ensure personnel safety.
- Static electricity can damage sensitive components.
- Observe safe handling precautions for static-sensitive components.
- Use proper grounding procedures/codes.
- If the instrument is installed in a high voltage environment and a fault or installation error occurs, high voltage may be present on any lead or terminal.
- Follow all fusing and wiring precautions requirements for the instrument integrated to the PD8 Series model number being connected.

To access the connectors, remove the enclosure cover and unscrew the two captive screws that fasten the electronics module. Signal connections are made to de-pluggable connectors on the back of the electronics module.

Some connectors may be provided already connected. These connections are required for proper operation of the ProtEX-MAX and should not be removed unless instructed to by this manual.

Wires marked as being used for testing purposes should be removed.

Grounding connections are made to the two ground screws provided on the base – one internal and one external.

After all connections have been completed and verified, apply power to the unit.

Required & Factory Wired Connection

The ProtEX-MAX comes with a pre-wired connection. This connection is detailed below and must be maintained in order for the instrument to function properly.

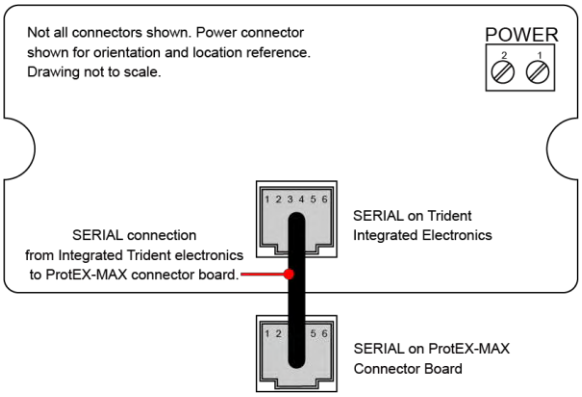


Figure 3: Integrated PD765 Trident Required Connections

PD765 Trident Electronics Module Layout for PD8-765-6X5-10*

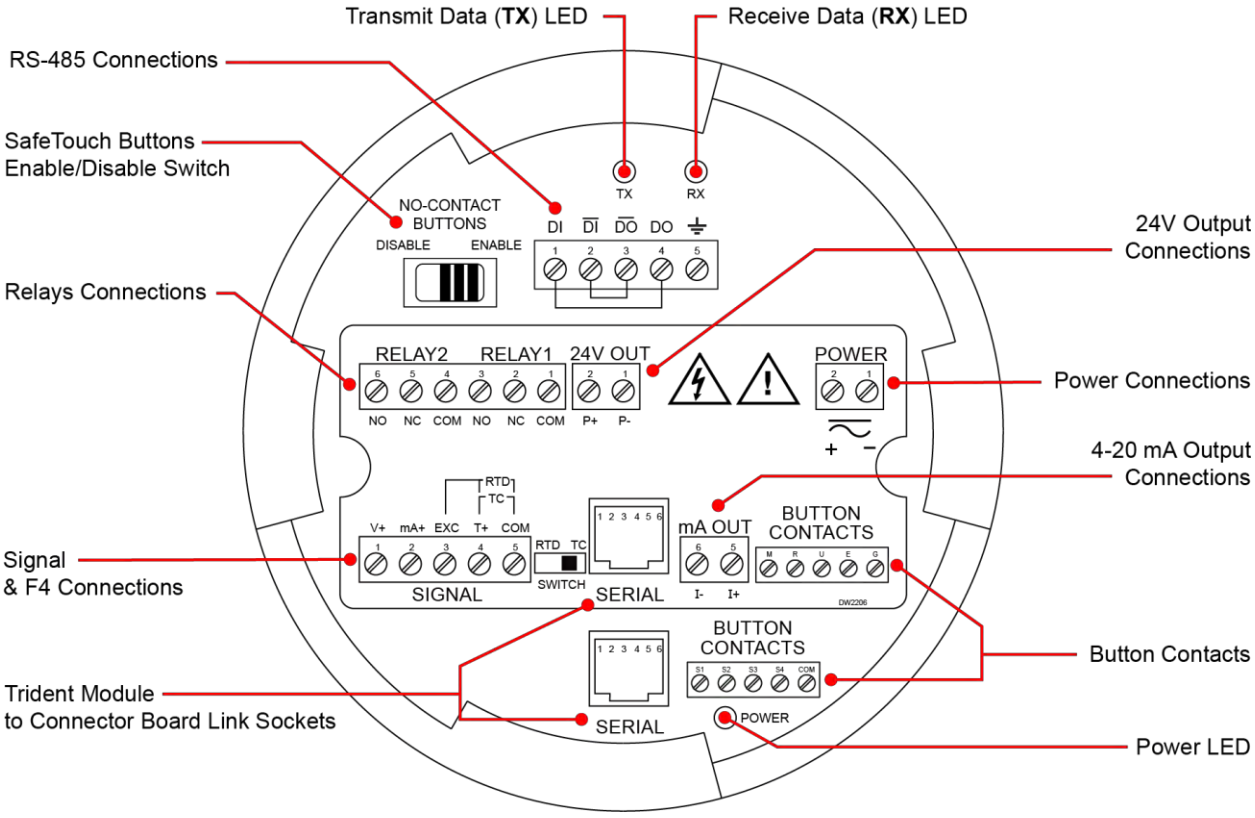


Figure 4. PD765 Trident Electronics Module Layout

Connector Labeling

The connectors label, affixed to the meter, shows the location of all connectors available with requested configuration. It also identifies the location of the RTD/TC selector switch. The images below (and one above) show all connector configurations for the PD8-765. Note that the connector in the upper left of the diagram has different configurations based on the model.

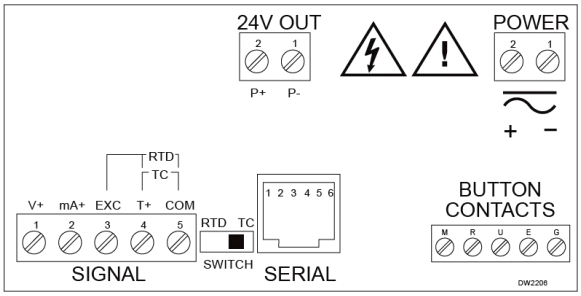


Figure 5. Connector Labeling for PD8-765-6X0-10

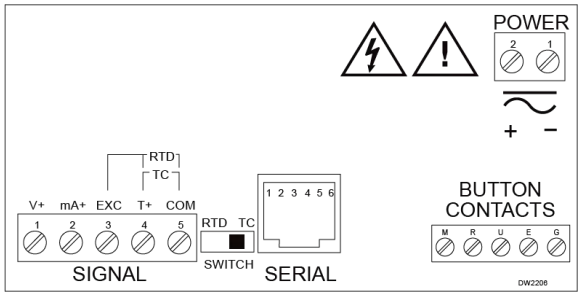


Figure 7. Connector Labeling for PD8-765-7X0-00

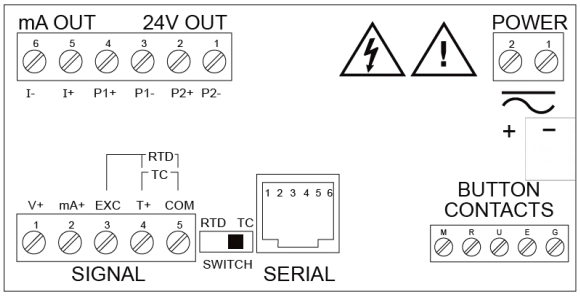


Figure 6. Connector Labeling for PD8-765-6X3-20

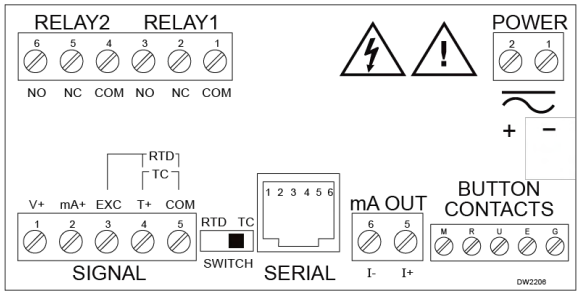


Figure 8. Connector Labeling for PD8-765-7X5-00

Power Connections

Power connections are made to a two-terminal connector labeled POWER on Figures 4-8. See *Connector Labeling* on page *30*. The meter operates regardless of DC polarity. The + and - symbols are only a suggested wiring convention.

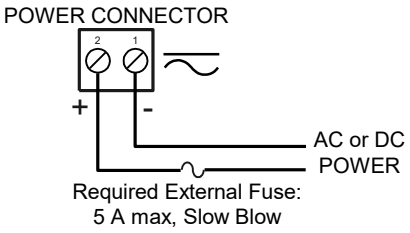


Figure 9. Power Connections

Signal Connections

Signal connections are made to a five-terminal connector labeled SIGNAL shown in Figures 4-8. See *Connector Labeling* on page *30*. The COM (common) terminal is the return for all types of inputs.

Current and Voltage Connections

The following figures show examples for current and voltage connections.
There are no switches or jumpers to set up for current and voltage inputs. Setup and programming is performed through the front panel buttons.

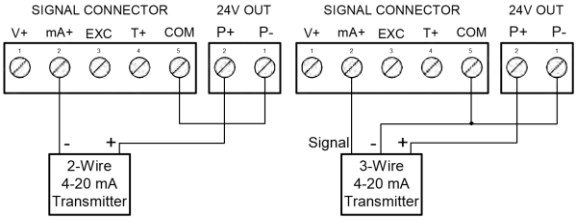


Figure 10. Transmitter Powered by Internal Supply (PD8-765-6X-10 and PD8-765-6X5-10)

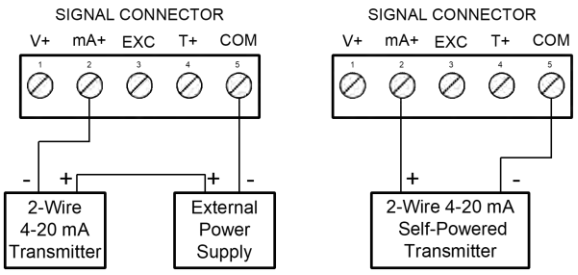


Figure 11. Transmitter Powered by External Supply or Self-Powered

The current input is protected against current overload by a resettable fuse. The display may or may not show a fault condition depending on the nature of the overload.
The fuse limits the current to a safe level when it detects a fault condition, and automatically resets itself when the fault condition is removed.

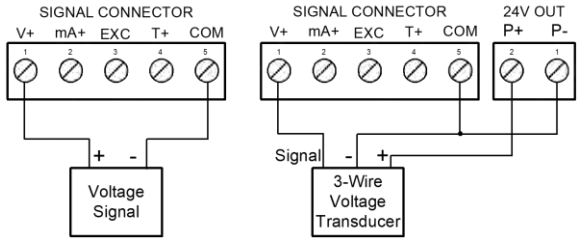


Figure 12. Voltage Input Connections

The meter is capable of accepting any voltage from -10 VDC to +10 VDC.

Thermocouple and RTD Connections

The following figures show examples for thermocouple and RTD connections.
The RTD/TC selector switch must be set to the proper position for the meter to accept the selected temperature input.
The input type is selected using the *Setup* menu.
The selected thermocouple input must correspond to the thermocouple sensor and wire type used.

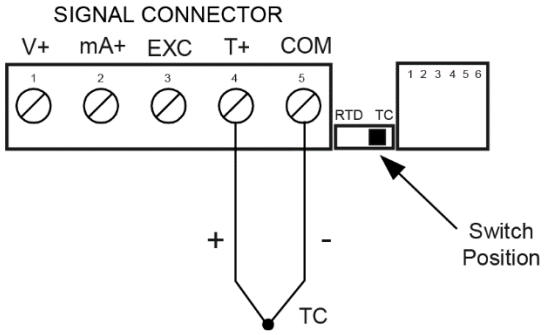


Figure 13. Thermocouple Input Connections

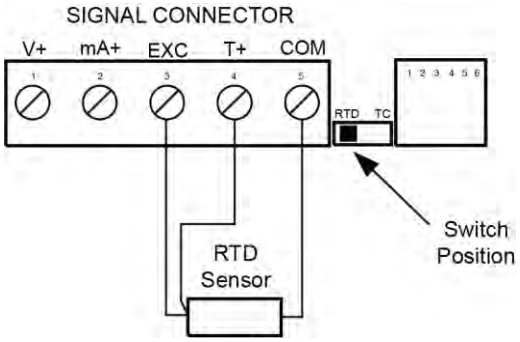


Figure 14. Three-Wire RTD Input Connections

The meter accepts two, three, or four-wire RTDs.
The three-wire RTD connection has built-in lead wire compensation.

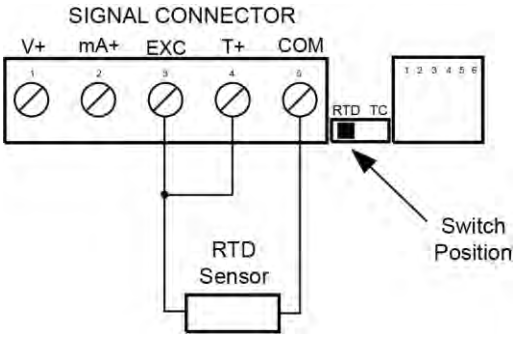


Figure 15. Two-Wire RTD Input Connections

Lead wire compensation for two-wire RTDs can be applied using the *Adjust* menu. *See Offset Adjustment (rtdJ)* on page *48*.

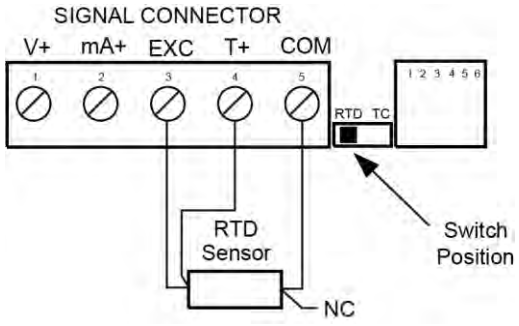


Figure 16. Four-Wire RTD Input Connections

The four-wire RTD connection is similar to the three-wire. One of the leads of a four-wire RTD is not connected and may be clipped off.

The three-wire connection provides sufficient lead wire compensation to provide accurate readings even with long leads.

RC Networks Available from Precision Digital

RC networks are available from Precision Digital and should be applied to each relay contact switching an inductive load. Part number: PDX6901.

Note: *Relays are de-rated to 1/14th HP (50 watts) with an inductive load.*

Relays and 24 V Output Connections

Relay connections are made to a six-terminal connector labeled RELAY1, RELAY2. See *Connector Labeling* on page *30*. The COM (common) terminals of the relays should not be confused with the COM (common) terminal of the SIGNAL connector. The 24 VDC output (available on AC powered units only) is available at the connector labeled 24V OUT, next to the relays connector.

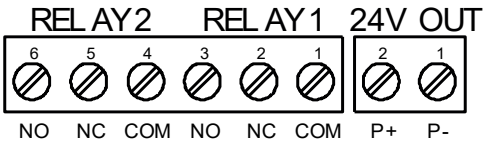


Figure 17. Relay & 24 V Output Connections

Switching Inductive Loads

The use of snubbers to suppress electrical noise is strongly recommended when switching inductive loads to prevent disrupting the microprocessor's operation. The snubbers also prolong the life of the relay contacts. Suppression can be obtained with resistor-capacitor (RC) networks assembled by the user or purchased as complete assemblies. Refer to the following circuits for RC network assembly and installation:

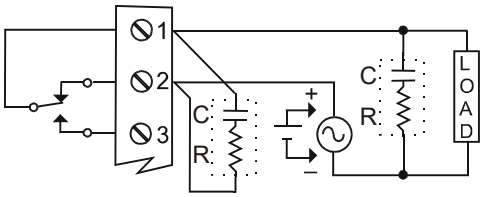
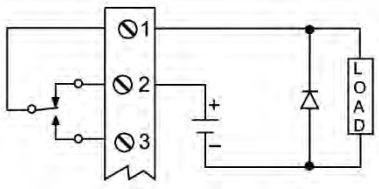


Figure 18. AC and DC Loads Protection

Choose R and C as follows:
R: 0.5 to 1 Ω for each volt across the contacts
C: 0.5 to 1 µF for each amp through closed contacts

Notes:

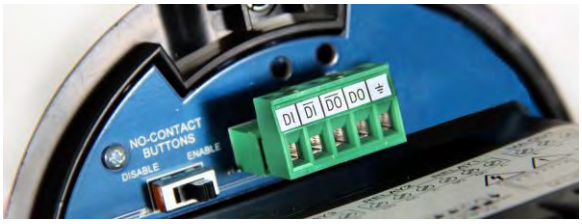
1. *Inductive relay rating is 1/14 HP (50 W) at 115/230 VAC*
2. *Use capacitors rated for 250 VAC.*
3. *RC networks may affect load release time of solenoid loads. Check to confirm proper operation.*
4. *Install the RC network at the meter's relay screw terminals. An RC network may also be installed across the load. Experiment for best results.*



Use a diode with a reverse breakdown voltage two to three times the circuit voltage and forward current at least as large as the load current.

Figure 19. Low Voltage DC Loads Protection

RS-485 Connections



The RS-485 connections are made to a five terminal connector used for Modbus® RTU serial communications. The RS-485 terminals include Transmit Data (DO) and (/DO), Receive Data (DI) and (/DI), and Signal Ground. See *Serial Communications (SErL)* on page *49* for more information.

There are two diagnostic LEDs: Transmit Data (TX), and Receive Data (RX) to show when the meter is transmitting and receiving data from other devices.

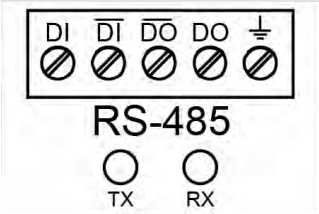


Figure 20. RS-485 Connections

RS-485 Multi-Drop Connection

When using more than one meter in a multi-drop mode, each meter must be provided with its own unique address. The meter address (Slave ID) can be programmed between 1 and 247. The transmit delay can be set between 0 and 199 ms. The parity can be set to even, odd, or none with 1 or 2 stop bits.

To change the meter address:

1. Press and hold the Menu button for three seconds to access Advanced Features menu of the meter.
2. Press Up arrow until Serial (SErL) menu is displayed and press Enter, Addr is displayed.
3. Press Enter to change meter address using Right and Up arrow buttons. Press Enter to accept.
4. Press Menu button to exit and return to Run Mode.

Three-Wire Connections

In order to wire the five pins for use as a three-wire half-duplex RS-485 connection, it is necessary to create a jumper connection between DI to DO and /DI to /DO- as shown below.

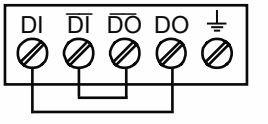
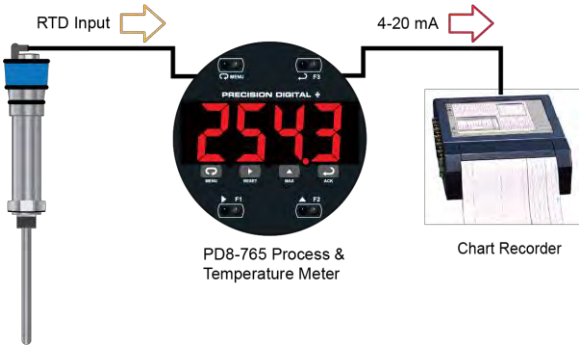


Figure 21. Three-Wire RS-485 Connections

4-20 mA Output & Input Signal Connections

The PD8-765, with an optional 4-20 mA output, can be used as an isolated temperature transmitter with a big display by converting the thermocouple or RTD input into an isolated 4-20 mA output.



Connections for the 4-20 mA transmitter output are made to the connector terminals labeled "mA OUT: I-, I+". The 4-20 mA output may be powered from an internal power supply (optional) or from an external power supply.

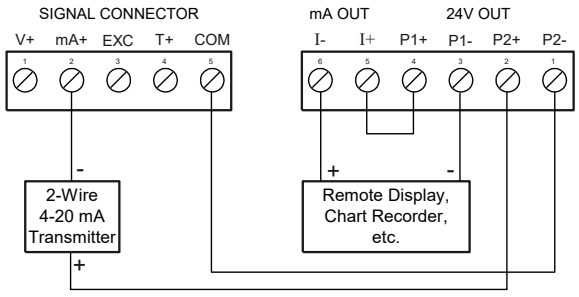


Figure 22. 4-20 mA Output & Input Signal Powered by PD8-765-6X3-20

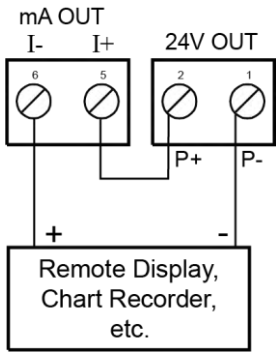


Figure 23. 4-20 mA Output Signal Powered by PD8-765-6X5-10

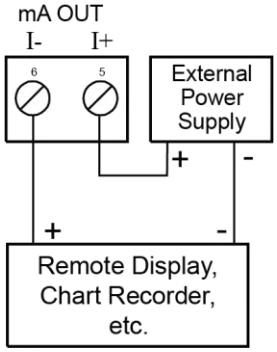


Figure 24. 4-20 mA Output Powered Externally

Models include PD8-765-6X3-00, PD8-765-7X3-00, PD8-765-7X5-00

Other Uses for Transmitter Power Supplies

The most common use for the PD8-765's two power supplies is for the 200 mA transmitter power supply to power the field transmitter and the other power supply to power the 4-20 mA output from the meter. However, the power supplies can be used in other ways. For instance, for level transmitters that require the use of a heated lens, the PD8-765's 200 mA power supply could be used to power both the heated lens and the 4-20 mA signal from the transmitter.

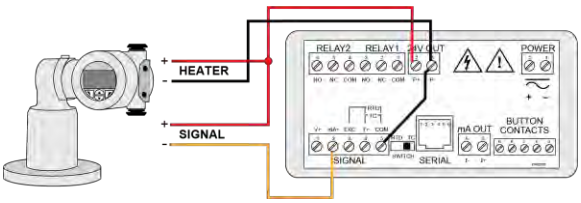
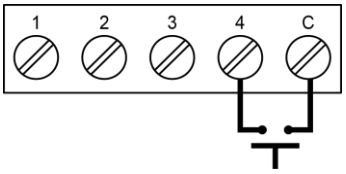


Figure 25. PD8-765-6X5-10 Powers Both the Heater and 4-20 mA Input Signal

External Button Contacts

The PD8-765 is equipped with four external button contacts that can be used to remotely operate the PD8-765's front panel buttons. For instance, these button contacts can be used to program the meter and to remotely acknowledge/reset the relays:



Terminal	Programming	Operation
M	Menu	
R	Right Arrow	Reset Max/Min
U	Up Arrow	Display Max/Min
E	Enter	Acknowledge Relays

Setup and Programming

There is **no need to recalibrate** the meter when first received from the factory. The meter is **factory calibrated** prior to shipment for milliamps and volts with calibration equipment that is certified to NIST standards.

Overview

There are no jumpers involved in the setup process of the meter. The RTD/TC selector switch, located between the SIGNAL and SERIAL connectors, must be set accordingly for the meter to accept RTD or thermocouple inputs. See Figures under *Connector Labeling* on page *30*.

Setup and programming is done using MeterView or through the programming buttons.

After power and input signal connections have been completed and verified, apply power to the meter.

LED Status Indicators

LED	State	Indication
1	Steady	Alarm 1
2	Steady	Alarm 2

See *Quick Interface Reference Guide* on page *57*

Programming Buttons

Button Symbol	Description
	Press to enter or exit Programming Mode, view settings, or exit max/min readings
	Press to reset max/min readings or other parameter/function assigned through the *User* menu
	Press to display max/min readings or other parameter/function assigned through the *User* menu
	Press to acknowledge relays or other parameters/function assigned through the *User* menu

- Press the Menu button to enter or exit the Programming Mode at any time.
- Press the Right arrow button to move to the next digit during digit or decimal point programming.
- Press or hold the Up arrow button to scroll through the menus, decimal point, or to increment the value of a digit.
- Press the Enter/Ack button to access a menu or to accept a setting.
- Press and hold the Menu button for three seconds to access the advanced features of the meter.

SafeTouch Buttons

The ProtEX-MAX is equipped with four sensors that operate as through-glass buttons so that it can be programmed and operated without removing the cover (and exposing the electronics) in a hazardous area.

These buttons can be disabled for security by selecting DISABLE on the switch labeled NO-CONTACT BUTTONS located on the connector board.

To actuate a button, press one finger to the glass directly over the marked button area. Then retract finger more than three inches from the glass before pressing the next button. When the cover is removed, the four mechanical buttons located next to the sensors are used. The sensors are disabled when a mechanical button is pressed and will automatically be re-enabled after 60 seconds of inactivity.

The SafeTouch Buttons are designed to filter normal levels of ambient interference and to protect against false triggering, however, it is recommended that the SafeTouch Buttons be disabled (slide switch to DISABLE) if there is an infrared interference source in line-of-sight to the display.

The SafeTouch Buttons are configured by default to duplicate the function of the front panel mechanical pushbuttons associated with the integrated meter. The symbols by each SafeTouch button correspond to a mechanical button as shown in the above table.

SafeTouch Button Tips:

- To the extent possible, install the display facing away from sunlight, windows, reflective objects and any sources of infrared interference.
- Keep the glass window clean.
- Tighten the cover securely.
- Use a password to prevent tampering.

Display Functions and Messages

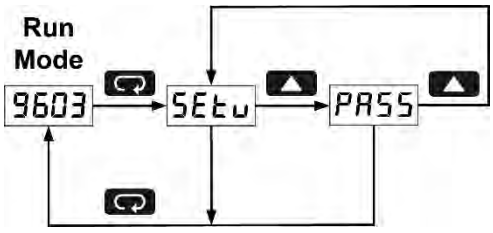
The meter displays various functions and messages during setup/programming and operation. The following table shows the displayed functions and messages with their action/setting description.

Display	Parameter	Action/Setting
SEtu	*Setup*	Enter *Setup* menu
inPt	*Input*	Enter *Input* menu
4-20	*4-20 mA*	Set meter for 4-20 mA input
0- 10	*0-10 VDC*	Set meter for ±10 VDC input
rtd	*RTD*	Set meter for RTD input
A385	*Alpha 385*	Set α = 0.00385 European curve 100Ω RTD
A392	*Alpha 392*	Set α = 0.00392 American curve 100Ω RTD
tC	*TC*	Set meter for TC input
0 J	*0 J*	Type J
1 K	*1 K*	Type K
2 t	*2 T*	Type T
3 t0	*3 T.0*	Type T, 0.1° resolution
4 E	*4 E*	Type E
F C	*°F or °C*	Set temperature scale
°F	*°F*	Set meter to Fahrenheit
°C	*°C*	Set meter to Celsius
dECP	*Decimal point*	Set decimal point
Prog	*Program*	Enter the *Program* menu
ScAL	*Scale*	Enter the *Scale* menu
CAL	*Calibrate*	Enter the *Calibrate* menu
inP 1	*Input 1*	Calibrate input 1 signal or program input 1 value
d isp 1	*Display 1*	Program display 1 value
inP2	*Input 2*	Calibrate input 2 signal or program input 2 value
d isp2	*Display 2*	Program display 2 value
Err	*Error*	Error, calibration not successful, check signal
rELY	*Relay*	Enter the *Relay* menu
rLY 1	*Relay 1*	Relay 1 setup
Act 1	*Action 1*	Set relay 1 action (automatic, latching, etc.)
Auto	*Automatic*	Set relay for automatic reset
A-mn	*Auto-manual*	Set relay for automatic + manual reset any time
LtCH	*Latching*	Set relay for latching operation
L-CL	*Latching-cleared*	Set relay for latching operation with manual reset only after alarm condition has cleared
ALtr	*Alternate*	Set relays for pump alternation control
oFF	*Off*	Disable relay and front panel status LEDs Disable relay's fail-safe operation
SEt 1	*Set 1*	Program set point 1
rSt 1	*Reset 1*	Program reset point 1
rLY2	*Relay 2*	Setup relay 2
Act2	*Action 2*	Set relay 2 action (automatic, latching, etc.)
SEt2	*Set 2*	Program set point 2
rSt2	*Reset 2*	Program reset point 2
FLSF	*Fail-safe*	Enter *Fail-safe* menu
FLS 1	*Fail-safe1*	Set relay 1 fail-safe operation
on	*On*	Enable fail-safe operation
oFF	*Off*	Disable fail-safe operation
FLS2	*Fail-safe2*	Set relay 2 fail-safe operation
dLAY	*Delay*	Enter *Time Delay* menu
dLY 1	*Delay 1*	Enter relay 1 time delay setup
On 1	*On 1*	Set relay 1 On time delay
OFF 1	*Off 1*	Set relay 1 Off time delay
dLY2	*Delay 2*	Enter relay 2 time delay setup
On2	*On 2*	Set relay 2 On time delay
OFF2	*Off 2*	Set relay 2 Off time delay
brEK	*Break*	Set RTD/TC input break relay behavior
brK 1	*Relay 1 Break*	Set relay 1 input break relay behavior
OFF	*Off*	Set relay to non-alarm condition at break
On	*On*	Set relay to alarm condition at break
brK2	*Relay 2 Break*	Set relay 2 input break relay behavior
Aout	*Analog output*	Enter the *Analog output* menu
ScAL	*Scale*	Enter the Scale menu
d isp 1	*Display 1*	Program display 1 value
out 1	*Output 1*	Program output 1 value (e.g. 4 mA)
d isp2	*Display 2*	Program display 2 value
out2	*Output 2*	Program output 2 value (e.g. 20 mA)
SEbr	*Sensor break*	Program TC or RTD sensor break value for analog out
PASS	*Password*	Enter the *Password* menu
unLC	*Unlocked*	Program password to lock meter
LoCd	*Locked*	Enter password to unlock meter
9999 - 1999 oPEn	*Flashing display*	Overrange condition Underrange condition Open TC or RTD sensor

Main Menu

The main menu consists of the most commonly used functions: *Setup* and *Password*.

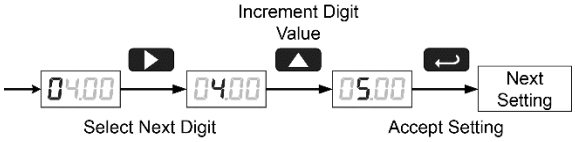
- Press **Menu** button to enter Programming Mode then press **Up** arrow button to scroll main menu.



- Press **Menu**, at any time, to exit and return to Run Mode. Changes made to settings prior to pressing **Enter/Ack** are not saved.
- Changes to the settings are saved to memory only after pressing **Enter/Ack**.
- The display moves to the next menu every time a setting is accepted by pressing **Enter/Ack**.

Setting Numeric Values

The numeric values are set using the **Right** and **Up** arrow buttons. Press **Right** arrow to select next digit and **Up** arrow to increment digit value.
The digit being changed is displayed brighter than the rest.
Press the **Enter/Ack** button, at any time, to accept a setting or **Menu** button to exit without saving changes.



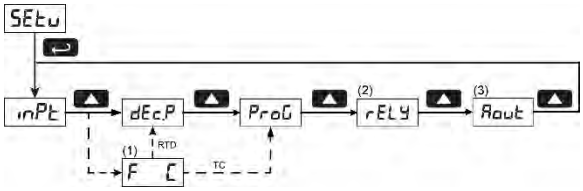
The decimal point is set using the **Up** arrow button in the *Setup-decimal point* menu.

Setting Up the Meter (SEtu)

The *Setup* menu is used to select:

1. Input signal the meter will accept
2. Decimal point position for process inputs
3. Units (°F or °C) for temperature inputs
4. Relay operation
5. 4-20 mA analog output setup

Press the **Enter/Ack** button to access any menu or press **Up** arrow button to scroll through choices.
Press the **Menu** button to exit at any time.

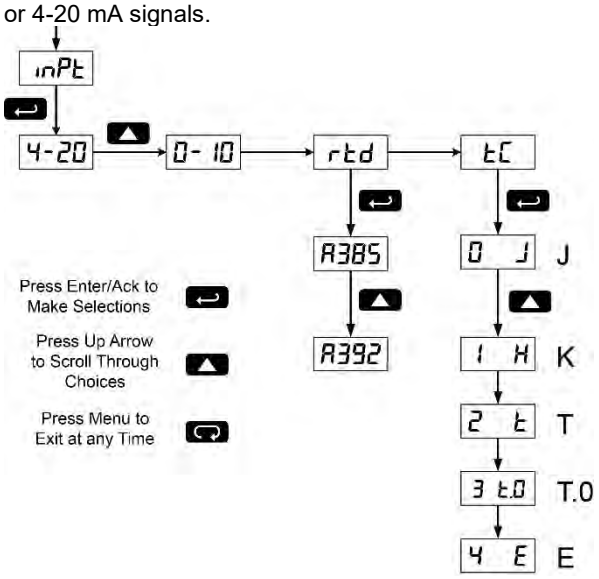


Notes:

1. *Selecting RTD or TC mode from the Input menu will include the Fahrenheit/Celsius menu in the setup menu structure. RTD will allow the selection of a decimal point location after this menu and TC has a fixed decimal point location and will not allow the selection of a decimal point location.*
2. *Relay menu is always available even if relays option is not installed. Visual alarm indication is available through front panel LEDs and MeterView software.*
3. *Analog Output menu is available if selected in the Advanced Features menu. 4-20 mA output option board is installed and set up at the factory.*

Setting the Input Signal (inPt)

Enter the *Input* menu to set up the meter to display current (4-20), voltage (0- 10), thermocouple (tC), or RTD (rtd) inputs.
The voltage input is capable of accepting any signal from -10 to +10 VDC. Select voltage input to accept 0-5, 1-5, 0-10, or ±10 VDC signals.
The current input is capable of accepting any signal from -20 to 20 mA. Select current input to accept 0-20 or 4-20 mA signals.

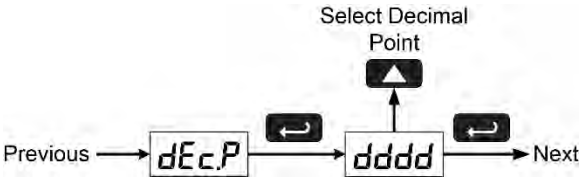


If RTD is selected, the display shows A385 or A392. Select the coefficient to match the RTD sensor, either 0.00385 (A385 European curve) or 0.00392 (A392 American curve). The display then shows the decimal point menu, dEcP. Select the decimal point resolution as shown on page *39*.
If TC is selected, scroll through the thermocouple types and select the type matching the TC sensor.
The input signal must be connected to the appropriate input terminals and the RTD/TC selector switch must be set, see *Figure 13. Thermocouple Input* on page *31*.

For thermocouple inputs, allow at least 30 minutes warm-up time for meter to reach specified accuracy.

Setting the Decimal Point (dcPt)

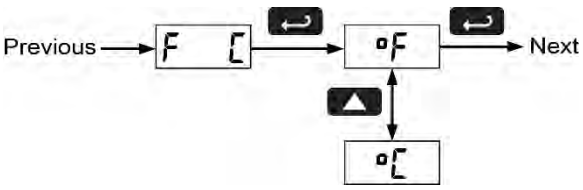
The decimal point for process inputs may be set with up to three decimal places or with no decimal point at all.
The decimal point for RTD inputs may be set with 1 decimal place or none.
The decimal point for thermocouple inputs is fixed per input selection.
Pressing the **Up** arrow moves the decimal point one place to the right until no decimal point is displayed, it then moves to the leftmost position.



Setting the Temperature Scale (F C)

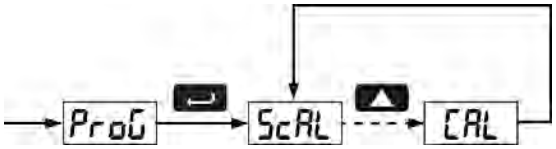
Meters with a thermocouple or RTD input can be set to display temperature in degrees Fahrenheit or Celsius.

Press **Up** arrow to change selection.
Press **Enter/Ack** to accept.



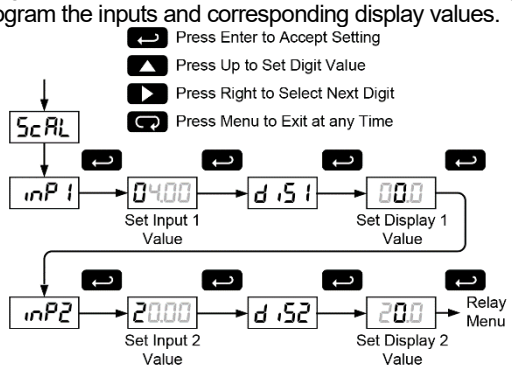
Programming the Meter (ProG)

The meter may either be scaled (ScAL) without applying an input or calibrated (CAL) by applying an input. The meter comes factory calibrated to NIST standards, so for initial setup, it is recommended to use the (ScAL) function.
The Program menu contains the Scale (ScAL) and the Calibrate (CAL) menus.
Process inputs may be scaled or calibrated to any display within the range of the meter.



Scaling the Meter (ScAL)

The process inputs (4-20 mA and ±10 VDC) can be scaled to display the process in engineering units.
A signal source is not needed to scale the meter; simply program the inputs and corresponding display values.



For instructions on how to program numeric values see *Setting Numeric Values*, page *38*.

Note: *The Scale menu is not available for temperature inputs.*

Error Message (Err)

An error message indicates that the calibration or scaling process was not successful.
After the error message is displayed, the meter reverts to input 1, allowing the appropriate input signals to be applied.
The error message might be caused by any of the following conditions:

1. Input signal is not connected to the proper terminals or it is connected backwards.
2. Wrong signal selection in *Setup* menu.
3. Minimum input span requirements not maintained.
4. Input 1 signal inadvertently applied to calibrate input 2.

⚠ IMPORTANT

- **Reverse Scaling**
  The meter can be scaled so that 4 mA represents the high end of the process value range being measured by the transmitter and 20 mA represents the low end of the process value range.

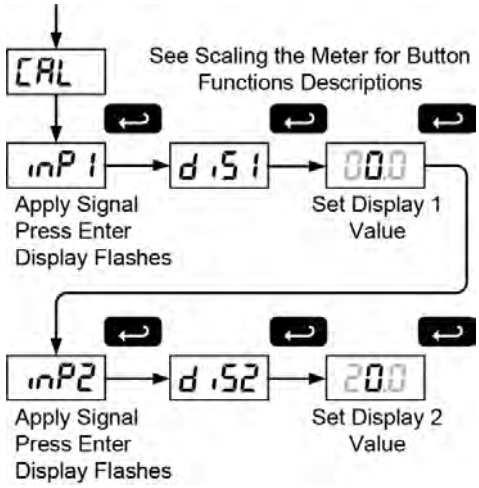
Minimum Input Span

The minimum input span is the minimum difference between input 1 and input 2 signals required to complete the calibration or scaling of the meter.

Input range	Input 1 & input 2 span
4-20 mA	0.40 mA
±10 VDC	0.20 VDC
TC	100°F (56°C)
RTD	50°F (28°C)

Calibrating the Meter (CAL)

The meter can be calibrated to display the process in engineering units by applying the appropriate input signals and following the calibration procedure.
The use of a calibrated signal source is required to calibrate the meter.



Recalibrating Temperature Inputs (CAL)

Remember, the meter is **calibrated** at the factory prior to shipment. Recalibration is recommended at least every twelve months.
The *Calibration* (CAL) menu is used to **recalibrate** the thermocouple and RTD inputs.

Allow at least 30 minutes warm-up time before performing recalibration procedure to ensure specified accuracy.

Recommended Calibration Points

To recalibrate the meter, it is recommended to use the Fahrenheit scale; this will give a greater degree of accuracy to the calibration. The scale can be changed to the Celsius scale after calibration is completed. The meter will display temperature accurately in any scale. The following table shows the recommended low and high calibration points for all types.

Type of input	Input 1 (Low)	Input 2 (High)	Check (Middle)
Type J T/C	32°F	1182°F	600°F
Type K T/C	32°F	1893°F	960°F
Type T T/C	32°F	693°F	360°F
Type T T/C	32.0°F	693.0°F	360.0°F
Type E T/C	32°F	1652°F	840°F
100 Ω RTD (0.00385)	32°F 100Ω	1148°F 320.12Ω	590°F 215.61Ω
100 Ω RTD (0.00392)	32°F 100Ω	1127°F 320.89Ω	580°F 215.87Ω

Recalibration Procedure for Temperature Inputs

1. Connect signal to the meter using the appropriate wire (e.g. type J thermocouple wire to recalibrate type J input), see page *31*.
2. Set up the meter to accept the selected input (e.g. type J T/C), see page *38*.
3. Set up the meter to display temperature in degrees Fahrenheit, see page *39*.
4. Apply signal corresponding to input 1 (32°F) and program display 1 to 32, see page *40*.
5. Apply signal corresponding to input 2 (1182°F for type J) and program display 2 accordingly, see page *40*.
6. After the meter accepts input 2, the display flashes the message CJr that indicates the meter is sensing the cold junction reference. This completes the recalibration procedure for the selected input.

Recalibrating Process Inputs (ICAL)

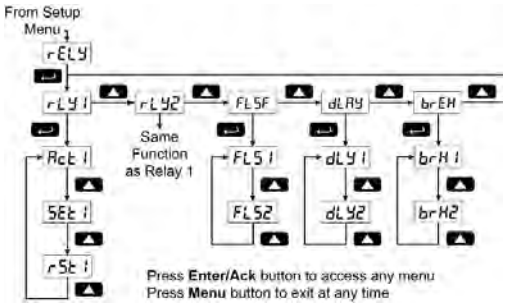
The *Internal Calibration* (ICAL) menu, located in the Advanced features menu, is used to recalibrate the current and voltage inputs. Recalibration is recommended at least every twelve months.
Refer to *Internal Calibration* (ICAL), page *51* for instructions.

Setting the Relay Operation (rELY)

This menu allows you to set up the operation of the relays:

1. Relay action (ACt)
   a. Automatic reset only (non-latching)
   b. Automatic + manual reset at any time (non-latching)
   c. Latching (manual reset only)
   d. Latching with Clear (manual reset only after alarm condition has cleared)
   e. Pump alternation control (automatic reset only)
   f. Off (relay and status LED disabled)
2. Set point
3. Reset point
4. Fail-safe operation
   a. On (enabled)
   b. Off (disabled)
5. Time delay
   a. On delay (0-199 seconds)
   b. Off delay (0-199 seconds)
6. Break Condition Behavior
   a. Off (non-alarm condition)
   b. On (alarm condition)

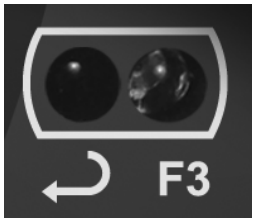
Refer to page *37* for a description of *Display Functions and Messages*



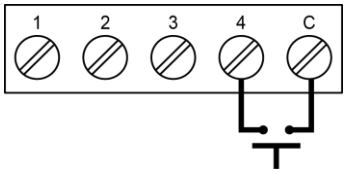
Acknowledging Relays

There are two ways to acknowledge relays programmed for manual reset:

1. Via ACK (F3) SafeTouch through-glass button.



2. Remotely via terminal at the back of the meter by a connector switch across terminals 4 and C.

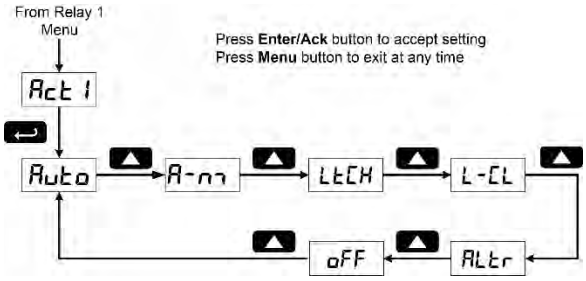


Setting the Relay Action

The relays' *Action* menu allows the user to set up the operation of the relays. The relays may be set up for any of the following modes of operation:

1. Automatic reset (non-latching)
2. Automatic + manual reset at any time (non-latching)
3. Latching (manual reset only, at any time)
4. Latching with Clear (manual reset only after alarm condition has cleared)
5. Pump alternation control (automatic reset only)
6. Off (relay and status LED disabled)

The following graphic shows relay 1 action setup; relay 2 is set up in a similar fashion.



Programming Set and Reset Points

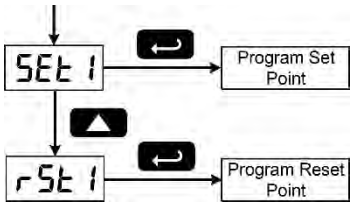
High alarm indication: program set point above reset point.

Low alarm indication: program set point below reset point.

The deadband is determined by the difference between set and reset points. Minimum deadband is one display count. If set and reset points are programmed the same, relay will reset one count below set point.

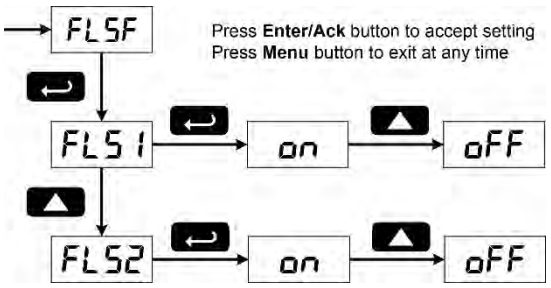
Quick Set Points

Press **Up** arrow and **Menu** at the same time to access set/reset points quickly.



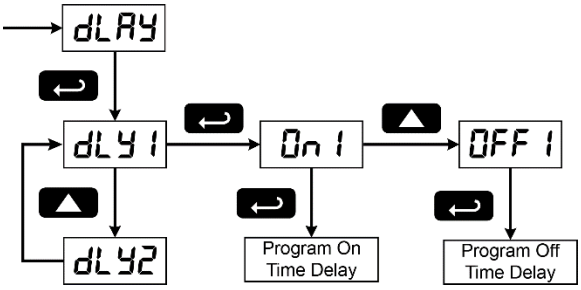
Setting Fail-Safe Operation

The fail-safe operation is set independently for each relay. Select on to enable or select oFF to disable fail-safe operation.



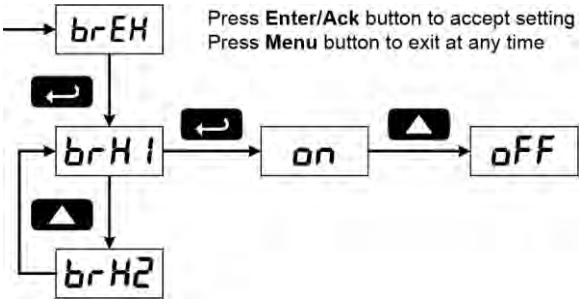
Programming Time Delay

The *On* and *Off* time delays may be programmed for each relay between 0 and 199 seconds. The relays will transfer only after the condition has been maintained for the corresponding time delay.
The *On* time delay is associated with the set point.
The *Off* time delay is associated with the reset point.



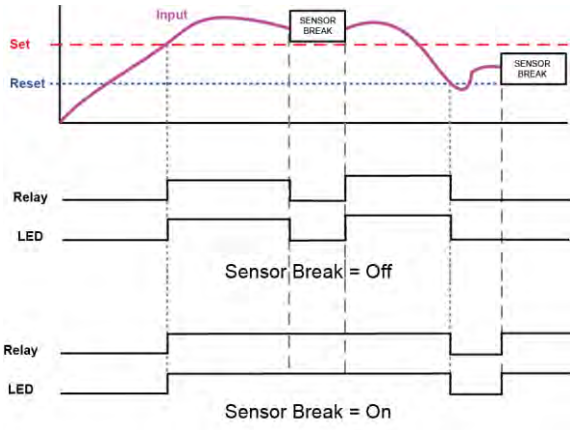
Setting Sensor Break Condition

The sensor break relay condition may be programmed for each relay as *On* (alarm) or *Off* (non-alarm). The relays will enter these states when a sensor break is detected for RTD or thermocouple inputs. These settings have no effect when current or voltage inputs are selected.



Sensor Break Operation

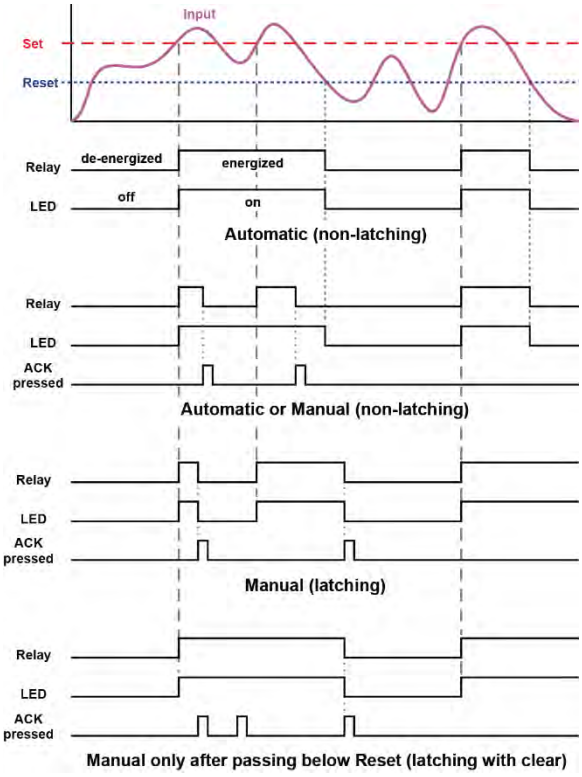
The following graphs illustrate the operation of how the meter reacts when a sensor break is detected.



Relay and Alarm Operation

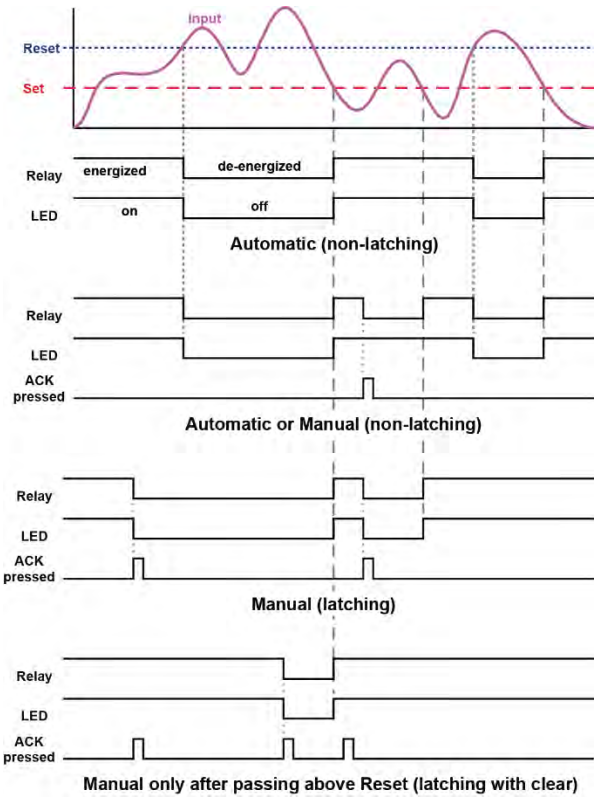
The following graphs illustrate the operation of the relays, status LEDs, and ACK button.

High Alarm Operation (Set > Reset)



For Manual reset mode, ACK can be pressed anytime to turn "off" relay. For relay to turn back "on", signal must go below set point, and then go above it.

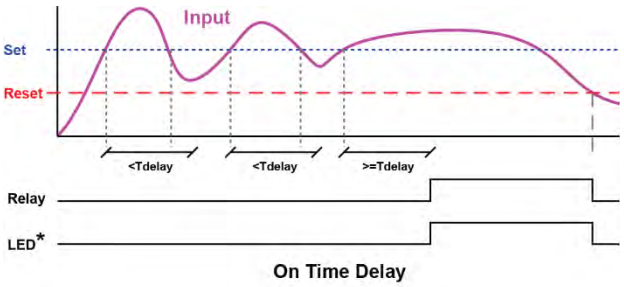
Low Alarm Operation (Set < Reset)

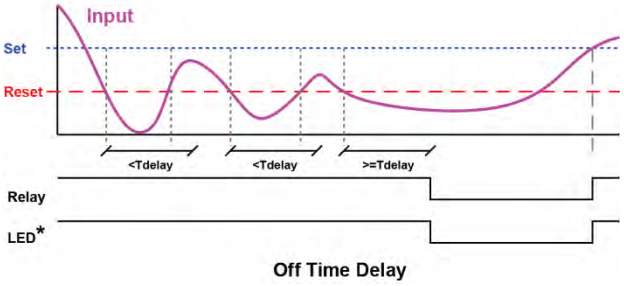


For Manual reset mode, ACK can be pressed anytime to turn "off" relay. For relay to turn back "on", signal must go above set point, and then go below it.

Time Delay Operation

The following graphs show the operation of the time delay function.

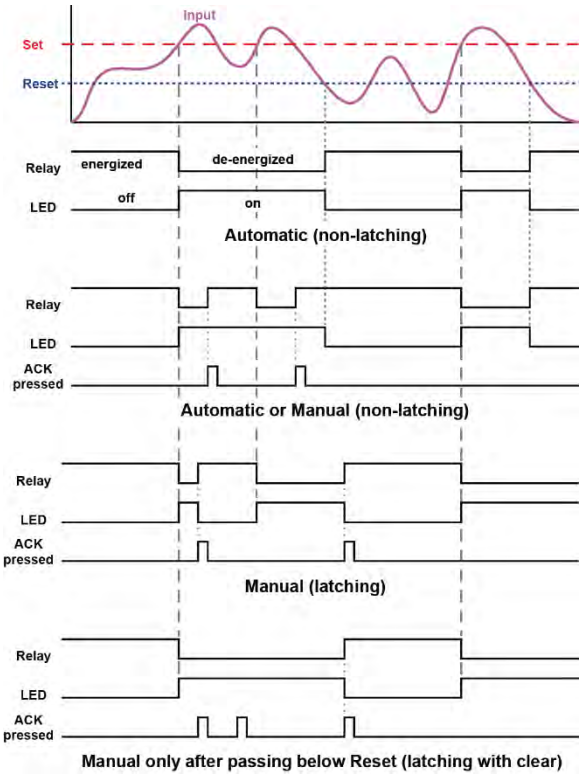




If the signal crosses the set point, the *On* time delay timer starts and the relay trips when the time delay has elapsed. If the signal drops below the set point (high alarm) before the time delay has elapsed, the *On* time delay timer resets and the relay does not change state. The same principle applies to the *Off* time delay.

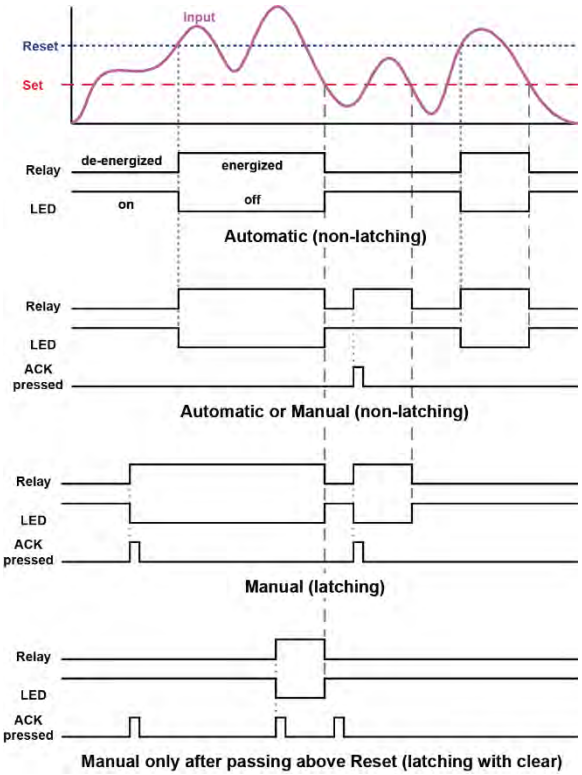
* **Note:** The LED is not affected by Time Delay when *"Automatic or Manual"* reset mode is selected. Rather the LED follows the set and reset points.

High Alarm with Fail-Safe Operation (Set > Reset)



*** Note:** Relay coil is energized in non-alarm condition. In case of power failure, relay will go to alarm state.

Low Alarm with Fail-Safe Operation (Set < Reset)

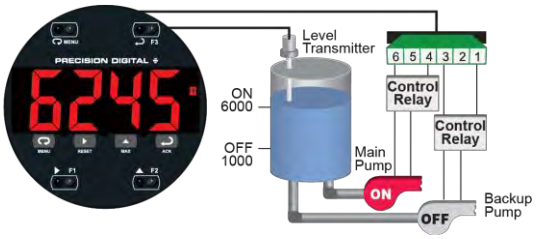


*** Note:** Relay coil is energized in non-alarm condition. In case of power failure, relay will go to alarm state.

Pump Controller with Dual-Pump Alternation

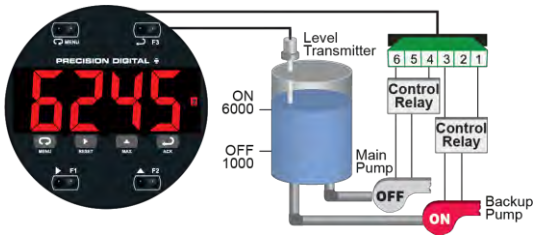
The PD8-765 can be used as a low-cost pump controller when combined with a continuous level transmitter. One of the most common pump control applications is shown below: controlling and alternating two pumps. The goal is to control the level between 1000 and 6000 gallons. The main pump turns on when the level reaches 6000 gallons and pumps down to 1000 gallons and then shuts the pump off. The next cycle, the backup pump turns on at 6000 gallons and shuts off at 1000 gallons. If at any time the active pump can't keep the level below 7000 gallons, the other pump would come on also.

1



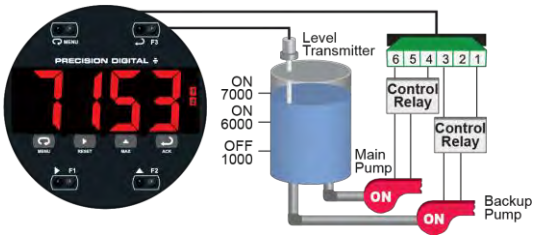
Relay #1 turns the main pump on at 6000 gallons and turns it off at 1000 gallons.

2



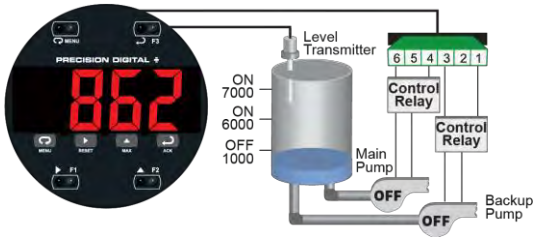
With the Pump Alternation feature activated, the next time the level reaches 6000 gallons, relay #2 starts the backup pump.

3



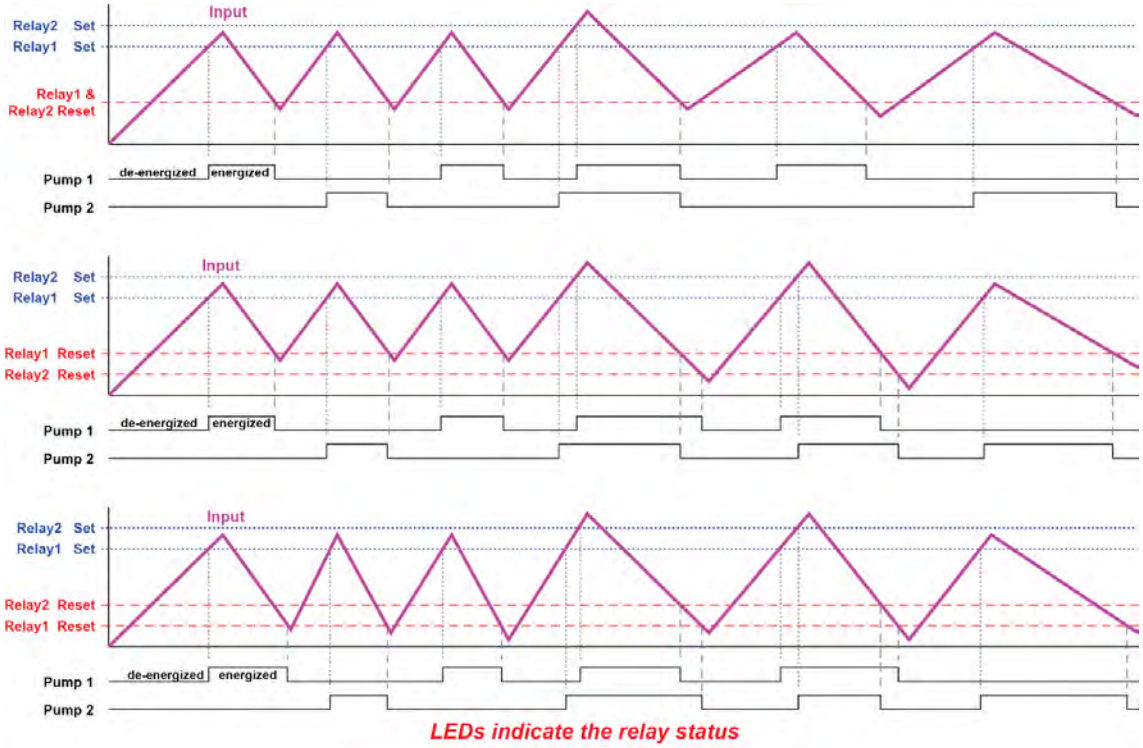
If the active pump is not able to keep up, and the level reaches 7000 gallons, the other relay will start the inactive pump as well.

4



When the level falls below 1000 gallons, both pumps will turn off.

Pump Alternation Control Operation



LEDs indicate the relay status

Scaling the 4-20 mA Analog Output (Aout)

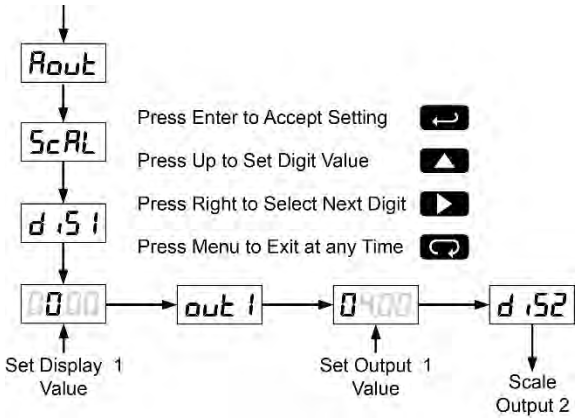
The 4-20 mA analog output can be scaled to provide a 4-20 mA signal for any display range selected.

No equipment is needed to scale the analog output; simply program the display values to the corresponding mA output signal.

The *Analog Output* menu appears in the *Setup* menu only on meters that are equipped with a 4-20 mA output. This menu is enabled or disabled at the factory via the *Advanced Features* menu. For more information on the *Advanced Features Menu*, see page *47*.

The *Analog Output* menu is used to program:

1. 4-20 mA output based on display values
2. Sensor break value in mA



For instructions on how to program numeric values see *Setting Numeric Values*, page *38*.

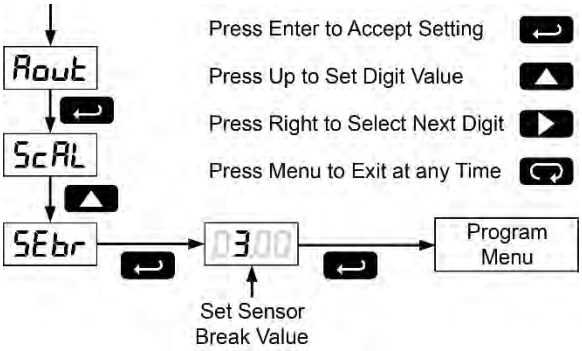
Program the Sensor Break Output Value (SEbr)

The sensor break value corresponds to the output signal generated when the meter detects a sensor break for thermocouple and RTD inputs.

For example, if there is an open thermocouple, the meter displays the message "oPEn" and the analog output goes to the programmed sensor break value (e.g. 3.00 mA).

The sensor break value can be programmed from 0.00 to 23.99.

The typical output signal range is 1.00 to 23.00 mA (e.g. If sensor break value is programmed to 0.00, the actual output will not be greater than 1.00 mA).



Analog Output when Display is Out of Range

The analog output reflects the display out of range conditions as follows:

Input Condition	Display	Analog Output
Underrange	Flashing -1999	3.00 mA
Overrange	Flashing 9999	21.00 mA
Open TC or RTD	Flashing oPEn	Sensor break value

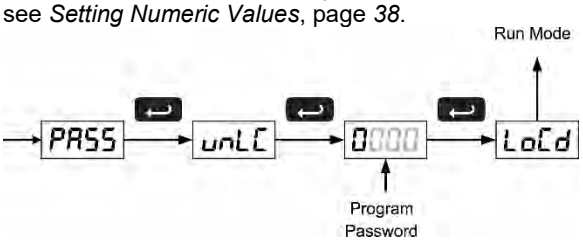
Setting Up the Password (PASS)

The *Password* menu is used to program a four-digit password to prevent unauthorized changes to the programmed parameter settings.

Locking the Meter

Enter the *Password* menu and program a four-digit password.

For instructions on how to program numeric values see *Setting Numeric Values*, page *38*.

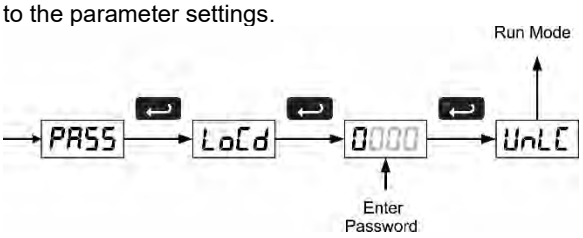


Record the password for future reference.
If appropriate, it may be recorded in the space provided.

Model:	
Serial Number:	
Password:	

Unlocking the Meter

If the meter is password protected, the correct password must be entered in order to make changes to the parameter settings.



Entering the correct four-digit number sets the password to 0000, disabling the protection. Changes to the programmed parameter settings are allowed only with the password set to 0000.
If the password entered is incorrect, the meter displays LoCd (Locked) for about two seconds, then it returns to Run Mode. To try again, press **Enter/Ack** while the *Locked* message is displayed.

Forgot the Password?

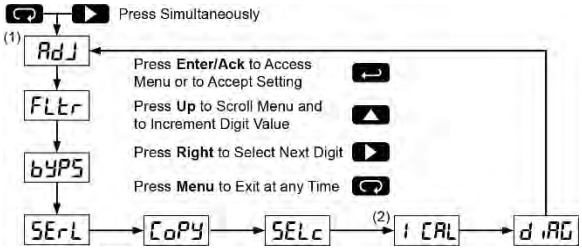
The password may be disabled by the following procedure:

1. Note display reading prior to pressing the Menu button. Ignore decimal point and sign.
2. Access the *Password* menu, add 2 to the noted reading and enter that number as the password (e.g. display reading = -1.23, password = 0125)

Advanced Features Menu

To simplify the setup process, functions not needed for most applications are located in the *Advanced Features* menu.

Press the **Right** arrow and **Menu** button simultaneously or hold the Menu button for approximately 3 seconds to access the *Advanced Features Menu* of the meter.



1. Available for temperature inputs only
2. Available for process inputs only

Advanced Features Menu & Display Messages

Display Functions and Messages

Display	Parameter	Action/Setting
AdJ	*Adjust*	Set offset adjustment for temperature, not available for process inputs
FLtr	*Filter*	Set noise filter value
byPS	*Bypass*	Set filter bypass value
SErL	*Serial*	Set serial communication parameters
Prot	*Protocol*	Enter the Protocol menu
PdC	*PDC*	Select PDC protocol
nrbS	*Modbus®*	Select Modbus® protocol
Addr	*Address*	Set meter address
bAud	*Baud rate*	Select baud rate
trdE	*Transmit delay*	Set transmit delay for serial communication
PrtY	*Parity*	Select none, even, or odd (Modbus® only)
tbyt	*Byte-to-byte*	Program byte-to-byte timeout (silent time – Modbus® only)
CoPY	*Copy*	Enter copy function
SEnd	*Send*	Send meter settings to another meter
donE	*Done*	Copy function completed
SELc	*Select*	Enter the Select menu (function, cutoff, out)
Func	*Function*	Select linear or square root function
L inr	*Linear*	Set meter for linear function
Sqrt	*Square root*	Set meter for square root extraction
cutF	*Cutoff*	Set low-flow cutoff

Display Functions and Messages

Display	Parameter	Action/Setting
out	*Output*	Set meter for either relay or analog output (factory set only; only included in certain models)
Aout	*Analog output*	Set meter for analog output option
rELY	*Relay*	Set meter for relay option
Aout	*Analog output*	Enable or disable analog output (factory set only; only included in certain models)
YES	*Yes*	Enable analog output
no	*No*	Disable analog output
Inty	*Intensity*	Select display intensity
ICAL	*Initial calibration*	Enter initial calibration for process inputs
Curr	*Current*	Calibrating current input
I Lo	*I low*	Calibrate low current input
I Hi	*I high*	Calibrate high current input
volt	*Volt*	Calibrating voltage input
ULo	*V low*	Calibrate low voltage input
UHi	*V high*	Calibrate high voltage input
diAG	*Diagnostics*	Display parameter settings
LEd	*LED*	Test display
CJC	*CJC*	Display cold junction compensation voltage
CFG	*CFG*	Display meter configuration
PtS	*Points*	Display calibration points for process inputs
rELY	*Relays*	Display relay settings
Aout	*Analog output*	Display analog output settings
GoFF	*Gain/offset*	Display gain and offset for process inputs
SErL	*Serial*	Display serial communication settings
Info	*Information*	Display software version and S/N information

Offset Adjustment (AdJ)

This parameter allows the user to select an offset adjustment to the temperature being displayed. Offset adjustment values can be either positive or negative and can be any number within ±19.9°. The offset adjustment value is programmed through the *Adjust* menu.

The offset adjustment feature can be useful to compensate for errors due to thermocouple junctions or excessive lead wire resistance in RTDs.

The offset adjustment value is automatically reset to zero whenever the type of temperature sensor is changed (*i.e.,* Thermocouple type or RTD curve).

Celsius/Fahrenheit conversion of the offset adjustment value is automatic, see note 2 below for important limitations.

Notes:

1. Offset adjustment is available only when TC or RTD input is selected.
2. If adjustment value is greater than 11°C and the temperature scale is changed to Fahrenheit, the maximum applied adjustment will be 19.9°F.

Noise Filter (FLtr)

Most applications do not require changing this parameter. It is intended to help attain a steady display with an unsteady (noisy) input signal.

The field selectable noise filter averages any minor or quick changes in the input signal and displays the reading with greater stability.

Increasing the filter value will help stabilize the display, however this will reduce the display response to changes on the input signal.

The filter level may be set anywhere from 2 to 199.

Setting filter value to zero disables filter function, and bypass setting becomes irrelevant.

Noise Filter Bypass (byPS)

The meter can be programmed to filter small input changes, but allow larger input changes to be displayed immediately, by setting the bypass value accordingly.

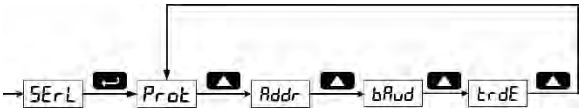
If the input signal goes beyond the bypass value, it will be displayed immediately with no averaging done on it.

The noise filter bypass value may be set anywhere from 0.2 to 99.9. It corresponds to percentage of full scale for process inputs and to degrees Fahrenheit for temperature inputs.

Increasing the bypass value may slow down the display response to changes on the input signal.

Serial Communications (SErL)

The meter is equipped with serial communications capability as a standard feature using PDC protocol and MeterView software or using the Modbus® RTU protocol. The Modbus® RTU protocol is included on all models after 5/1/2010. To communicate with a computer or other data terminal equipment, an RS-232, RS-485, or USB adapter option is required; see *Ordering Information* on page 7 for details.



When using more than one meter in an RS-485 multi-drop mode, each meter must be provided with its own unique address. The address may be programmed from 00 to 99 for PDC protocol and from 1 to 247 for Modbus® protocol. The transmit delay may be set between 0 and 199 ms (see Serial Communication Adapter manual for more details). The PD8-765 can also be connected directly to another PD8-765 through a cable assembly (PDA7420). This allows the user to copy all the settings from one meter to another, using the *Copy* function.

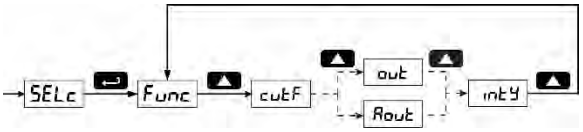
Protocol Selection Menu (Prot)

The Protocol selection menu is used to select either the PDC or the Modbus® protocol. PDC protocol should be selected to run MeterView software.

Select Menu (SELc)

The *Select* menu is used to select linear or square root function, display intensity, and low-flow cutoff. Selection for relay or analog output is a factory setting depending on the option installed.

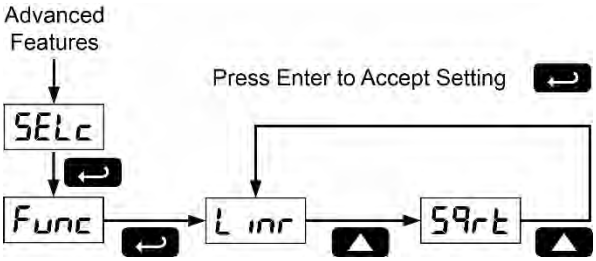
- Output options are installed and set up at the factory.
- Changing the output selection will cause erroneous operation.



Note: Depending on meter model, the Select menu will display either out or Aout. In either case, the output selection menu is for factory use only. Do not attempt to change output selection.

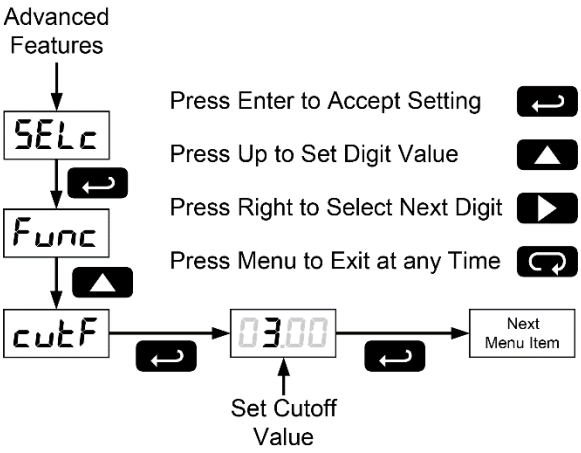
Linear or Square Root Function (L inr or Sqrt)

Meters are set up at the factory for linear function. The linear function provides a display that is linear with respect to the input signal.
The square root function is used to linearize the signal from a differential pressure transmitter and display flow rate in engineering units.



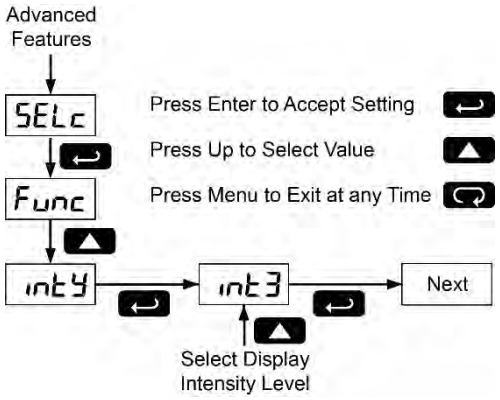
Low-Flow Cutoff (cutF)

The low-flow cutoff feature allows the meter to be programmed so that the often-unsteady output from a differential pressure transmitter, at low flow rates, always displays zero on the meter.
The cutoff value may be programmed from 0 to 9999. Below the cutoff value, the meter will display zero. Programming the cutoff value to zero disables the cutoff.



Display Intensity (intY)

The Display Intensity function allows the selection of eight levels of intensity for various lighting conditions.



Meter Copy Function (CoPY)

The *Copy* function is used to copy (or clone) all the settings from one meter to other meters requiring exactly the same setup and programming (*i.e.* type of input, scaling, decimal point, filter, bypass, etc.).

Copy Function Requirements

To successfully copy settings from one meter to another, both meters must have:

1. *Same software version*
2. *Same baud rate setting*
3. *PDC protocol selected*

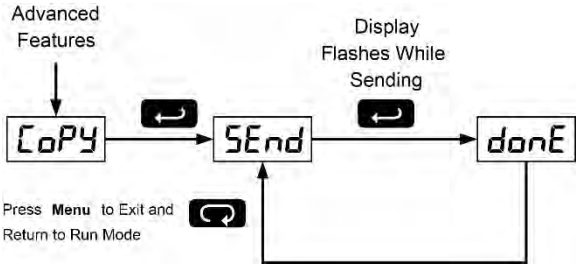
See *Determining Software Version*, page *53* for instructions.

Meter Cloning Instructions

⚠ CAUTION

- Do not connect the two meters to the same 4-20 mA loop while cloning. Internal calibration may be affected.
- Connect the two meters using cable assembly PDA7420 or equivalent (e.g. Digi-Key P/N H1663-07-ND). Cable should not exceed 7' (2.1 m).

1. Power up both meters. Leave Clone meter in Run Mode.
2. Enter the *Advanced Features Menu* of the Master meter, see *Advanced Features Menu*, page *47*.
3. Scroll to *Copy* function using **Up** arrow button then press **Enter/Ack**.
4. The meter displays the message SEnd. Press **Enter/Ack**, the display flashes while sending data. The message donE is displayed when copying is completed.



5. The Clone meter displays the memory address being programmed then the message donE when copying is completed. The meter initializes and returns to Run Mode using the same settings as the Master.
6. If meter to be cloned does not respond to the data being sent, refer to ***Copy Function Requirements*** above.

Internal Calibration (iCAL)

- There is **no need to recalibrate** the meter when first received from the factory.
- The meter is ***factory calibrated*** prior to shipment, for all input types, in milliamps, volts, and degrees respectively. The calibration equipment is certified to NIST standards.

The internal calibration allows the user to scale the meter without applying a signal. This menu is not available if the meter is set up for TC or RTD inputs.

The use of calibrated signal sources is necessary to perform the internal calibration of the meter. Check calibration of the meter at least every 12 months. Each input type must be recalibrated separately, if meter will be used with all input types.

Notes:
- If meter is in operation and it is intended to accept only one input type (e.g. 4-20 mA), recalibration of other inputs is not necessary.
- Allow the meter to warm up for at least 30 minutes before performing the internal calibration procedure.

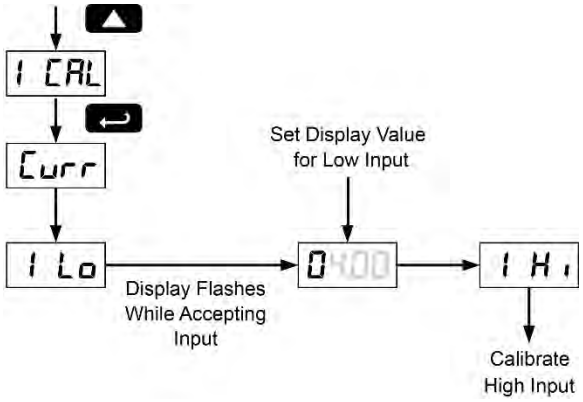
The *Internal calibration* menu is part of the *Advanced Features Menu*.

1. Press the **Up** arrow button to scroll to the *Internal calibration* menu and press **Enter/Ack**.
2. The meter displays either current (Curr) or voltage (volt), according to the meter input setup. Press **Enter/Ack** to start the calibration process.

Example for current input internal calibration:

3. The meter displays *Low* input current (I Lo). Apply the low input signal and press **Enter/Ack**. The display flashes for a moment while meter is accepting the low input.
4. After the display stops flashing, a number is displayed with the leftmost digit brighter than the rest. The bright digit is the active digit that can be changed by pressing the **Up** arrow button. Press the **Right** arrow button to move to the next digit.
5. Set the display value to correspond to the input signal being calibrated.
6. The display moves to the high input calibration (I Hi). Apply the high input signal and press **Enter/Ack**.
7. Set the display for the high input calibration in the same way as it was set for the low input calibration.

For instructions on how to program numeric values see *Setting Numeric Values,* page *38*.



The graphic above shows the calibration of the current input. The voltage input is calibrated in a similar way.

Tips:
- Low and high input signals can be any valid values within the range of the meter.
- Observe minimum input span requirements between input 1 and input 2.
- Low input must be less than high input signal.

Error Message (Err)

An error message indicates that the calibration or scaling process was not successful.
After the error message is displayed, the meter reverts to input 1, allowing the appropriate input signals to be applied.

The error message might be caused by any of the following conditions:
1. Input signal is not connected to the proper terminals, or it is connected backwards.
2. Wrong signal selection in *Setup* menu.
3. Minimum input span requirements not maintained.

Minimum Input Span

The minimum input span is the minimum difference between input 1 and input 2 signals required to complete the calibration or scaling of the meter.

Input range	Input 1 & input 2 span
4-20 mA	0.40 mA
±10 VDC	0.20 VDC

Meter Operation

For process inputs, the meter is capable of accepting positive and negative signals and displaying these signals in engineering units from -1999 to 9999 (*e.g.* a signal from -10 to +10 VDC could be displayed as -10.00 to 10.00).
The temperature inputs are displayed according to the input type and temperature units (°F or °C) selected. RTD and Type T thermocouple inputs can be displayed with either 1° or 0.1° resolution.

Buttons Operation

Button Symbol	Description
	Press to enter or exit Programming Mode, view settings, or exit Max/Min readings Hold to enter *Advanced Features Menu*
	Press to reset Max/Min readings
	Press to display Max/Min readings alternately
	Press to display Max/Min reading indefinitely while displaying Max/Min Press ACK to acknowledge relays

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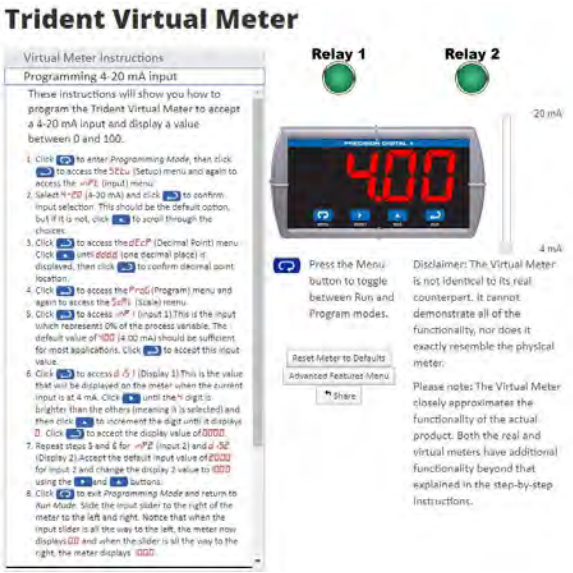
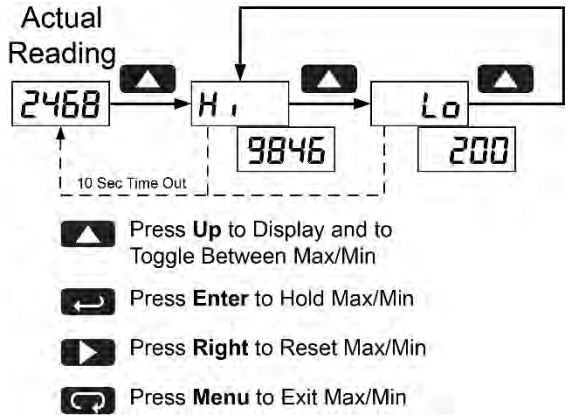


Maximum/Minimum Readings

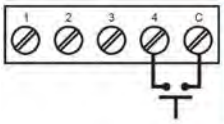
The main function of the front panel buttons during operation is to display the maximum and minimum readings reached by the process or temperature inputs.



1. Press **Up** arrow/**Max** button to display maximum reading since the last reset/power-up.
2. Press **Up** arrow/**Max** again to display the minimum reading since the last reset/power-up.
3. Press **Enter/Ack** to hold Max/Min display reading, the meter will continue to track new Max/Min readings.
4. If **Enter/Ack** is not pressed, the Max/Min display reading will time out after ten seconds and the meter will return to display the actual reading.
5. Press **Right** arrow/**Reset** button to reset Max/Min while reading is being displayed. Max/Min display readings are reset to actual reading.

Remote Operation of Meter Buttons

The PD8-765 is equipped with four external button contacts that can be used to remotely operate the PD8-765's front panel buttons. For instance, these button contacts can be used to program the meter and to remotely acknowledge/reset the relays:



Terminal	Programming	Operation
1	Menu	
2	Right Arrow	Reset Max/Min
3	Up Arrow	Display Max/Min
4	Enter	Acknowledge Relays

Troubleshooting

For an *Interactive Virtual Meter Demo* visit predig.com/tvm

Due to the many features and functions of the meter, it's possible that the setup of the meter does not agree with what an operator expects to see. If the meter is not working as expected, refer to the *Diagnostics* menu and consult the recommendations described below.

It may also be helpful to program the meter using MeterView software. A free USB adapter can be sent to you if you register your meter.

Diagnostics Menu (d iAG)

The *Diagnostics* menu is located in the *Advanced Features Menu*, to access *Diagnostics* menu see Advanced Features Menu, page *47*.
It provides an easy way to view the programmed parameter settings for troubleshooting purposes.
Press the **Enter/Ack** button to view the settings and the **Menu** button to exit at any time.
For a description of the diagnostics messages see *Advanced Features Menu & Display Messages*, page *47*.

Determining Software Version

To determine the software version of a meter:

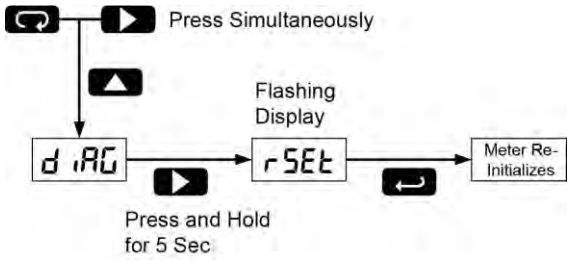
1. Go to the *Diagnostics* menu (d iAG) and press **Enter/Ack** button.
2. Press **Up** arrow/**Max** button and scroll to Information menu (InFo).
3. Press **Enter/Ack** to access the software number (SFt), version (UEr). Write down the information as it is displayed. Continue pressing **Enter/Ack** until all the information is displayed.

Reset Meter to Factory Defaults

When the parameters have been changed in a way that is difficult to determine what's happening, it might be better to start the setup process from the factory defaults.
Instructions to load factory defaults:

1. Enter the *Advanced Features Menu*. See *Advanced Features Menu*, page *47*.
2. Press **Up** arrow to go to *Diagnostics* menu
3. Press and hold **Right** arrow/Reset for five seconds, press **Enter/Ack** when display flashes rESEt.

   Note: If **Enter/Ack** is not pressed within three seconds, display returns to Diagnostics menu.
4. The meter goes through an initialization sequence (same as on power-up) and loads the factory default settings.



Factory Defaults & User Settings

The following table shows the factory setting for most of the programmable parameters on the meter. Next to the factory setting, the user may record the new setting for the particular application. MeterView software allows the saving of all meter parameters to a file for restoring meter settings, reporting, and copying settings to other meters.

Model: _____ S/N: _____
Date: _____

Parameter	Display	Default Setting	User Setting
Input type	inPt	4-20 mA	
Decimal point	dddd	2 places	
Programming	Prog		
Input 1	inP1	4.00 mA	
Display 1	d.S1	4.00	
Input 2	inP2	20.00 mA	
Display 2	d.S2	20.00	
Relay 1	rLY1		
Action 1	Act1	Automatic	
Set 1	SEt1	7.00	
Reset 1	rSt1	6.00	
Relay 2	rLY2		
Action 2	Act2	Automatic	
Set 2	SEt2	10.00	
Reset 2	rSt2	9.00	
Fail-safe	FLSF		
Fail-safe 1	FLS1	Off	
Fail-safe 2	FLS2	Off	
Time delay	dLAY		
On delay 1	On1	0 sec	
Off delay 1	OFF1	0 sec	
On delay 2	On2	0 sec	
Off delay 2	OFF2	0 sec	
Break 1	brK1	Off	
Break 2	brK2	Off	
Password	PASS	0000 (unlocked)	
Advanced Features	N/A		
Adjust	AdJ	0.0° (temp only)	
Filter	FLtr	10	
Bypass	bYPS	0.2	
Serial settings	SErL		
Protocol	Pdt	PDC protocol	
Address	Addr	00	
Baud rate	bAud	2400	
Trans delay	trdE	10 ms	
Function	Func	Linear	
Cutoff value	CutF	0.00 (disabled)	
Output option	out/Aout	Factory set only	
Display intensity	intY	Level 8	
Modbus® defaults	N/A		
Address	Addr	247	
Parity	PrtY	Even	
Byte-to-byte timeout*	tbYt	0.01 sec	

*** Note:** The byte-to-byte timeout setting might be updated automatically depending on the baud rate selected and the previous timeout setting. The minimum timeout allowed is saved to memory if a lower value is entered (e.g. If user enters 0.00 with a baud rate of 300, 0.06 is saved)

Troubleshooting Tips

This meter is a highly sophisticated instrument with an extensive list of features and capabilities. If the front panel buttons are used to program the meter, it may be a difficult task to keep everything straight. That is why we strongly recommend the use of the MeterView software for all programming activities. A free USB adapter is available for programming with MeterView software if you register your meter.

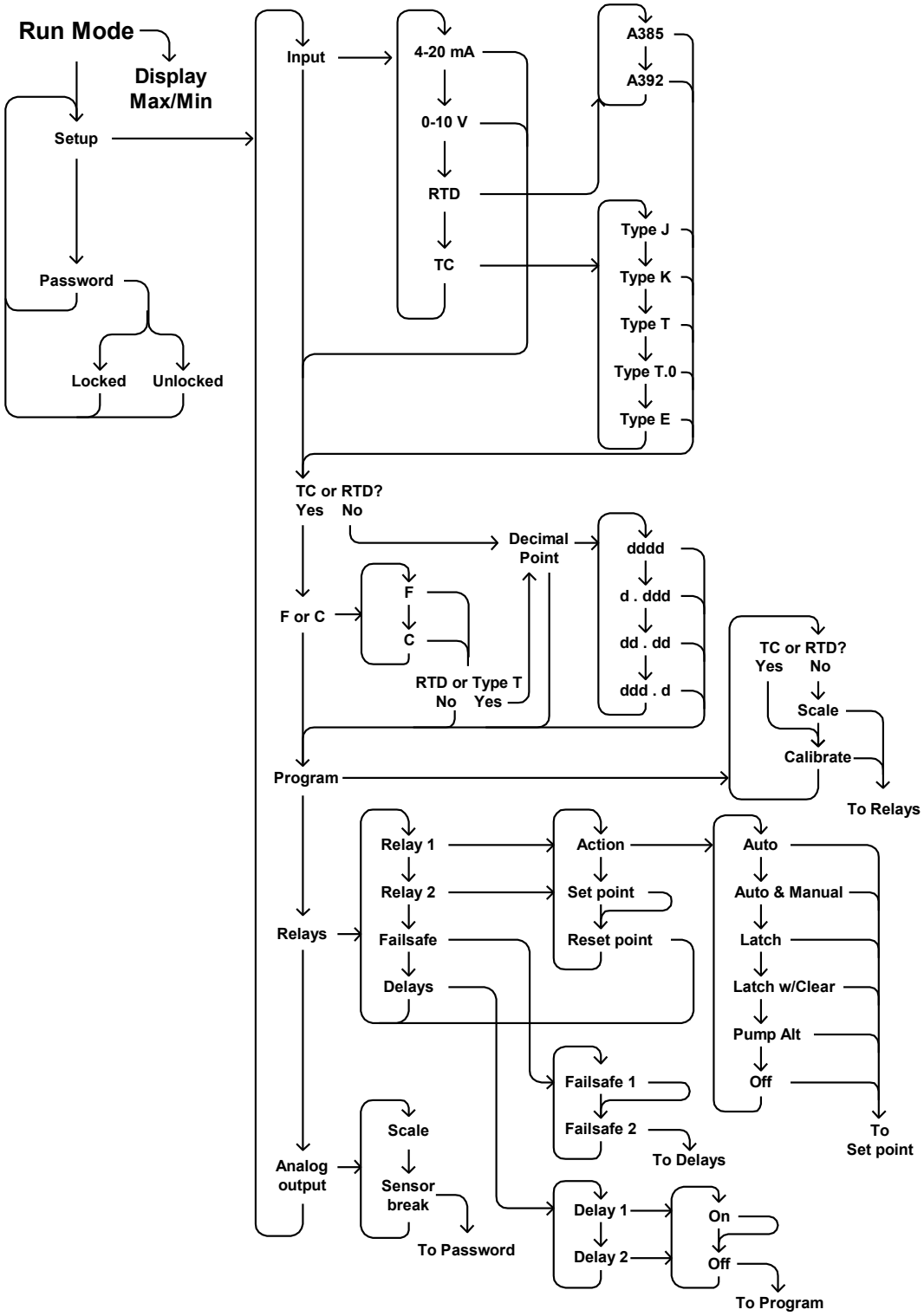
Symptom	Check/Action
No display at all	Check power at power connector
Not able to change setup or programming, LoCd is displayed	Meter is locked, enter correct four-digit password to unlock
Meter does not respond to input change	If a Low-Flow Cutoff Value has been programmed, the meter will display zero below that point, regardless of the input – which can appear like the meter is not responding to an input change. Check to make sure the problem is not being caused by an undesired low-flow cutoff value.
Meter displays error message during calibration (Err)	Check: 1. Signal connections 2. Input selected in *Setup* menu 3. Minimum input span requirements
Meter displays • oPEn • 9999 • -1999 • Displays negative number, not responding to RTD.	Check: 1. Input selected in *Setup* menu 2. TC/RTD Switch position 3. Corresponding signal at Signal connector
Display alternates between 1. Hi and a number 2. Lo and a number	Press **Menu** to exit Max/Min display readings.
Display response is too slow	Check filter and bypass values
Inaccurate temperature reading	Check: 1. Temperature units (°F or °C) 2. TC type or RTD curve selected 3. Offset adjustment 4. TC wire used 5. Calibration
If the display locks up or the meter does not respond at all	Cycle the power to restart the microprocessor.
Relay operation is reversed	Check: 1. Fail-safe in *Setup* menu 2. Wiring of relay contacts
Relay and status LED do not respond to signal	Check: 1. Relay action in *Setup* menu 2. Set and reset points
Meter not communicating with MeterView or other programs	Check: 1. Serial adapter and cable 2. Serial protocol selected 3. Meter address and baud rate 4. MeterView address and baud rate

Troubleshooting Tips

Symptom	Check/Action
SafeTouch buttons do not respond	1. If mechanical button was pushed, the SafeTouch buttons will be re-enabled automatically 60 seconds after the last button push. 2. If slide switch on connector board is in DISABLE position, switch to ENABLE. 3. Strong direct sunlight may interfere with SafeTouch button operation. It is recommended to operate the buttons by standing so as to block direct sunlight.
Serial Communications Power LED Indicator is off	Check 1. Modular cable connection 2. Power to the device
If only the TX (or DATA IN) data status LED is flashing when serial communications attempted	Check 1. Serial cable 2. Protocol selected on device 3. Instrument address & baud rate 4. Program address & baud rate
If both data status LEDs (TX and RX) are off when trying to communicate	Remove all unnecessary cables and instruments from the bus. Try getting the system to work with only one device (to ease troubleshooting) and then expand the system one device at a time.
Communications slow	Increase the baud rate
Random communication errors	1. Increase the TX delay time 2. Decrease the baud rate
Other symptoms not described above	Call Technical Support for assistance.

Note: Certain sequences of events can cause unexpected results. To solve these issues, it is best to start fresh from factory defaults and use the manual as a step by step programming guide, rather than a random approach to programming. To reset the meter to factory defaults, see *Reset Meter to Factory Defaults* on page *53*. In addition, for best results, we recommend using the free MeterView software for all programming needs.

Quick Interface Reference Guide



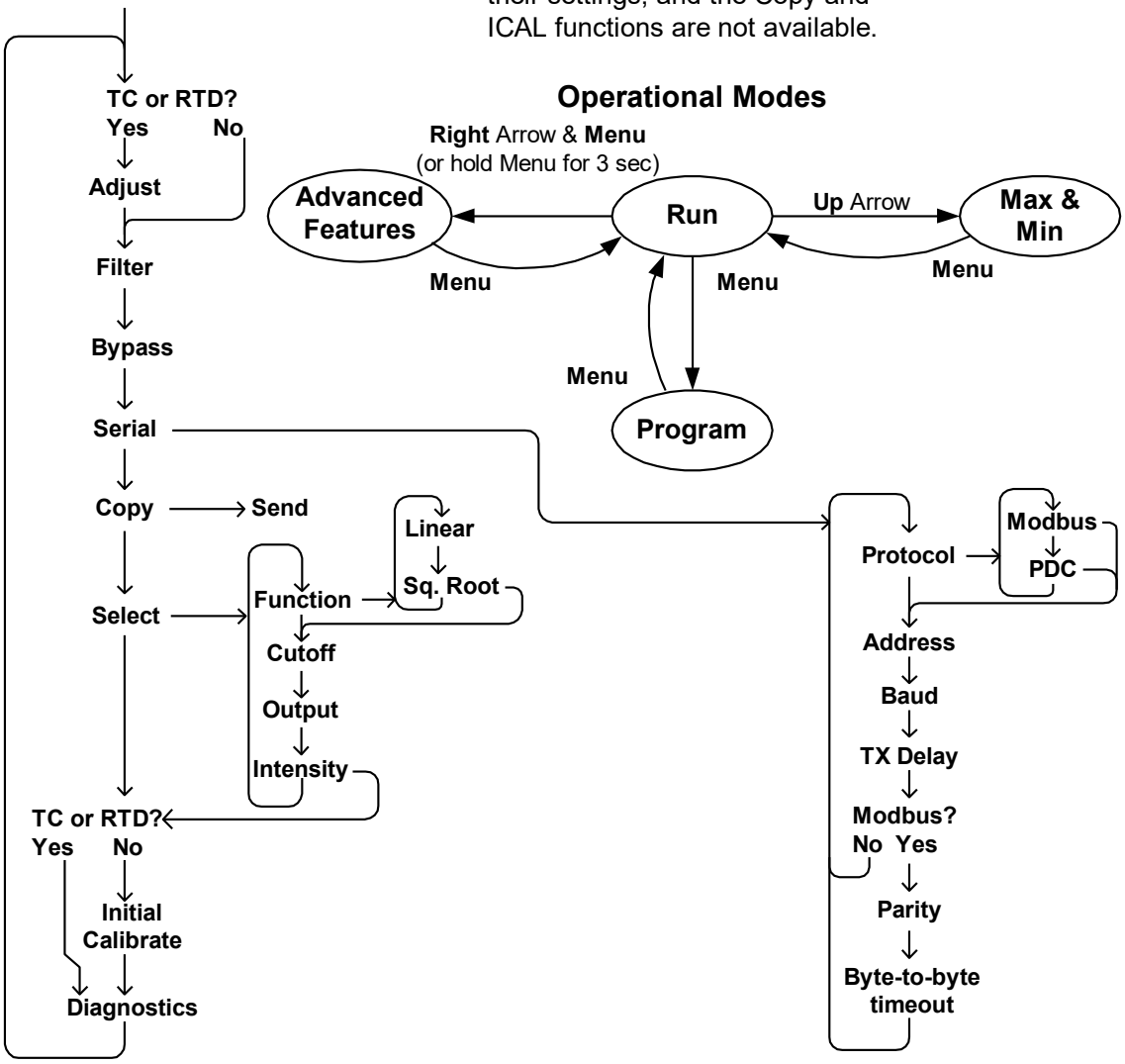
Pushbutton	Function
Menu	Go to Programming Mode or leave Programming, Advanced Features, and Max/Min Modes.
Right Arrow	Move to next digit.
Up Arrow	Move to next selection or increment digit.
Enter/Ack	Accept selection/value and move to next selection.

Right Arrow & **Menu** simultaneously enters Advanced Features

Max/Min Mode
While in Run Mode, pressing **Up** Arrow will initiate Max/Min Mode. **Up** Arrow toggles between Max & Min displays, and **Right** Arrow resets the Max/Min to the current value. Press **Menu** or wait 10 seconds to return to Run Mode. Pressing **Enter/Ack** will disable the 10 second timeout and continuously display Max or Min.

Press **Right** arrow and **Menu** to access Advanced Features Menu

When the meter is locked, Adjust, Filter and Bypass can only display their settings, and the Copy and ICAL functions are not available.



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Tab - 2.03

SITRANS F

Electromagnetic flowmeters

SITRANS F M MAG 5000/6000

Operating Instructions

Edition 12/2013

Answers for industry.

SIEMENS

SITRANS F

Flowmeters
SITRANS F M MAG 5000/6000

Operating Instructions

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Electromagnetic flow transmitter designed for use with flow sensor types
MAG 1100/1100 F/3100/3100 P/5100 W
Compact and remote installation

12/2013
A5E02338368-002

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG
GERMANY

Order number: A5E02338368
℗ 12/2013 Technical data subject to change

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Introduction

1

1.1 Preface

These instructions contain all the information you need for using the device.

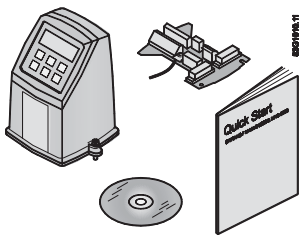
The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it as well as service and maintenance engineers.

Note

It is the responsibility of the customer that the instructions and directions provided in the manual are read, understood and followed by the relevant personnel before installing the device.

1.2 Items supplied

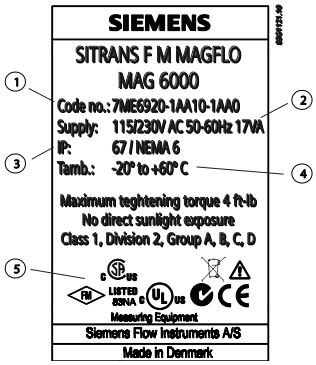
- SITRANS F M MAG 5000/6000 transmitter
- Calibration report
- SITRANS F literature CD
- Quick start guide



Inspection

1. Check for mechanical damage due to possible improper handling during shipment. All claims for damage are to be made promptly to the shipper.
2. Make sure the scope of delivery, and the information on the type plate corresponds to the ordering information

Device identification



① Code number
② Power supply
③ Enclosure rating
④ Ambient temperature
⑤ Approvals

Figure 1-1 MAG 5000/6000 nameplate

1.3 History

This document describes:

- SITRANS F MAG 5000 and MAG 6000 transmitters (standard version).
- Optional versions:
  - MAG 5000 Blind and MAG 6000 Blind
  - MAG 5000 CT and MAG 6000 CT
  - MAG 6000 SV

Documentation history

The contents of these instructions are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

The following table shows the most important changes in the documentation compared to each previous edition.

Edition	Remarks	FW version
01 01/2010	First edition	
02 01/2012		4.04
03 12/2013	• Customer defined unit • Velocity value with unit • Operational without SensorProm • EPD for 60 Hz mains	4.07

1.4 Further Information

Product information on the Internet

The Operating Instructions are available on the CD-ROM shipped with the device, and on the Internet on the Siemens homepage, where further information on the range of SITRANS F flowmeters may also be found:

Product information on the internet (http://www.siemens.com/flow)

Worldwide contact person

If you need more information or have particular problems not covered sufficiently by these Operating Instructions, get in touch with your contact person. You can find contact information for your local contact person on the Internet:

Local contact person (http://www.automation.siemens.com/partner)

Safety notes

2

⚠ CAUTION

Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance. Only qualified personnel should install or operate this instrument.

Note

Alterations to the product, including opening or improper repairs of the product, are not permitted.

If this requirement is not observed, the CE mark and the manufacturer's warranty will expire.

2.1 Laws and directives

General requirements

Installation of the equipment must comply with national regulations. For example EN 60079-14 for the European Community.

Instrument safety standards

The device has been tested at the factory, based on the safety requirements. In order to maintain this condition over the expected life of the device the requirements described in these Operating Instructions must be observed.

Environmental conditions according to IEC 61010-1 (2001)

- Indoor use
- Altitude up to 2000m
- Maximum relative humidity 80% for temperatures up to 31°C (88°F) decreasing linearly up to 50% relative humidity from 40°C (104°F)
- Main supply voltage fluctuations up to ±10% of the nominal voltage (see technical specifications)
- Overvoltage category II
- Pollution degree 2

CE-marked equipment

The CE mark symbolizes the compliance of the device with the following guidelines:

- EMC-guideline 89/336/EEC
- Low voltage guideline 73/23/EWG
- ATEX Directive 94/9/EG
- CT: (MI-001) Directive 2004/22/EC

2.2 Installation in hazardous location

⚠ WARNING

Equipment used in hazardous locations must be Ex-approved and marked accordingly.

It is required that the special conditions for safe use provided in the manual and in the Ex certificate are followed!

Ex approvals

CSA Class I, Division 2, Groups A, B, C and D. Code T5 for an ambient temperature of +60 °C.

FM Class I, Division 2, Groups A, B, C and D and Class I, Zone 2, Group IIC indoor/outdoor Type IP67 hazardous (classified) locations

Temperature specifications for Ex use

Temperature class	Ambient temperature [°C]		
	-40 to +40	-40 to +50	-40 to +60
T2	180 (process temperature)	-	-
T3	165 (process temperature)	140 (process temperature)	-
T4	100 (process temperature)	100 (process temperature)	80 (process temperature)
T5	65 (process temperature)	65 (process temperature)	65 (process temperature)
T6	50 (process temperature)	50 (process temperature)	50 (process temperature)

EX requirements

It is required that:

- Electrical connections are in accordance with Elex V (VO in explosion hazardous areas) and EN60079-14 (Installing Electrical Systems in Explosion Hazardous Areas).
- The protective cover over the power supply is properly installed. For intrinsically safe circuits the connection area can be opened.

- Appropriate cable connectors are used for the output cicuits: intrinsically safe: blue, non-intrinsically safe: black
- Sensor and transmitter are connected to the potential equalization. For intrinsically safe output circuits potential equalization must be maintained along the entire connection path.
- Sensor insulation thickness is max. 100mm (only insulated sensors).
- EN50281-1-2 is considered for installation in areas with combustible dust.
- When protective earth (PE) is connected, no potential difference between the protective earth (PE) and the potential equalization (PA) can exist, even during a fault condition.

Description

3

3.1 System components

A SITRANS F M MAG 5000/6000 flowmeter system includes:

- Transmitter (type SITRANS F M MAG 5000/6000)
- Sensor (types: SITRANS F MAG 1100/1100F/3100/3100 P/5100 W)
- Communication module (optional) (types: HART, PROFIBUS PA/DP, MODBUS RTU RS 485, Foundation Fieldbus H1, Devicenet)
- SENSORPROM memory unit

Communication solutions

The SITRANS F USM II range of add on modules, presently including HART, Foundation Fieldbus. MODBUS RTU RS 485, PROFIBUS PA / DP and Devicenet, are all applicable with the SITRANS F M MAG 6000 transmitter.

3.2 Operating principle

The transmitters are microprocessor-based with a built-in alphanumeric display in several languages. The flow measuring principle is based on Faraday's law of electromagnetic induction. Magnet coils mounted diametrically on the measuring pipe generate a pulsed electromagnetic field. The liquid flowing through this electromagnetic field induces a voltage.

The transmitters evaluate the signals from the associated electromagnetic sensors, convert the signals into appropriate standard signals such as 4 ... 20 mA, and also fulfil the task of a power supply unit providing the magnet coils with a constant current.

The transmitter consists of a number of function blocks which convert the sensor voltage into flow readings.

3.3 Applications

The pulsed DC-powered magnetic flowmeters are suitable for measuring the flow of almost all electrically conductive liquids, pastes, and slurries with max. 40% solids.

The main applications can be found in the following sectors:

- Water and waste water
- Chemical and pharmaceutical industries
- Food & beverage industry
- Mining and cements industries

- Pulp and paper industry
- Steel industry
- Power generation; utility and chilled water industry

3.4 Features

Power supply

2 different types of power supply are available. A 12 ... 24 V AC/DC and a 115 ... 230 V AC switch mode type.

Coil current module generates a pulsating magnetizing current that drives the coils in the sensor. The current is permanently monitored and corrected. Errors or cable faults are registered by the self-monitoring circuit.

Input circuit amplifies the flow-proportional signal from the electrodes. The input impedance is extremely high: $>10^{14}$ Ω which allows flow measurements on fluids with conductivities as low as 5 µS/cm. Measuring errors due to cable capacitance are eliminated due to active cable screening.

Digital signal processor converts the analog flow signal to a digital signal and suppresses electrode noise through a digital filter. Inaccuracies in the transmitter as a result of long-term drift and temperature drift are monitored and continuously compensated for via the self-monitoring circuit. The analog to digital conversion takes place in an ultra low noise ASIC with 23 bit signal resolution. This has eliminated the need for range switching. The dynamic range of the transmitter is therefore unsurpassed with a turn down ratio of minimum 3000:1.

CAN communication

The transmitter operates internally via an internal CAN communication bus. Signals are transferred through a signal conditioner to the display module and to/from internal/external option modules and the dialog module.

Dialog module

The display unit consists of a 3-line display and a 6-key keypad. The display shows a flow rate or a totalizer value as a primary reading.

Output module

The output module converts flow data to analog, digital and relay outputs. The outputs are galvanically isolated and can be individually set to suit a particular application.

3.5 MAG 5000/MAG 6000 versions

The transmitters are designed in various versions and offer high performance and easy installation, commissioning and maintenance.

Standard version

The standard version is an IP67 version for compact or remote installation. Its robust design ensures a long lifetime if installed outdoors.

Blind version

This version carries all the normal MAG 5000/6000 features, except those associated with the display and keypad.

Both current and digital outputs are available.

Factory setting of current output in unit is switched off when delivered.

CT version

The MAG 5000/6000 CT version is a custody transfer-approved transmitter.

It is approved according to:

- Cold water pattern approval (MAG 5000/6000 CT):
  - OIML R 49
- Cold water pattern approval (MAG 6000 CT only):
  - MI-001
- Hot water pattern approval (MAG 6000 CT only):
- Heat meter pattern approval (MAG 6000 CT only):
  - OIML R 75
- Other media than water (MAG 6000 CT only):
  - OIML R 117

* Energy metering

- PTB K7.2

SV version (MAG 6000 only)

This version is identical to the standard MAG 6000 transmitters except for the following additional functions:

- Zero point adjustment
- Adjustable excitation frequency up to 44 Hz

Installing/Mounting

4

4.1 Introduction

- SITRANS F flowmeters are suitable for indoor and outdoor installations.

⚠ WARNING
Installation in hazardous location
Special requirements apply to the location and interconnection of sensor and transmitter. See "Installation in hazardous area"

This chapter describes how to install the flowmeter in the compact version as well as in the remote version.

The transmitter is delivered ready for mounting on the sensor. The transmitter is delivered with a compression plate ready for mounting on the sensor. No further assembling is necessary.

The transmitter can be installed either compact on the sensor or remote.

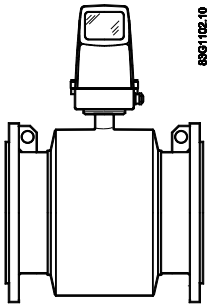


Figure 4-1 Compact installation

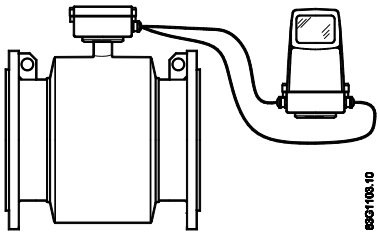
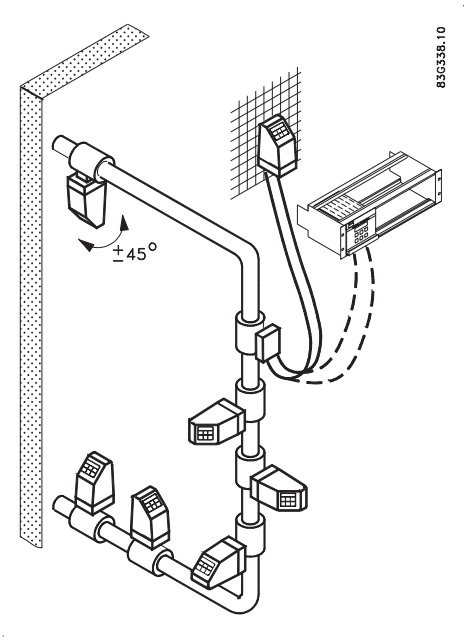


Figure 4-2 Remote installation

⚠ CAUTION
See Cable requirements (Page 72) before installing transmitter

4.2 Installation conditions

Reading and operating the flowmeter is possible under almost any installation conditions because the display can be oriented in relation to the sensor. To ensure optimum flow measurement, attention should be paid to the following:



Vibrations

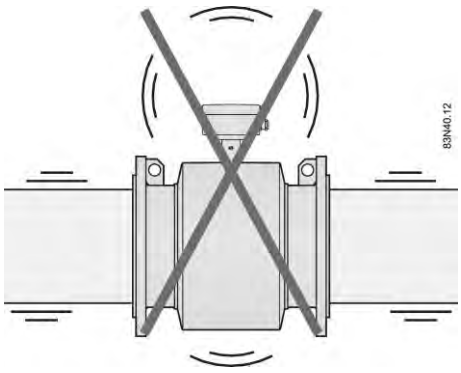
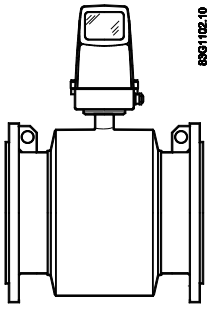


Figure 4-3 Avoid strong vibrations

Compact installation



Medium temperature must be in accordance with the graphs showing max. ambient temperature as a function of medium temperature.

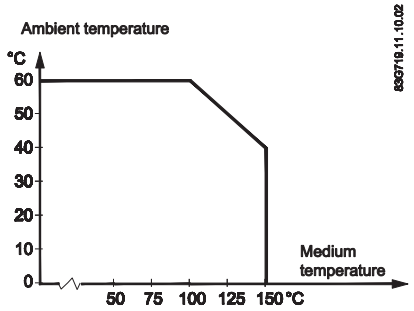


Figure 4-4 Standard, blind and SV versions

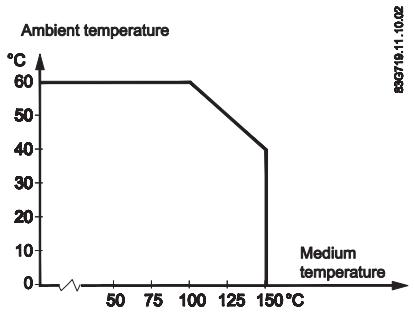
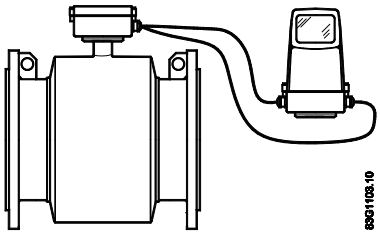


Figure 4-5 CT version

Remote installation



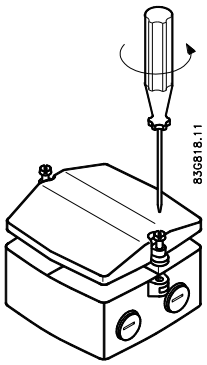
Cable length and type (as described in Cable requirements (Page 72)) must be used.

For installation conditions for sensors, see respective sensor operating instructions.

4.3 MAG 5000/6000 compact

Install MAG 5000 / MAG 6000 compact version

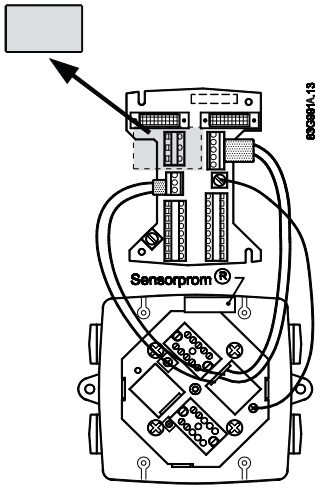
1. Remove and discard terminal box lid of sensor.



2. Ensure SENSORPROM® memory unit is installed.
3. Fit M20 or ½" NPT cable glands for supply and output cables.
4. Unplug the two black plug assemblies for coil and electrode cables in terminal box.
5. Connect earth wire from connection board to bottom of terminal box.
6. Connect 2-pin connector and 3-pin connector as shown to their corresponding terminal numbers on connection board as shown in Electrical connection (Page 36).

Note

System will not register flow if black plugs are not connected to connection board.



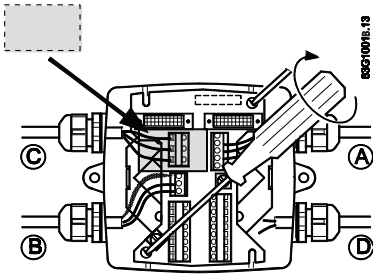
7. Fit supply and output cables through cable glands and connect to connection plate as shown in Electrical connection (Page 36).

8. Mount connection plate in terminal box.

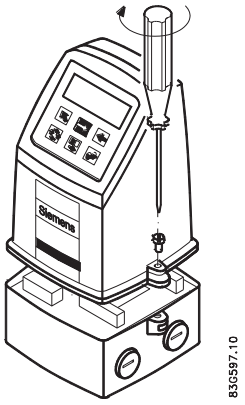
Note

Check that your connection board lines up with SENSORPROM® unit, if not, move SENSORPROM® unit to the other side of terminal box.

SENSORPROM® memory unit connections will be established automatically when connection plate is mounted in terminal box.



9. Tighten cable glands to obtain optimum sealing.
10. Mount transmitter on terminal box.



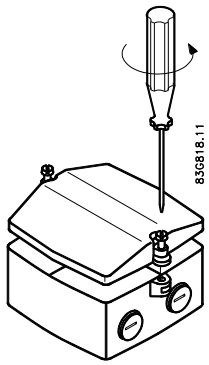
11. Transmitter is ready to be powered up.

NOTICE
Exposing transmitter to direct sunlight may increase operating temperature above its specified limit, and decrease display visibility.
A sunshield is available as accessory.

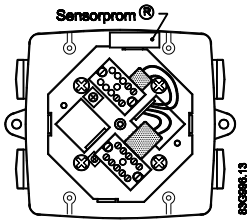
4.4 Remote installation

At sensor

1. Remove terminal box lid.

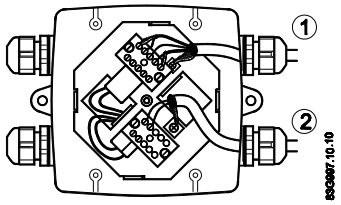


2. Remove SENSORPROM® unit from sensor terminal box and mount it in terminal box of wall mounting unit.



3. Fit M20 or ½" NPT cable glands for cables.

4. Fit and connect electrode (1) and coil (2) cables as shown in Electrical connection (Page 36).

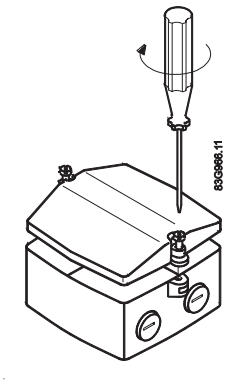


Note

Unscreened cable ends must be kept as short as possible.

Electrode cable and coil cable must be kept separate to prevent interference.

5. Tighten cable glands well to obtain optimum sealing.



⚠ WARNING

Mount terminal box lid before power up.

Wall mounting

1. Mount bracket on a wall or on a horizontal or a vertical pipe using ordinary hose clips or duct straps.

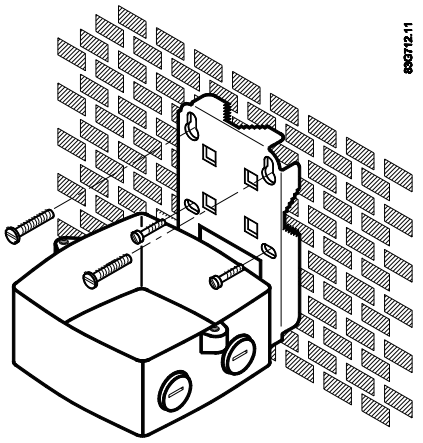


Figure 4-6 Wall mounting

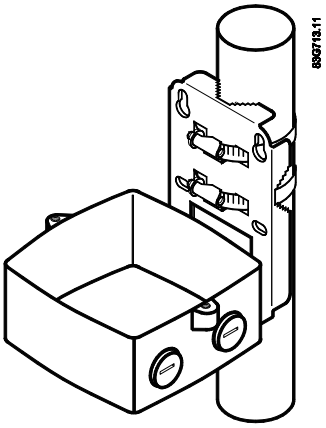


Figure 4-7 Pipe mounting - vertical

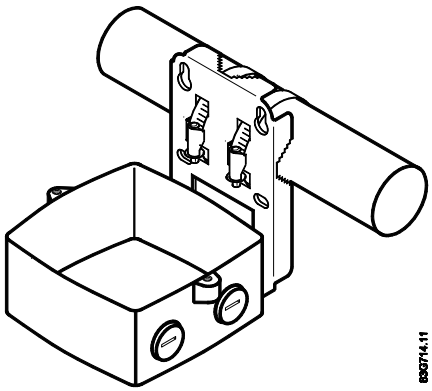
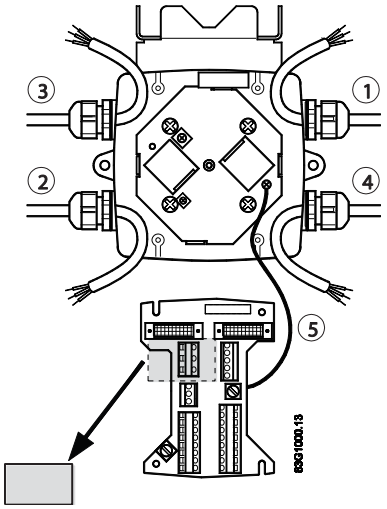


Figure 4-8 Pipe mounting - horizontal

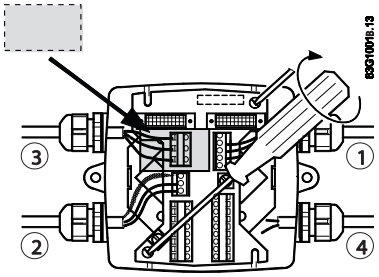
2. Ensure that correct SENSORPROM® memory unit is mounted in wall/pipe mounting unit.

3. Fit M20 or ½" NPT cable glands for cables from bottom or sides of terminal box.
4. Mount earth wire in bottom of terminal box.



① Connect electrode cable
② Connect coil cable - keep separate from electrode cable
③ Connect power supply
④ Connect output cable
⑤ Connect PE (ground) wire

5. Mount connection plate in terminal box.



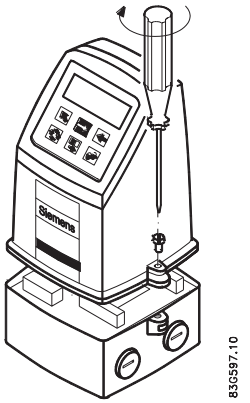
① Electrode cable
② Coil cable
③ Power supply
④ Output cable

6. Fit coil, electrode, supply and output cables through cable glands and connect to connection plate as shown in Electrical connection (Page 36).
7. Fix connection plate with the two diagonally opposite screws.

8. Tighten cable glands to obtain optimum sealing.

⚠ CAUTION
When remote mounted, power supply PE wire must be connected to PE terminal (⏚). Coil cable shield must be connected to SHIELD terminal.

9. Mount transmitter on terminal box.



10. Transmitter is ready to be powered up.

NOTICE
Exposing the transmitter to direct sunlight may increase the operating temperature above its specified limit, and decrease display visibility. A sun shield is available as accessory.

4.5 MAG 5000/6000 CT

To ensure that the settings of this custody transfer-approved MAG 5000/6000 CT transmitter are not changed, it is necessary to install a hardware key to lock the software functions and to seal the device.

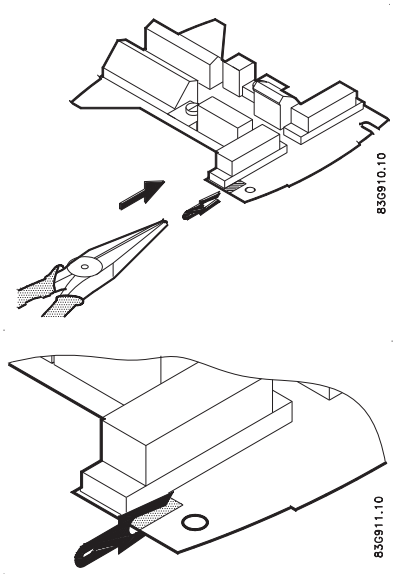
MAG 6000 CT is installed like a Standard MAG 6000 except for the final sealing.

Calibration sealing has been carried out at calibration.

4.5.1 Installing hardware key

Use hardware key on non-verified transmitter

1. Mount hardware key on transmitter connection plate during setting of primary operating parameters such as $Q_{max.}$, low-flow cut-off, units, approvals, etc. in connection with commissioning or calibration. See setup menus in appendix menu diagrams.



2. Remove hardware key after setting up and calibrating unit.

   This locks the menu structure and the selected settings.

Note

Hardware key function

Setting of primary operating parameters is blocked during normal operation.

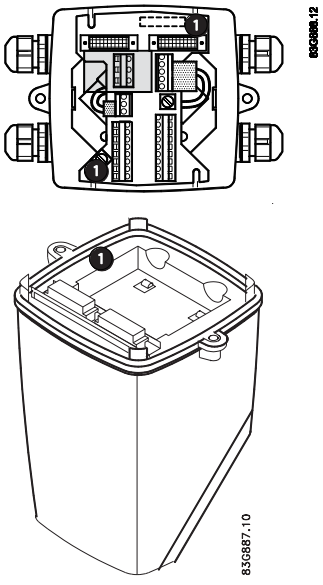
When key is mounted, access to all menu items is gained. When key is removed, primary settings are blocked in accordance with requirements in authorisation.

4.5.2 Seal device

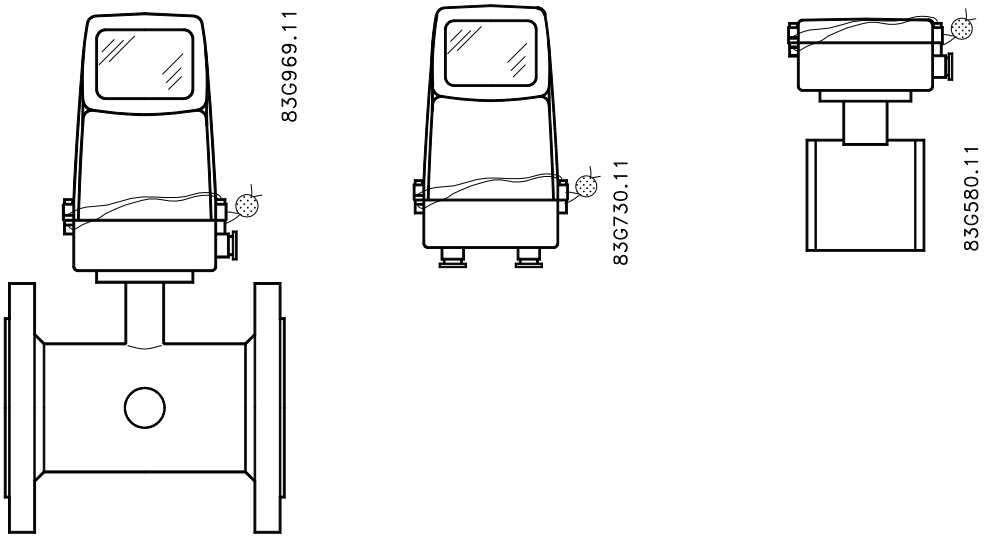
Seal transmitter

⚠ CAUTION
Seal transmitter to prevent unauthorized access.

1. Seal connection plate to prevent access to SENSORPROM® memory unit as shown below. 1 indicates sealing locations.



2. Drill through marked drilling holes in terminal box and transmitter/lid. Seal transmitter externally as shown below.



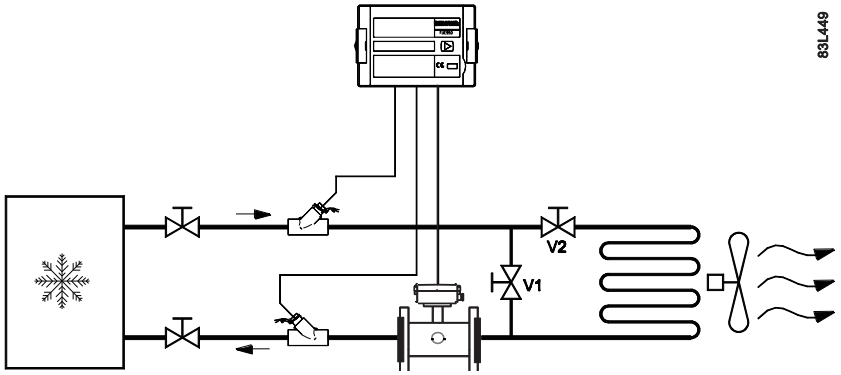
4.5.3 Installation conditions

4.5.3.1 MI-001

MAG 5000/6000 CT together with MAG 5100W (7ME652) are approved for Mi-001 under the following installation conditions.

- DN 50 to 300 mm (2" to 12")
- Horizontal installation
- Compact or remote with max. 3 m cable
- Power supply 115/230 V AC

Other restrictions may apply (see certificate).



4.5.3.2 PTB K7.2

MAG 5000/6000 CT together with MAG 5100W (7ME652) are approved for PTB K7.2 under the following installation conditions.

SITRANS F M MAG 5100 W with MAG 5000/6000CT

- DN 50 to 300 mm (2" to 12")
- Horizontal installation
- Compact or remote with max. 10 m (33 ft.) cable

Other restrictions may apply (see certificate 22.76/10.02)

**insert installation conditions as pasted

4.6 Turning transmitter/keypad

It is possible to alter the standard assembly, e.g. to turn transmitter or keypad.

Transmitter

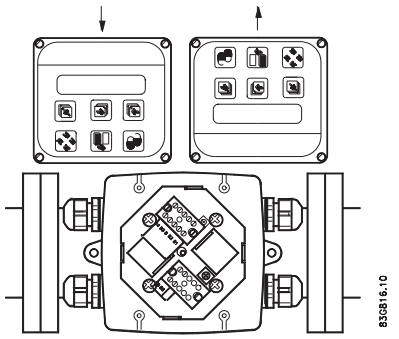


Figure 4-9 Transmitter can be mounted with its front in either direction indicated by the arrows without turning terminal box

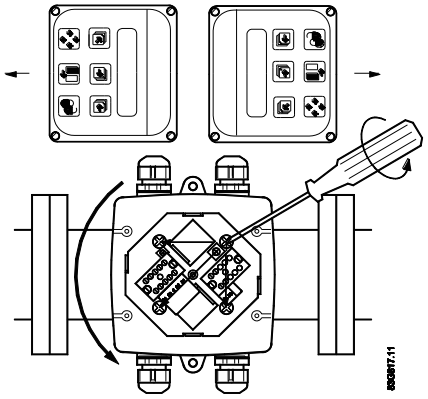
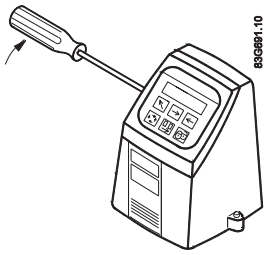


Figure 4-10 Terminal box can be rotated ±90° in order to optimize viewing angle of transmitter display/keypad

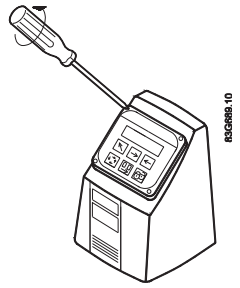
1. Unscrew the four screws in bottom of terminal box.
2. Turn terminal box to required position.
3. Retighten screws firmly.

Keypad

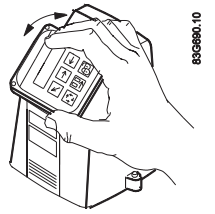
1. Remove outer frame using a screwdriver.



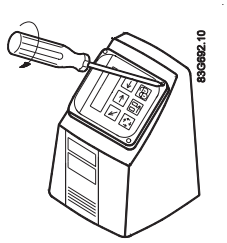
2. Loosen the four screws retaining keypad.



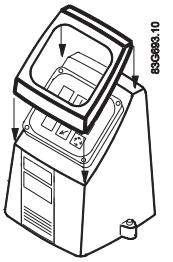
3. Withdraw keypad and turn it to required orientation.



4. Tighten the four screws until a mechanical stop is felt in order to obtain IP67 enclosure.



5. Snaplock outer frame onto keypad (click).



Connecting

5

⚠ WARNING

Mains supply from building installation Class II

A switch or circuit breaker (Max. 15 A) must be installed in close proximity to the equipment and within easy reach of the operator. It must be marked as the disconnecting device for the equipment.

⚠ WARNING

Protective conductor terminal

The required cable is min. AGW16 or 1.5 Cu.

⚠ WARNING

Wire insulation

The insulation between the connected mains supply and 24 V AC/DC supply for the flowmeter must at least be rated with double or reinforced insulation at mains voltage.

For field wiring installation: Ensure that the **National Installation Code** of the country in which the flowmeters are installed is met.

Note

National installation code

Observe country specific installation directives for field wiring.

5.1 Electrical connection

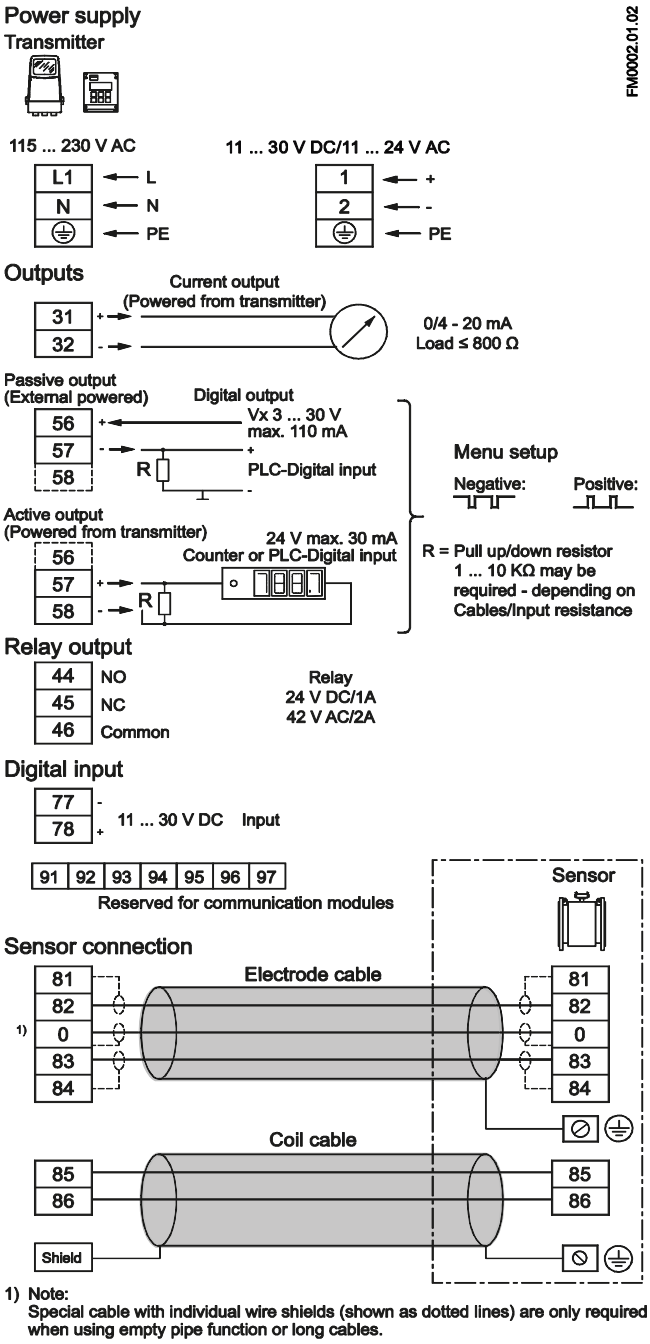


Figure 5-1 Wiring diagram

Note

Terminals 81 and 84 are only to be connected if special electrode cable with double screening is used, e.g. when empty pipe function or long cables are used.

Mains supply

Mains supply 115 ... 230 V AC from building installation Class II.

Note

For DC installations it is recommend to install an under voltage relay or protection circuit in the application where there is a risk of low power supply below the specifications for more than 10 minutes.

⚠ WARNING

Grounding

Connect mains protective earth wire to PE terminal in accordance with diagram (due to class 1 power supply).

Mechanical counter

Connect a 1000 µF capacitor (capacitor+ to terminal 56 and capacitor- to terminal 58) if a mechanical counter is connected to terminals 57 and 58 (active output).

Output cables

Use screened cables if long cables are used in noisy environments.

Digital output

If internal resistance of a load exceeds 10 kΩ, connect an external 10 kΩ load resistor in parallel to this load.

⚠ WARNING

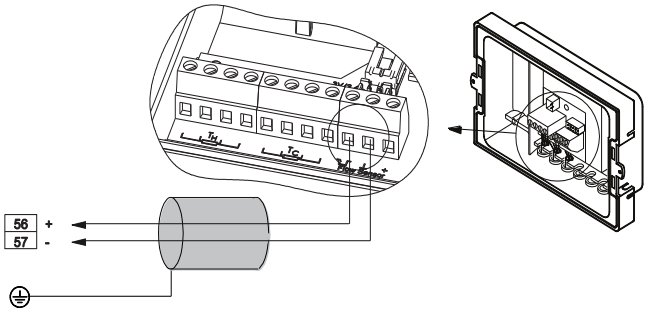
Intrinsically safe terminals

Always ensure that distance between cables/wires is **minimum 50 mm** in order to avoid that wires/terminals of intrinsically safe circuits get into contact with wires of other cables.

Fasten cables/wires in a way that they **cannot** get into contact with each other, not even in case of an error. Keep wire ends as short as possible.

5.2 Electrical connection PTB K7.2

Additional Electrical connection for PTB K7.2 approved MAG5000/6000 with MAG5100W (7ME652)



5.3 Connection of add-on modules

When the add-on module has been installed, the electrical connections are available on terminal rows 91-97.

For more information

Refer to the relevant BUS communication Quick Start or Operating Instructions available at the SITRANS F literature CD or on the internet, at : www.siemens.com/flowdocumentation (www.siemens.com/flowdocumentation).

Commissioning

6

In this chapter it is described how to commission the device via the local user interface (LUI).

The display is described in details in section Local user interface (Page 40).

Furthermore, the following functions are described in details:

- Changing password (Page 42)
- Changing basic settings (Page 43)
- Changing operator menu setup (Page 45)
- Changing language (Page 46)

Detailed diagrams concerning the specific menu are shown in appendix menu diagrams.

For factory settings, see Factory settings.

6.1 MAG 5000/6000 Blind

Note

Does not have a display. All factory settings will be uploaded from the SENSORPROM® unit after power-up.

For sensor dependent factory settings, see Appendix B.

Changing settings

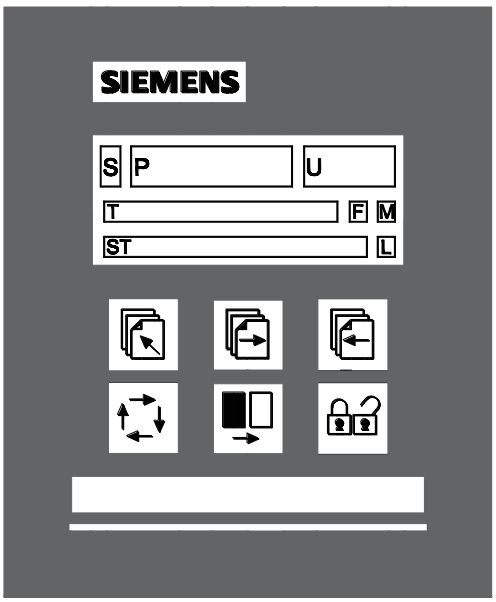
If other settings are required, a standard transmitter with display and similar power supply can be used.

1. Unscrew and remove MAG 5000/6000 Blind.
2. Mount standard MAG 5000/6000 transmitter.
3. Change required settings via display and keypad.

   All changed data will be stored in SENSORPROM® memory unit.
4. Remove standard transmitter and remount Blind transmitter.
5. Fasten screws holding transmitter.

New settings stored in SENSORPROM® memory unit will be uploaded in blind transmitter.

6.2 Local user interface



S Sign field

P Primary field for numeric value flow rate, Totalizer 1 or Totalizer 2)

U Unit field

T Title line with individual information according to operator or setup menu selected.

ST Subtitle line which will either add information to the title line or keep individual information independent of the title line.

F Alarm field. Two flashing triangles will appear in case of a fault condition.

M Mode field

L Lock field

Figure 6-1 Local User Interface

Mode field symbols

Communication mode	Language mode	Sensor characteristics
Service mode	Basic settings	Reset mode
Operator menu	Output	Operator-active
Product identity	External input	Operator-inactive

Lock field symbols

	Ready for change		Access to submenu
	Value locked		RESET MODE: Zero setting of totalizers and initialization of setting

Keypad

The keypad is used to set the flowmeter. The keys function as follows:

TOP UP KEY		This key (when held for 2 sec.) is used to switch between operator menu and setup menu. In transmitter setup menu, a short press will cause a return to previous level.
FORWARD KEY		This key is used to step forward through the menus. It is the only key normally used by the operator.
BACKWARD KEY		This key is used to step backwards through the menus.
CHANGE KEY		With this key settings or numerical values are changed.
SELECT KEY		With this key figures to be changed are selected.
LOCK/UNLOCK KEY		This key enables the operator to change settings and it gives access to submenus.

6.3 Menu structure

The menu is built up of two parts. An **operator menu** and a **setup menu**, see also overview diagrams MAG 5000/6000 and MAG 5000/6000 CT.

Operator menu

The operator menu is for daily operation. It is customized in the operator menu setup. The transmitter always starts up in operator menu No. 1. The forward and the backward keys are used to step through the operator menus.

Setup menu

The setup menu is for commissioning and service only. Access to the setup menu is gained by pressing the top up key for 2 seconds. The setup menu operates in two modes:

- View mode
- Setup mode

View mode is a read-only mode. The pre-selected settings can only be scanned.

Setup mode is a read and write mode. The pre-selected settings can be scanned and changed. Access to the setup mode is password-protected. The factory set password is 1000.

Access to a submenu in the setup menu is gained by pressing the lock key. Press the top up key briefly to return to the previous menu. Press longer (2 sec.) to exit the setup menu and return to operator menu No. 1.

6.4 Changing password

The setup menu is password-protected in order to ensure that only authorized personnel can make any changes in transmitter settings.

Change password as follows:

1. Press top up key for 2 sec.
2. Enter password.
3. Use forward key or backward key to reach password menu.
4. Press lock/unlock key to unlock password.
5. Use select key and change key to change password.
6. Press lock/unlock key to confirm new password.
7. Press top up key two times to exit setup mode.

See change password diagram.

The factory-set password is 1000, but it can be changed to any value between 1000 and 9999.

Factory setting of password can be re-established as follows:

1. Switch off power supply.
2. While pressing top up key - switch on power supply.
3. Release top up key after 10 sec.

6.5 Changing basic settings

In the basic settings menu it is possible to set the following parameters:

Parameter	Description
Main frequency	Selection of main power supply frequency corresponding to the country in which the flowmeter is installed (e.g. 60 Hz in America).
Flow direction	Selection of correct flow direction in pipe.
Customer units	Setting of user defined volume and time units.
Q_{max}	Setting of measuring range, analog outputs and frequency output. Also individual dimension-dependent setting of value, decimal point, unit and time.
Q_{max} 2	Setting of measuring range, analog outputs and frequency output. Also individual dimension-dependent setting of value, decimal point, unit and time. This menu is only visible if chosen as external digital input.
Totalizer	Setting of unit and decimal point.
Low flow cut-off	Setting of a percentage of selected Q_{max}. This filters noise in installation reducing fluctuations in display and all outputs.
Empty pipe cut-off	When set to "On" the alarm will indicate when sensor is running empty. All readings, display and outputs, will indicate zero.
Velocity unit	Setting of velocity unit per time unit
Error level	Selecting error level at which flowmeter will detect an error.

Note

Totalizer 2 is not visible when batch is selected as digital output.

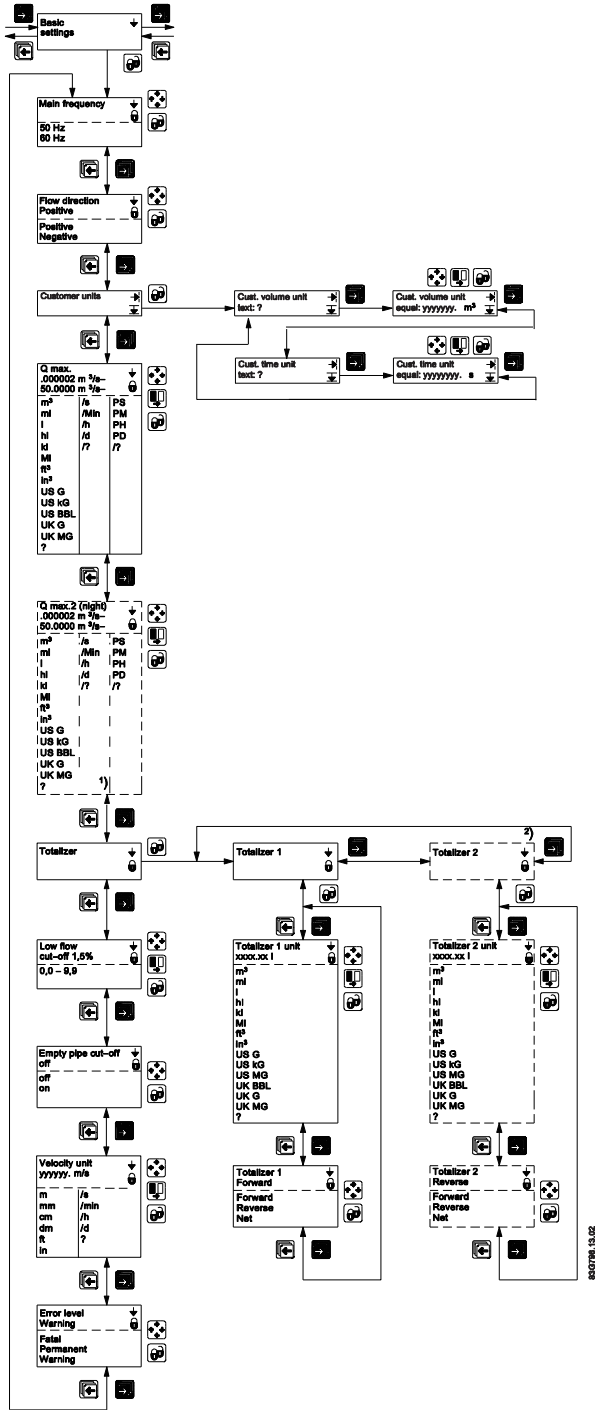
Note

Q_{max} 2 is visible only when chosen as digital input.

Change basic settings as follows:

1. Press top up key for 2 sec.
2. Enter password.
3. Use forward key to reach basic settings menu.
4. Press lock/unlock key to unlock settings.
5. Use forward key or backward key to reach relevant menu.
6. Press lock/unlock key to unlock settings.
7. Use select key and change key to change settings.
8. Press lock/unlock key to confirm new settings.

9. Repeat steps 5-8 to change other settings.
10. Press top up key ⇱ two times to exit setup mode.



Decimal point can be positioned and units set individually for flow rate in totalizer 1 and totalizer 2.

Changing decimal point position

1. Enter the respective totalizer menu.
2. Use select key to position cursor below decimal point.
3. Use change key to move decimal point to requested position.

Changing units

1. Use select key to position cursor below unit.
2. Press change key until requested unit is displayed.

6.6 Changing operator menu setup

In the operator menu the menus required for daily operation of the flowmeter are shown. It is possible to hide and change some of the menus in the operator menu. This is done in the operator menu setup menu, see operator menu setup diagram.

Customizing menus in operator menu

To customize the menus in the operator menu perform the following steps:

1. Press top up key for 2 sec.
2. Enter password.
3. Use forward key or backward key to reach operator menu.

Changing text in line 1

1. Press lock/unlock key to unlock setting.
2. Use change key to select desired text.
3. Press lock/unlock key to confirm selected text.

Note

If "Text" is selected in line 2, this line functions as a heading for the value shown in line 3. Otherwise it shows the actual value of the reading selected.

Enabling two readings

1. Use forward key to reach requested menu.
2. Press lock/unlock key to unlock setting.
3. Use select key to move cursor to upper line.
4. Use change key to select requested reading.
5. Press lock/unlock key to confirm selection.

6. Use select key to move cursor to line 3.
7. Use change key to select desired setting.
8. Press lock/unlock key to confirm new setting.
9. Repeat steps 1-8 for each requested menu.

Showing/hiding menus in operator menu

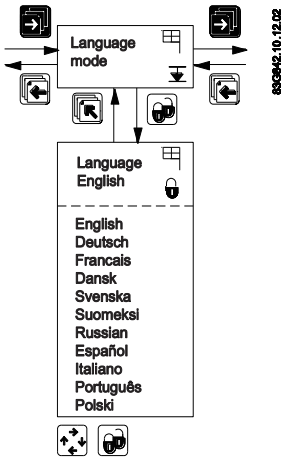
1. Use forward key to reach requested menu.
2. Press lock/unlock key to unlock setting.
3. Use select key to move cursor to √/÷ symbol.
4. Press change key to select visible (√) or hidden (÷).
5. Press lock/unlock key to confirm new setting.

6.7 Changing language

It is possible to change language in transmitter. Default language is English, but it can be changed to various other languages.

Change language as follows:

1. Press top up key for 2 sec.
2. Enter password.
3. Use forward key or backward key to reach language menu.
4. Press lock/unlock key to unlock language.
5. Use change key to select desired language.
6. Press lock/unlock key to confirm new language.
7. Press top up key two times to exit setup mode.



Functions

7

This chapter describes the various menus of the transmitter in details. The menu diagrams are shown in appendix menu diagrams.

7.1 Output settings

Three outputs are available:

- Current output (range and time constant); terminals 31 and 32.
- Digital output (pulse, frequency, error, limit, or batch settings); terminals 56, 57, and 58.
- Relay output (error, limit, and batch settings); terminals 44, 45, and 46.

Current output

In the current output menu it is possible to select current output direction, range and time constant, see also Current output menu diagram.

If current output "4-20 mA + Alarm" is selected, then alarm level and alarm differentiation may also be defined.

"Alarm level" defines if an alarm should be above 21 mA "High" or below 3.6 mA "Low".

"Alarm diff." defines whether or not the alarm should vary according to selected error level. Error level "Fatal". "Permanent" or "Warning" is selected in "Basic settings".

If Alarm differentiation is set to "Yes", depending on the Alarm level setting, the current output will show:

Alarm level	Output / Error level		
	Fatal	Permanent	Warning
Low	1.3 mA	2 mA	3 mA
High	23 mA	22 mA	21.5 mA

If Alarm differentiation is set to "No", depending on the Alarm level setting, the current output will show:

Alarm level	Output
Low	3.5 mA
High	22.6 mA

For setting of error level, see Error level menu diagram.

If current output is not used, it must be set to "Off".

Digital output

Digital output can be used to configure various settings:

- Pulse (volume/pulse, pulse output, pulse width, pulse polarity, and time constant), see pulse menu diagram.
- Frequency (frequency output, max frequency, and time constant), see frequency menu diagram.
- Error settings (level and number), see error level menu diagram and error number menu diagram.
- Limit settings (number of setpoints, setpoint settings, and hysteresis), see direction/limit menu diagram.
- Batch settings (quantity, time and counter settings, and time constant), see batch menu diagram.

Note

Batch settings

Only MAG 6000.

Not available in MAG 5000, MAG 5000 CT and MAG 6000 CT.

Note

When relay is set to batch function, pulse/frequency is not available on digital output.

Relay outputs

Relay output can be used to configure various settings:

- Error settings (level and number), see error level menu diagram and error number menu diagram.
- Limit settings (number of setpoints, setpoint settings, and hysteresis), see direction/limit menu diagram.
- Batch settings (quantity, time and counter settings, and time constant), see batch menu diagram.
- Cleaning (cycle time), see cleaning menu diagram.

Note

Batch settings

Only MAG 6000.

Not available in MAG 5000, MAG 5000 CT and MAG 6000 CT.

Note

Cleaning

If a cleaning unit is installed together with transmitter, relay output must **always** be used to operate this unit. It cannot be used for other purposes.

7.2 External input

By applying 11 … 30 V DC to terminals 77 and 78, it is possible to perform:

- Batch control (start, stop, hold/continue)
- Reset totalizer
- Force/freeze output
- Q_{max} 2 (night)

See external input menu diagram.

Note

Batch settings

Only MAG 6000.

Not available in MAG 5000, MAG 5000 CT and MAG 6000 CT.

Note

Manual cleaning

If the digital input is used for manual cleaning, the relay output also automatically changes to "cleaning".

7.3 Sensor characteristics

The sensor characteristics menu shows:

- If a SENSORPROM® is installed or not.
- Suppress error P 40 (SENSORPROM® not installed)
- Sensor size.
- Calibration factor.
- Correction factor.
- Excitation.

See also sensor characteristics menu diagram.

7.4 Reset mode

The reset mode is used for resetting totalizers/counters or for restoring MAG 5000/6000 to its factory settings.

Resetting

1. Press top up key for 2 sec.
2. Enter password.
3. Use forward key or backward key to reach reset mode menu.
4. Press lock/unlock key to enter reset menu.
5. Press forward key to reach totalizer/counter to be reset or default setting menu.
6. Press lock/unlock key to start resetting.

If restoring of factory settings is required:

1. Press lock/unlock key again to confirm destruction of customized settings.

See also reset menu diagram.

Zero point adjustment (MAG 6000 SV only)

Auto adjustment

Before auto zero point adjustment is carried out ensure that valves to and from flowmeter are completely closed and that flow velocity in sensor is zero.

1. Press top up key for 2 sec.
2. Enter password.
3. Use forward key or backward key to reach reset mode menu.
4. Press lock/unlock key to enter reset menu.
5. Press forward key to reach zero adjust menu.
6. Press lock/unlock key to enter the menu.
7. Use change key to select "auto".
8. Press forward key to view actual offset (lower line in display). Value will be zero after adjustment has been performed.
9. Press lock/unlock key to start adjustment.

Manual adjustment.

1. Press top up key for 2 sec.
2. Enter password.
3. Use forward key or backward key to reach reset mode menu.
4. Press lock/unlock key to enter reset menu.
5. Press forward key to reach zero adjust menu.
6. Press lock/unlock key to enter the menu.
7. Use change key to select "manual".

8. Press forward key and then select key and change key to key in offset value.
9. Press lock/unlock key to start adjustment.

Zero point can be adjusted manually in range -1.000 ... +1.000 m^3/s. If value outside this range is keyed in, zero point adjustment will not be implemented.

See also reset mode menu diagram (MAG 6000 SV).

7.5 Service mode

All outputs of the transmitter can be forced-controlled in the service mode menu, see also service mode menu diagram.

Here it is possible to check whether e.g. the current output is functioning.

Error pending and status log lists are also accessible from this menu and the operating time (in days) can be read.

The forced control is cut off and all previous settings are reinitialized the moment the service mode is left by pressing top up key .

7.6 MAG 5000 CT and MAG 6000 CT settings

Internal totallizers

Depending on the type of approval it is possible to reset the internal totalizers. The type of approval is selected in the reset menu with the hardware key mounted. It is possible to choose between:

- Hot/cold water
- Other liquids

Resetting of totalizers by electrical input is not possible.

Hot/cold water

- Totalizer 1 is allocated to forward flow (cannot be reset)
- Totalizer 2 is allocated to reverse flow (cannot be reset)

Other liquids

Both totalizer 1 and totalizer 2 are allocated to measure the net flow, i.e. any reverse flow will make the totalizers count backwards.

- Totalizer 1 cannot be reset.
- Totalizer 2 can be reset if the flow velocity in the meter pipe is <0.25 m/s. When the totalizer is reset, the pulse output register will also be reset.

Output

- When choosing hot water, changing the output settings is not allowed and the output setting menus are not shown in display.
- When choosing cold water or other liquids, all output settings can be changed.

7.7 MAG 6000 SV

Excitation frequency

The MAG 6000 SV excitation frequency can be changed in sensor characteristics menu to one of the following frequencies:

- 1 $^{9}/_{16}$ Hz
- 3 $^{1}/_{8}$ Hz
- 6 ¼ Hz
- 12½ Hz
- 25 Hz
- 44 Hz

Note

Calibration has been made with the frequency stored in SENSORPROM® memory unit. A change in excitation frequency is not recommended and will always mean decreased measuring accuracy. In some instances, however, it may be necessary to change frequency due to pulsating flow from piston pumps or other resonance frequencies from surroundings.

It is highly recommended to carry out a External input (Page 49) after changing the excitation frequency as the offset is affected by the frequency selected. When this is done, the decrease in measuring accuracy can be kept below 1% o.r.

A too high frequency for the sensor used will cause a coil current alarm indication.

Alarm, error, and system messages

8

8.1 Diagnostics

Error system

Transmitter system is equipped with an error and status log system with 4 groups of information.

(**I**) Information - system will continue to measure as normal, relay and current outputs will not be affected.

(**W**) Warning - system will continue to measure, but an event that may cause a system malfunction and require operator attention has occurred. The cause of the error may disappear on its own.

(**P**) Permanent error - may cause malfunction in the application and operator attention is required.

(**F**) Fatal error - is essential for the operation of the flowmeter. Immediate operator attention is required.

Two menus are available in service and operator menus for registration of information and errors.

- Error pending
- Status log

Note

Registration of errors in different modes

- In setup mode (local dialog) errors are entered only to Error pending list and not to Error log list, and not registered on physical outputs (current or relay).
- In service mode errors are entered to both Error pending and Error log lists, but not registered on physical outputs (current or relay).

Note

Power-off

Both error pending and status logs are reset at power-off.

Error pending

The first 9 pending errors are stored in the error pending list. When the error is corrected, it is removed from the error pending list.

The acceptance level for "error pending" can be individually configured to a particular application.

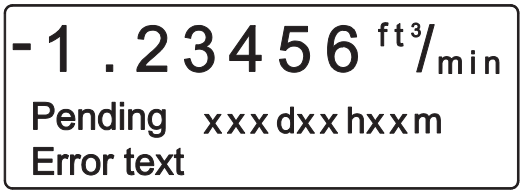
The acceptance level is set in the basic settings menu (Page 43).

Acceptance levels

The following three acceptance levels are selectable.

- Fatal error: Only fatal errors are registered as errors
- Permanent error: Permanent and fatal errors are registered as errors
- Warning (Default value): Warnings, permanent and fatal errors are registered as errors

Error information is displayed in title and subtitle lines, see display layout (Page 40). Title line will show time since occurrence of error in days, hours and minutes. Subtitle line will flash between an error text and a remedy text. Error text will indicate type of error (I, W, P or F), error number, and error text. Remedy text will inform operator of action to take to remove error.



Status log

The latest 9 errors are stored in the status log. Errors are stored in the status log for 180 days, even if they are corrected.

Alarm field

The alarm field on the display will always flash when an error is pending.

Error output

The digital and relay output can be activated individually error by error (error level). The relay output is default selected to error level. An output can also be selected to activate on a single error number.

The alarm field, error output and error pending always operate together.

Operator menu

Error pending and status log are as default enabled (√) in the operator menu.

8.2 List of error numbers

Error No.	*Error text* Remedy text	Comment	Output status	Input status
1	*I1 - Power on* OK	Device powered on	Active	Active
2	*I2 - Add-on module* Applied	A new module has been applied to the system	Active	Active
3	*I3 - Add-on module* Install	An add-on module is defect or has been removed. This can be an internal add-on module	Active	Active
4	*I4 - Param. corrected* OK	A less vital parameter in the transmitter has been replaced by its default value	Active	Active
20	*W20 - Totalizer 1* Reset manually	During initialisation the check of the saved totalizer value has failed. It is not possible to rely on the saved totalizer value anymore. The totalizer value must be reset manually in order to rely on future readings	Active	Active
20	*W20 - Totalizer 2* Reset manually	During initialisation the check of the saved totalizer value has failed. It is not possible to rely on the saved totalizer value anymore. The totalizer value must be reset manually in order to rely on future readings	Active	Active
21	*W21 - Pulse overflow* Adj. pulse settings	Actual flow is too big compared with pulse width and volume/pulse	Reduced pulse width	Active
22	*W22 - Batch timeout* Check installation	Duration of batching has exceeded a predefined maximum time	Batch output on zero	Active
23	*W23 - Batch overrun* Check installation	Batch volume has exceeded a predefined maximum overrun volume	Batch output on zero	Active
24	*W24 - Batch neg. flow* Check flow direction	Negative flow direction during batch	Active	Active
30	*W30 - Overflow* Adj. Q_{max}	Flow is above Q_{max} settings	Max. 120 %	Active
31	*W31 - Empty pipe*	Pipe is empty	Zero	Active
40	*P40 - SENSORPROM®* Insert/change	SENSORPROM® unit not installed	Active	Active
41	*P41 - Parameter range* Switch off and on	A parameter is out of range. The parameter could not be replaced by its default value. The error will disappear at the next power-on	Active	Active

Error No.	*Error text* Remedy text	Comment	Output status	Input status
42	*P42 - Current output* Check cables	Current loop is disconnected or the loop resistance is too big	Active	Active
43	*P43 - Internal error* Switch off and on	Too many errors occurred at the same time. Some errors are not detected correctly	Active	Active
44	*P44 - CT SENSORPROM®*	SENSORPROM® unit has been used as CT version	Active	Active
60	*F60 - CAN comm. error* Transmitter/AOM	CAN bus communication error. An add-on module, the display module or the transmitter is defective	Zero	Inactive
61	*F60 - SENSORPROM® error* Replace	It is not possible to rely on the data in SENSORPROM® unit anymore	Active	Active
62	*F62 - SENSORPROM® ID* Replace	The SENSORPROM® unit ID does not comply with the product ID. The SENSORPROM® unit is from another type of product SITRANS F C, SITRANS F US etc.	Zero	Inactive
63	*F63 - SENSORPROM®* Replace	It is not possible to read from the SENSORPROM® unit anymore	Active	Active
70	*F70 - Coil current* Check cables	Coil excitation has failed	Active	Active
71	*F71 - Internal error* Replace transmitter	Internal convertion error in ASIC	Active	Active

Service and maintenance

9

The device is maintenance-free, however, a periodic inspection according pertinent directives and regulations must be carried out.

An inspection can include check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover screws
- Reliability of power supply, lightning protection, and grounds

Under ideal conditions the flowmeter will operate continuously with no manual adjustment or intervention required.

The SITRANS F M Verificator is an external tool developed for verifying the MAG 5000/6000 system, installation, and application. It is a highly advanced instrument, which carries out the complex verification of the entire flowmeter system according to unique SIEMENS patented principles. The verification test is automated and the instrument easy to use, so no human error or influence will affect the verification.

9.1 Transmitter check list

If unstable/wrong measurements occur, it is often due to insufficient/wrong earthing or potential equalization. If earthing connection is OK, check transmitter as described below, and sensor as described in sensor check lists (see the respective operating instructions).

The easiest way to check the transmitter in a SITRANS F M installation is to replace the transmitter with another MAG 5000/6000 with a similar power supply.

As all settings are stored in and downloaded from the SENSORPROM®, replacement is easily done and no extra settings need to be made.

Check transmitter

If no replacement transmitter is available, check transmitter according to the following check table.

Power on transmitter		
0	Display light on?	Yes ⇒ 1
		No ⇒ 2
1	Flashing error triangles?	Yes ⇒ Check error table
		No ⇒ 1.2
1.2	Output and display readings OK?	Yes ⇒ 1.2.1
		No ⇒ 1.2.2

Power on transmitter		
1.2.1	Transmitter OK	Check application Check installation/sensor/earthing connection etc.
1.2.2	Check cables/conndections Check connection board Check pins in transmitter multiplug	OK ⇒ 1.2.1
		Not OK ⇒ correct fault
2	Check cables/conndections Check connection board Check pins in transmitter multiplug	OK ⇒ 2.1
		Not OK ⇒ Correct fault
2.1	Output readings OK?	Yes ⇒ 2.1.1
		No ⇒ 2.1.2.
2.1.1	Dispaly defective	Replace display
2.1.2	Transmitter defective	Replace transmitter

Note

Sensor check list

Check list for sensors are included in the respective sensor operating instructions.

9.2 Technical support

NOTICE
Repair and service must be carried out by approved Siemens Flow Instruments personnel only.

Note

Siemens Flow Instrument defines sensors as non-repairable products.

Technical Support

If you have any technical questions about the device described in these Operating Instructions and do not find the right answers, you can contact Technical Support:

- Via the Internet using the **Support Request:**
  Support request (http://www.siemens.com/automation/support-request)
- Phone: +49 (0) 180 5050 222

Further information about our technical support is available in the Internet at
Technical support (http://support.automation.siemens.com/WW/view/en/16604318)

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base online on the Internet at:

Service and support (http://www.siemens.com/automation/service&support)

There you will find:

- The latest product information, FAQs, downloads, tips and tricks.
- Our newsletter, providing you with the latest information about your products.
- A Knowledge Manager to find the right documents for you.
- Our bulletin board, where users and specialists share their knowledge worldwide.
- You can find your local contact partner for Industry Automation and Drives Technologies in our partner database.
- Information about field service, repairs, spare parts and lots more under "Services."

Additional Support

Please contact your local Siemens representative and offices if you have additional questions about the device

Find your contact partner at:

Local contact person (http://www.automation.siemens.com/partner)

9.3 Return procedures

Enclose the delivery note, the cover note for return delivery together with the declaration of decontamination form on the outside of the package in a well-fastened clear document pouch.

Required forms

- **Delivery Note**
- **Cover Note for Return Delivery** with the following information

  Cover note
  (http://cache.automation.siemens.com/dnl/zY/zY0OTg1AAAA_16604370_TxtObj/Begleitschein_RW_AD.pdf)

  – product (ordering number)

  – number of devices or spare parts returned

  – reason for the return

- **Declaration of Decontamination**

  Decontamination declaration
  (http://pia.khe.siemens.com/efiles/feldg/files/Service/declaration_of_decontamination_en.pdf)

  With this declaration you certify *that the returned products/spare parts have been carefully cleaned and are free from any residues.*

  If the device has been operated together with toxic, caustic, flammable or water-damaging products, clean the device before return by rinsing or neutralizing. Ensure that all cavities are free from dangerous substances. Then, double-check the device to ensure the cleaning is completed.

  We will not service a device or spare part unless the declaration of decontamination confirms proper decontamination of the device or spare part. Shipments without a declaration of decontamination will be cleaned professionally at your expense before further proceeding.

You can find the forms on the Internet and on the CD delivered with the device.

9.4 Recalibration

Siemens A/S Flow Instruments offers to recalibrate the sensor. The following calibrations are offered as standard:

- Standard matched pair calibration

Note

For recalibration the SENSORPROM® memory unit must always be returned with the sensor.

Troubleshooting/FAQs

10

Symptom	Output signals	Error code	Cause	Remedy
Empty display	Minimum		1. No power supply	Power supply Check MAG 5000/6000 for bended pins on the connector
			2. MAG 5000/6000 defective	Replace MAG 5000/6000
No flow signal	Minimum		1. Current output disabled	Turn on current output
			2. Digital output disabled	Turn on digital output
			3. Reverse flow direction	Change direction
		F70	Incorrect or no coil current	Check cables/connections
		W31	Measuring pipe empty	Ensure that the measuring pipe is full
		F60	Internal error	Replace MAG 5000/6000
	Undefined	P42	1. No load on current output	Check cables/connections
			2. MAG 5000/6000 defective	Replace MAG 5000/6000
		P41	Initializing error	Switch off MAG 5000/6000, wait 5 sec. and switch on again
Indicates flow with no flow in pipe	Undefined		Measuring pipe empty	Select empty pipe cut-off
			Empty pipe cut-off is OFF	Ensure that the measuring pipe is full
			Electrode connection missing/electrode cable is insufficiently screened	Ensure that electrode cable is connected and sufficiently screened
Unstable flow signal	Unstable		1. Pulsating flow	Increase time constant
			2. Conductivity of medium too low	Use special electrode cable
			3. Electrical noise potential between medium and sensor	Ensure sufficient potential equalization
			4. Air bubbles in medium	Ensure medium does not contain air bubbles
			5. High concentration of particles or fibres	Increase time constant
Measuring error	Undefined		Incorrect installation	Check installation
		P40	No SENSORPROM® unit	Install SENSORPROM® unit
		P44	CT SENSORPROM® unit	Replace SENSORPROM® unit or reset SENSORPROM® unit with MAG CT transmitter
		F61	Defective SENSORPROM® unit	Replace SENSORPROM® unit
		F62	Wrong type of SENSORPROM® unit	Replace SENSORPROM® unit

Symptom	Output signals	Error code	Cause	Remedy
		F63	Defective SENSORPROM® unit	Replace SENSORPROM® unit
		F71	Loss of internal data	Replace MAG 5000/6000
	Maximum	W30	Flow exceeds 100% of Qmax.	Check Q_{max} (Basic Settings)
		W21	Pulse overflow Volume/pulse too small	Change volume/pulse
			Pulse width too large	Change pulse width
Measuring approx. 50%			Missing one electrode connection	Check cables
Loss of totalizer data	OK	W20	Initializing error	Reset totalizer manually
##### Signs in display	OK		Totalizer roll over	Reset totalizer or increase totalizer unit

Technical data

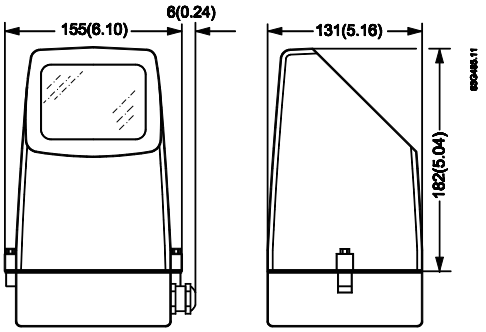
11

11.1 Technical specifications

Mode of operation and design	Measuring principle	Electromagnetic with pulsed constant field
	Empty pipe	Detection of empty pipe (special cable required in remote mounted installation)
	Excitation frequency	Depends on sensor size
	Electrode input impedance	> 1 x 10^{14} Ω
Input	**Digital input**	11 ... 30 V DC, R_i = 4.4 KΩ
	Activation time	50 ms
	Current	$I_{DC\ 11\ V}$ = 2.5 mA, $I_{DC\ 30\ V}$ = 7 mA
Output	**Current output**	
	Signal range	0 ... 20 mA or 4 ... 20 mA, Alarm
	Load	< 800 Ω
	Time constant	0.1 … 30 s, adjustable (for batch: fixed at 0.1 s)
	Digital output	
	Frequency	0 ... 10 kHz, 50% duty cycle (uni/bidirectional)
	Pulse (active)	DC 24 V, 30 mA, 1 kΩ ≤ R_i ≤10 kΩ, short-circuit protected (power supplied from flowmeter)
	Pulse (passive)	DC 3 … 30 V, max. 110 mA, 200 Ω ≤ R_i ≤10 kΩ (powered from connected equipment)
	Time constant	0.1 … 30 s, adjustable (for batch: fixed at 0.1 s)
	Relay output	
	Time constant	Changeover relay, same as current output
	Load	42 V AC/2 A, 24 V DC/1 A
Low flow cut off	0 ... 9.9% of maximum flow	
Galvanic isolation	All inputs and outputs are galvanically isolated	
Max. measuring error (incl. sensor and zero point)	MAG 5000	0.4% ± 1 mm/s (for v > 0.1 m/s)

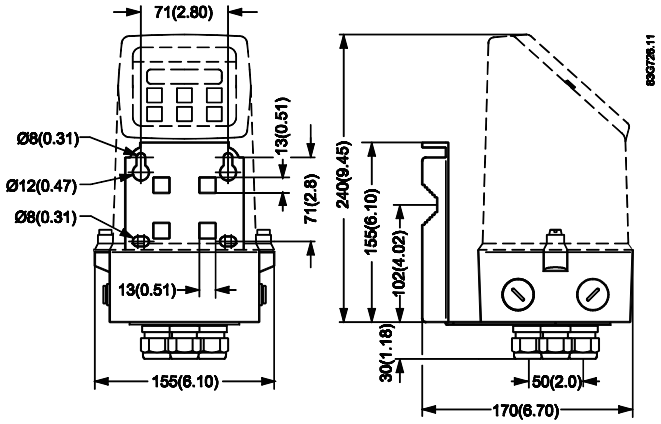
	MAG 6000	0.2% ± 1 mm/s (for v > 0.1 m/s)
Functions	Flow rate, 2 totalizers, low-flow cut-off, empty pipe cut-off, flow direction, error system, operating time, uni/bidirectional flow, limit switches, pulse output, control for cleaning and batch	
Rated operation conditions	**Ambient temperature**	
	Operation	Standard IP67, 19", blind and SV versions: -20 ... +60 °C (-4 ... +140 °F) CT version: -20 ... +50 °C (-4 ... +122 °F)
	Storage	-40 ... +70 °C (-40 ... +158 °F)
Mechanical load	18 ... 1000 Hz, 3.17 G rms, sinusoidal in all directions to IEC 68-2-36	
Degree of protection	IP67/NEMA 4X/6 to IEC 529 and DIN 40050 (1 mH_2O 30 min.)	
EMC performance	EN 61326-1 (industrial environments)	
	EN 61326-2-5	
Display and keypad	Totalizer	Two eight-digit counters for forward, net or reverse flow
	Display	Background illumination with alphanumeric text, 3 x 20 characters to indicate flow rate, totalized values, settings and faults; Reverse flow indicated by negative sign
	Time constant	Time constant as current output time constant
Design	Enclosure material	Fiber glass reinforced polyamide; optional (IP67 only): AISI 316 stainless steel
	Dimensions	See dimensional drawings
	Weight	0.75 kg (2 lb)
Power supply	115 ... 230 V AC +10% -15%, 50 ... 60 Hz, Fuse: 500 mA T 11 ... 30 V DC or 11 ... 24 V AC; Fuse 2 A T	
Power consumption	115 ... 230 V AC: 17 VA 24 V AC: 9 VA, I_N = 380 mA, I_{ST} = 8 A (30 ms) 12 V DC: 11 W, I_N = 920 mA, I_{ST} = 4 A (250 ms)	
Certificates and approvals	CE, C-UL US general purpose, C-tick, CSA/FM Class 1, div 2	
	Custody transfer approval (MAG 5000/6000 CT)	Cold water pattern approval: PTB OIML R 49, MI-001 Hot water pattern approval: DANAK OIML R 75 (MAG 6000 CT) Other media than water (milk, beer etc.) pattern approval: DANAK OIML R 117 (MAG 6000 CT) Energy metering : PTB K7.2
Communication	MAG 5000	Without communication or HART as option
	MAG 6000	Prepared for client mounted add-on modules: HART, MODBUS RTU/RS485, FOUNDATION Fieldbus H1, DeviceNet, PROFIBUS PA, PROFIBUS DP as add-on modules
	MAG 5000 CT / MAG 6000 CT	No communication modules approved

Transmitter IP67/NEMA 4X/6 compact polyamide



Weight: MAG 5000/6000: 0.75 kg (1.65 lbs)

Transmitter IP67/NEMA 4X/6 wall-mounted polyamide



Weight(transmitter and wall mounting bracket): 1.65 kg (3.64 lbs)

11.2 Accuracy

For accuracy reference conditions, please see below.

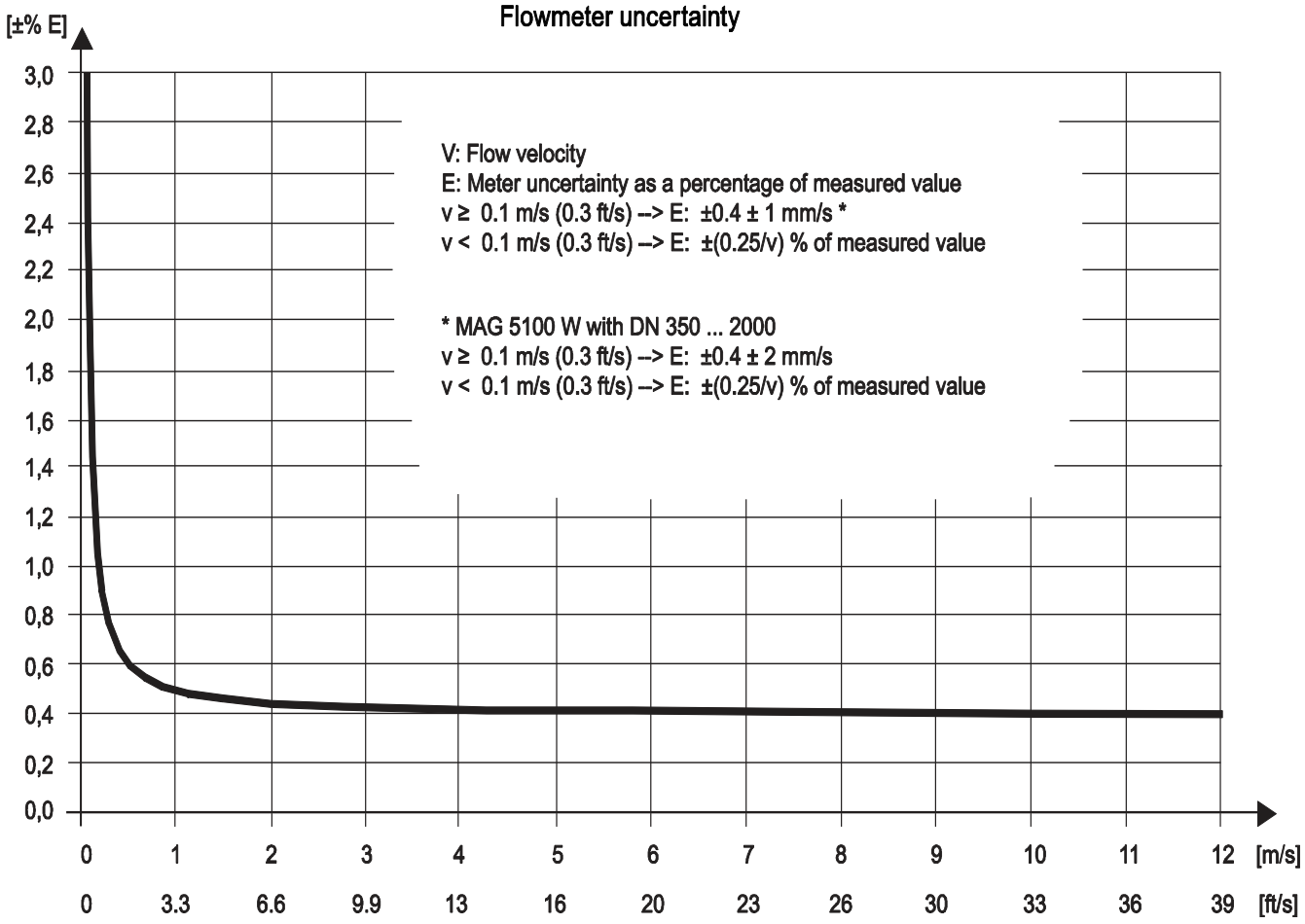


Figure 11-1 MAG 5000 with MAG 1100, MAG 1100 F, MAG 5100 W, MAG 3100 and MAG 3100 P and MAG 6000 with MAG 1100 (PFA), MAG 1100 F (PFA)

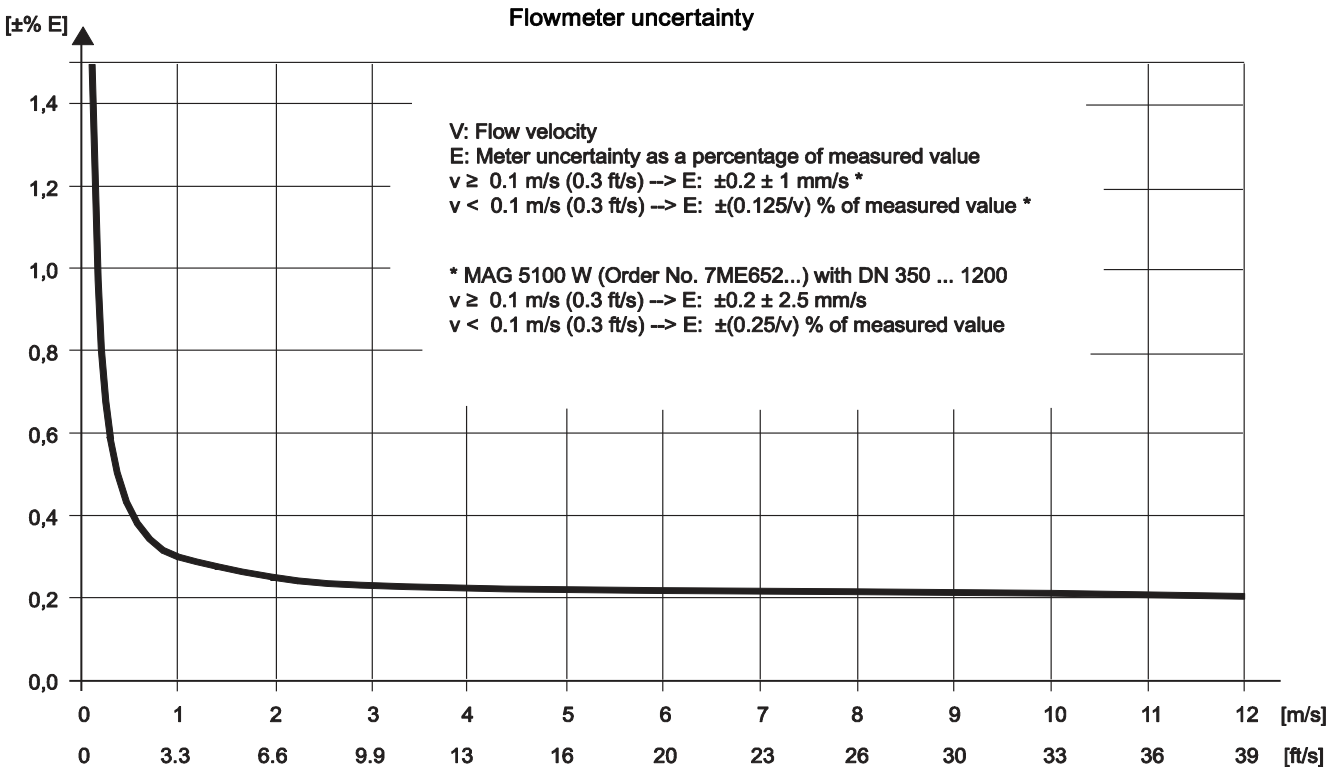


Figure 11-2 MAG 6000 with MAG 1100 (not PFA), MAG 1100 F (not PFA), MAG 5100 W, MAG 3100 and MAG 3100 P

Reference conditions

(ISO 9104 and DIN/EN 29104)

A calibration certificate is shipped with every sensor and calibration data are stored in SENSORPROM memory unit.

Medium temperature	20°C ± 5°C (68°F ± 9°C)
Ambient temperature	20°C ± 5°C (68°F ± 9°C)
Supply voltage	U_n ± 1%
Warming-up time	30 minutes
Incorporation in conductive pipe section Inlet section Outlet section	 10 x DN (DN ≤ 1200/48") 5 x DN (DN > 1200/48") 5 x DN (DN ≤ 1200/48") 3 x DN (DN > 1200/48")
Flow conditions	Developed flow profile

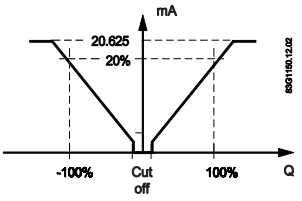
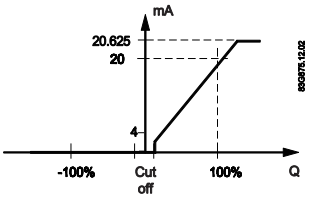
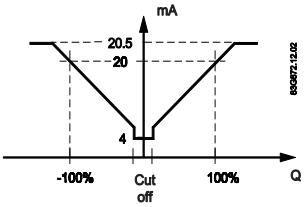
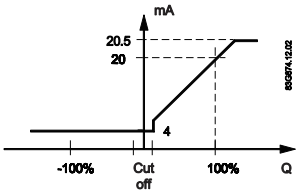
Reference conditions for sensor calibration

Current output	As pulse output ± (0.1% of actual flow + 0.05% FSO)
Effect of ambient temperature Display/frequency/pulse output Current output	 < ± 0.003% / °C act. < ± 0.005% / °C act.
Effect of supply voltage	< 0.005% of measuring value on 1% change
Repeatability	± 0.1% of actual flow for V ≥ 0.5 m/s (1.5 ft/s) and conductivity ≥ 10 µS/cm

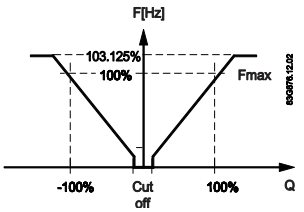
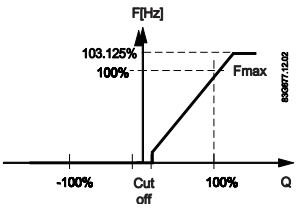
Additions in the event of deviations from reference conditions

11.3 Output characteristics

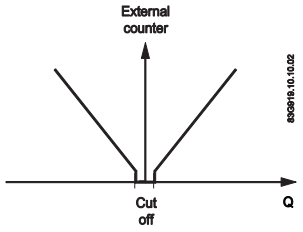
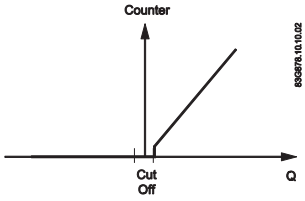
Current output

Output characteristics	Bidirectional mode	Unidirectional mode
0...20 mA		
4...20 mA		

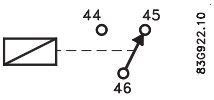
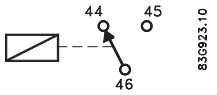
Frequency output

Bidirectional mode	Unidirectional mode
	

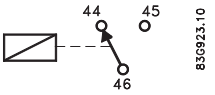
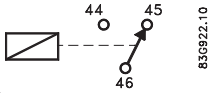
Pulse output

Bidirectional mode	Unidirectional mode
	

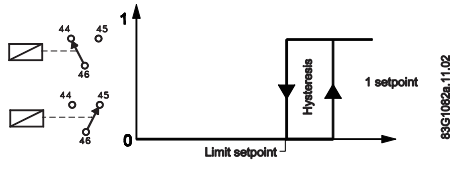
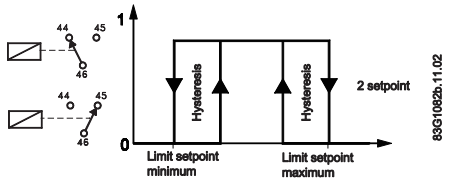
Relay output

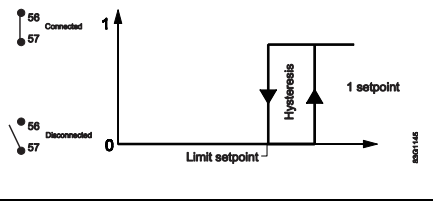
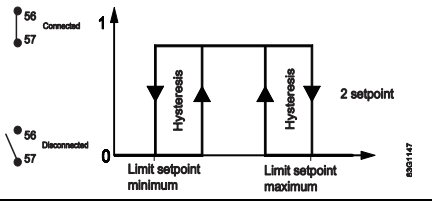
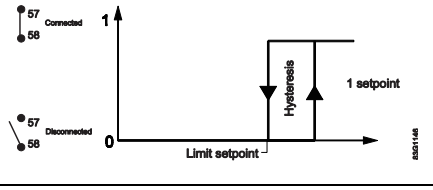
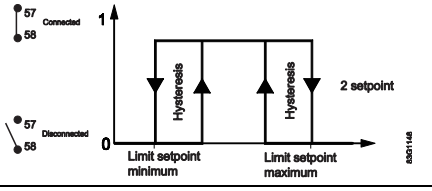
Bidirectional mode		Unidirectional mode	
Power down		Active	

Error relay output

Bidirectional mode		Unidirectional mode	
No error		Error	

Limit switch (can be used as direction switch)

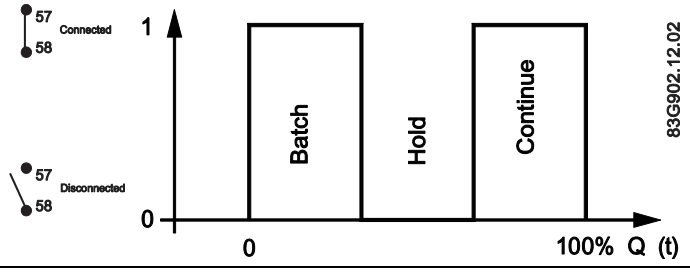
1 set point	2 set points
	
Passive Digital output	Passive Digital output

1 set point	2 set points
	
	

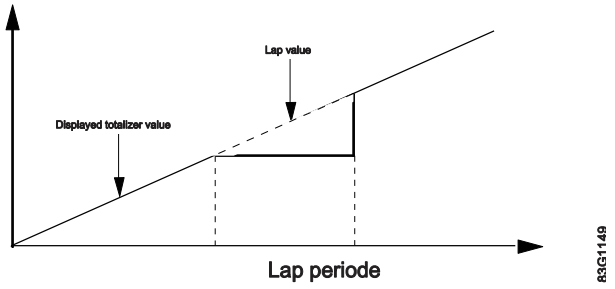
Note

Active digital output is not avaiable with MAG 6000 I.

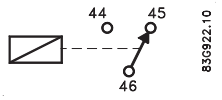
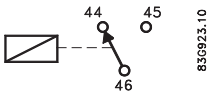
Batch on digital output

Unidirectional mode (forward flow only)


Totalizer lap



Batch on relay output

Unidirectional mode (forward flow only)			
Hold		Batch	

11.4 Cable data

Description

Cable for standard electrode or coil	
Electrode cable, double shielded	
Cable kit with standard coil cable and electrode cable double shielded (also available as low noise cable for MAG 1100 sensor)	

Technical data

		Standard electrode cable (electrode/coil)	Special cable (electrode)
Basic data	No. of conductors	3	3
	Sqr. area	1.5 mm^2	0.25 mm^2
	Screen	Yes	Double
	Color code	Brown, blue, black	Brown, blue, black
	Outside color	Grey	Grey
	Ext. diameter	7.8 mm	8.1 mm
	Conductor	Flexible CU	Flexible CU
	Isolation material	PVC	PVC
Ambient temperature	Flexible installation	-5 ... +70°C (23 ... 158°F)	-5 ... +70°C (23 ... 158°F)
	Non-flexible installtaion	-30 ... +70°C (-22 ... 158°F)	-30 ... +70°C (-22 ... 158°F)
Cable parameter	Capacity	161.50 pF/m	N/A
	Inductance	0.583 µH/m	N/A
	L/R	43.83 þH/Ω	N/A

11.5 Cable requirements

		Coil cable	Electrode cable
Basic data	No. of conductors	2	3
	Min. sqr. area	0.5 mm^2	0.2 mm^2
	Screen	Yes	Yes
	Max. capacitance	N/A	350 pF/m
Max. cable loop resistance	Media temperature:		
	< 100 °C	40 Ω	N/A
	> 200 °C	6 Ω	N/A
Cable glands on sensor	M20x1.5 gland - Cable ø 5 ... 13 mm (0.20 ... 0.51 inches)		
	½ NPT gland - cable ø 5 ... 9 mm (0.20 ... 0.35 inches)		

WARNING

Cable glands

For Ex zone 1 installations only certified cable glands with protection type "e" can be used for the power supply and the coil cable. The cable glands must be approved for the actual temperature and cable dimension.

Spare parts/Accessories

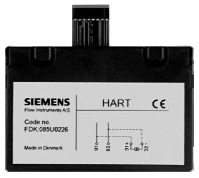
12

12.1 Ordering

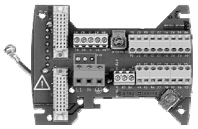
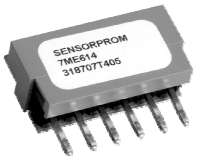
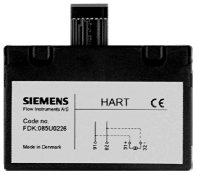
In order to ensure that the ordering data you are using is not outdated, the latest ordering data is always available on the Internet:

Catalog process instrumentation (http://www.siemens.com/processinstrumentation/catalogs)

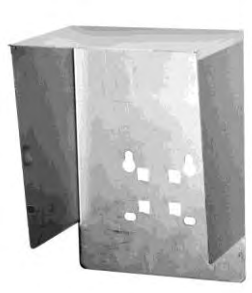
12.2 Accessories

Description	
Wall mounting unit	
Display protection lid	
Communication modules for MAG 6000	

12.3 Spare parts

Description	
Connection plate	
SENSORPROM® memory unit	
Display unit	
Communication modules for MAG 6000	

12.4 Sun shield

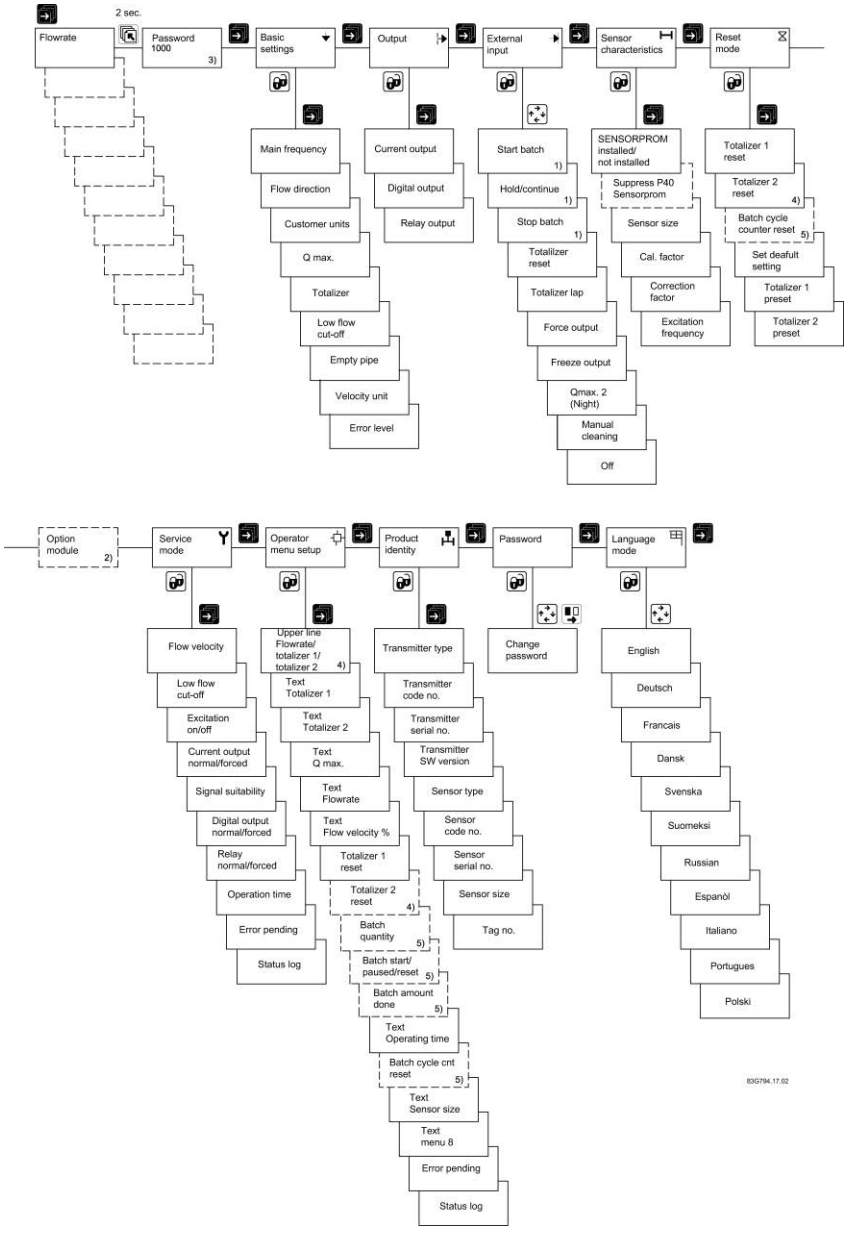
Description	
Sun shield	

Menu diagrams

A

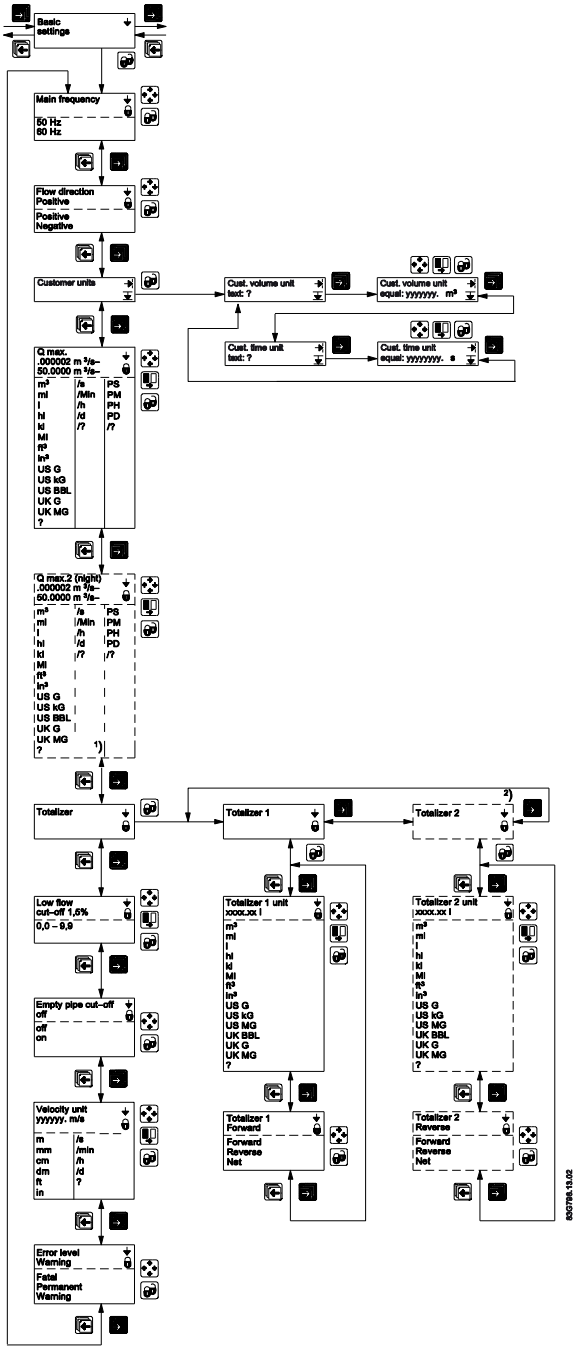
A.1 Transmitter menu overview

The menu diagrams shown on the following pages apply to MAG 5000/6000 as well as MAG 6000 I.



1) Not available in MAG 5000
2) Add-on module
3) Factory-set password: 1000
4) Not available when batch
5) Only available when batch

A.2 Basic settings

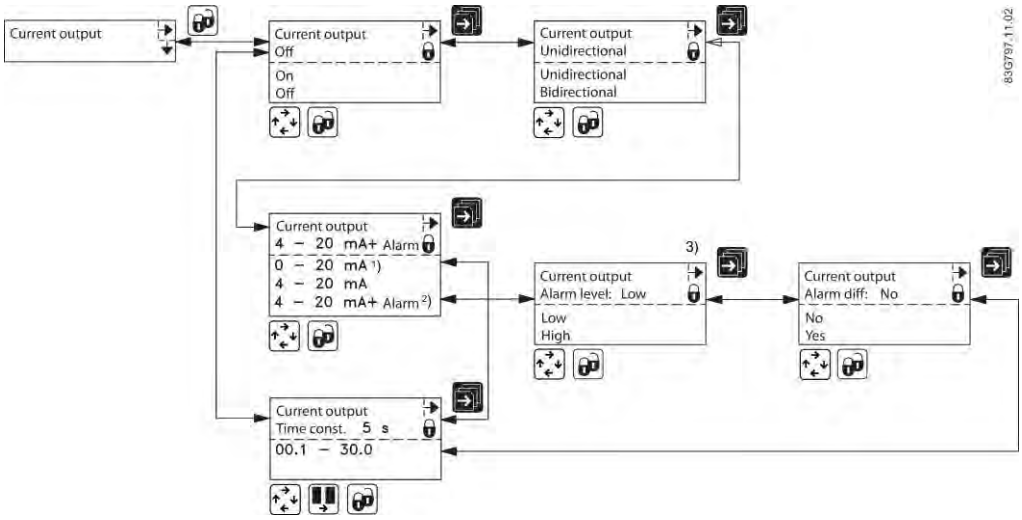


1) The question mark at unit selections stand for customer units. The unit is shown as a question mark on display if not overwritten with customer's own unit text setup using PDM or ordered specially using Y20 in ordering system.

   The flow rate unit can be "?/?" or show customer unit texts as for example "AcrFt/y" (Acre feet/year).

2) When batch is selected on digital output or relay, Totalizer 2 is not shown because it is controlled by the batch function.

A.3 Current output

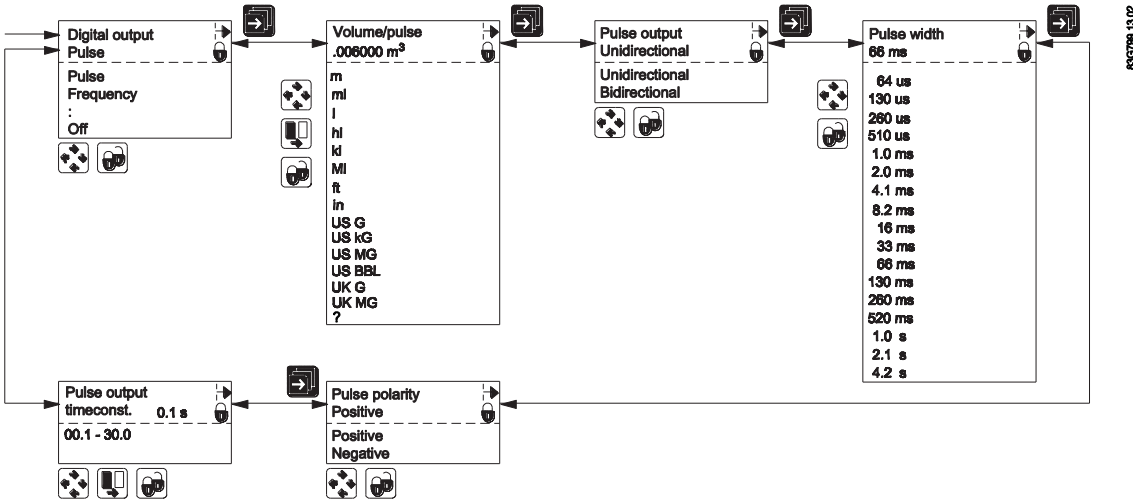


1) If HART communication is installed, it is not possible to set the output for 0-20 mA (even though the option is visible in the display). This is due to the fact that HART does not work if the output falls below 2-3 mA.

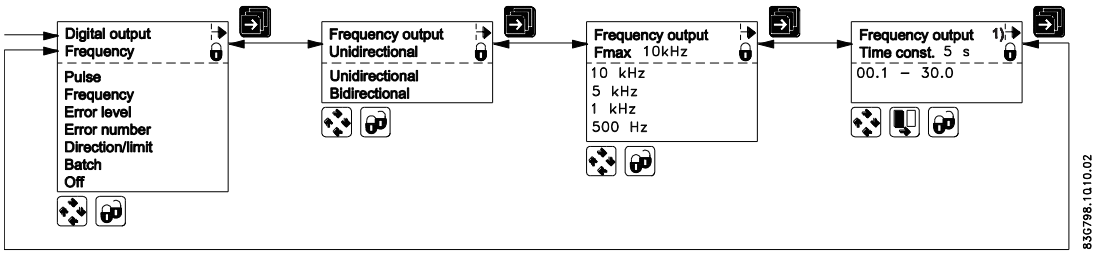
2) 4-20 mA + Alarm is the default setting for MAG 6000 I. For all other variants, the default setting is 4-20 mA.

3) The controlling of alarm levels does not recognize if the jumper is mounted for passive output. Do not combine differentiation and low alarm level together with passive output. The output will try to pull down the level to 1.3 mA at fatal errors which is not possible for passive output.

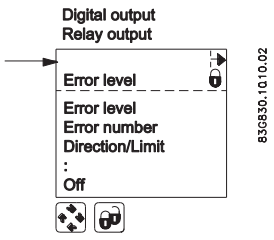
A.4 Digital output - pulse



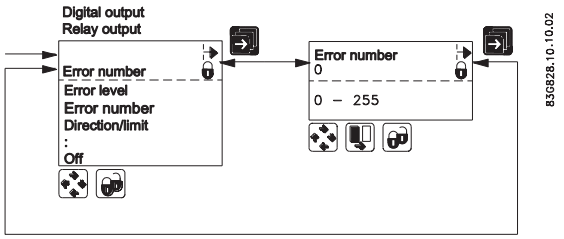
A.5 Digital output - frequency



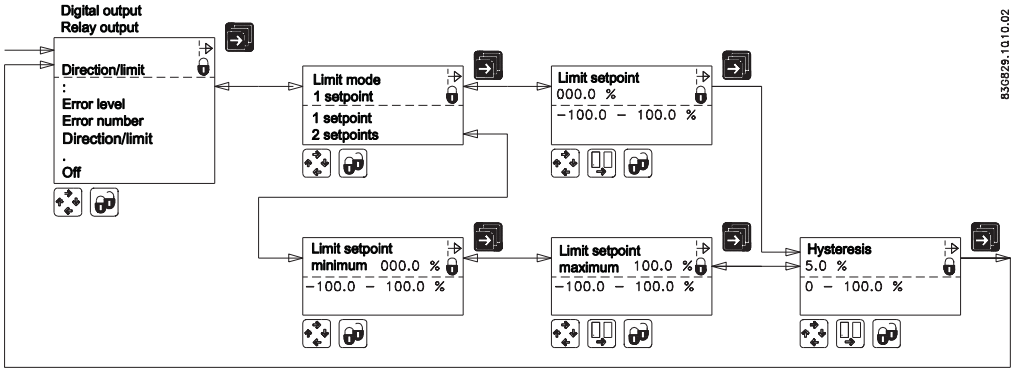
A.6 Error level



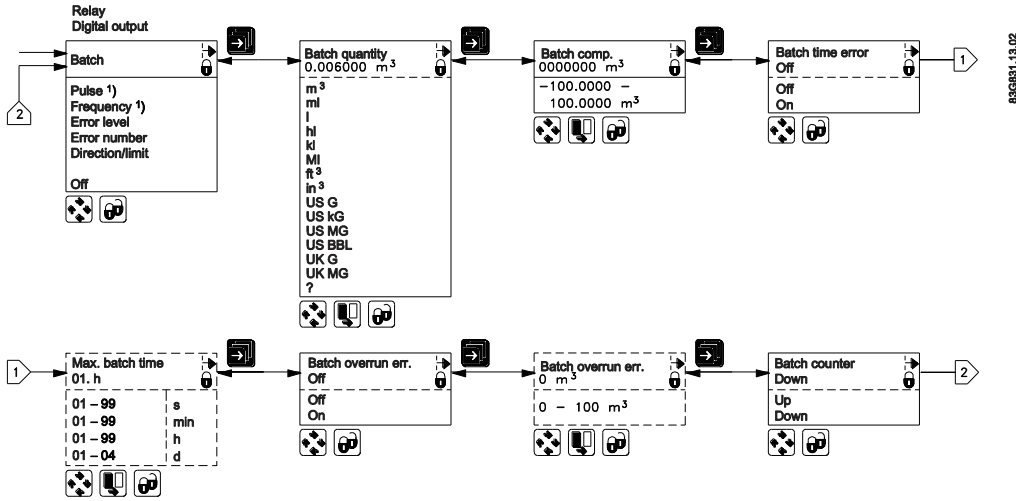
A.7 Error number



A.8 Direction/limit



A.9 Batch



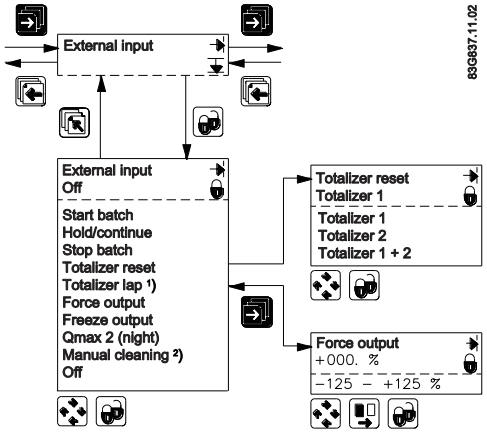
1) Visible only on Digital output.

Note

If batch function is chosen on the relay output, the digital output will be turned off if it has been set up for pulse, frequency or batch.

If digital output is set up for pulse, frequency or batch, then the relay output will be turned off if it has been set up for batch.

A.10 External input

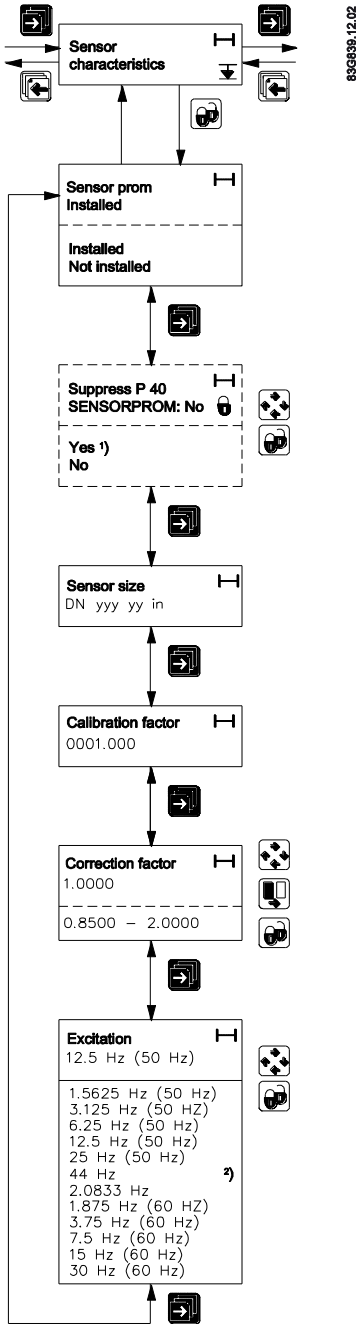


1) The value showing totalizer 1 on the display is frozen for as long as the digital output is activated. However, totalizer 1 continues counting, and when the digital input is released, the value on the display again follows totalizer 1.

2) MAG 6000 I cannot be equipped with cleaning unit. The cleaning option for relay output is however possible. When selecting function for MAG 6000 I relay output, the relay output has the same behavior as if cleaning unit was installed.

   The relay output of the transmitter determines when the relay is on by applying voltage for approximately 60 seconds. The metering is resumed after another 60 seconds when the cycle is complete. (The display is locked during this time). The time cycle can be set at 1 to 240 hours. If the cycle is set at for example three hours, the transmitter will be active every three hours.

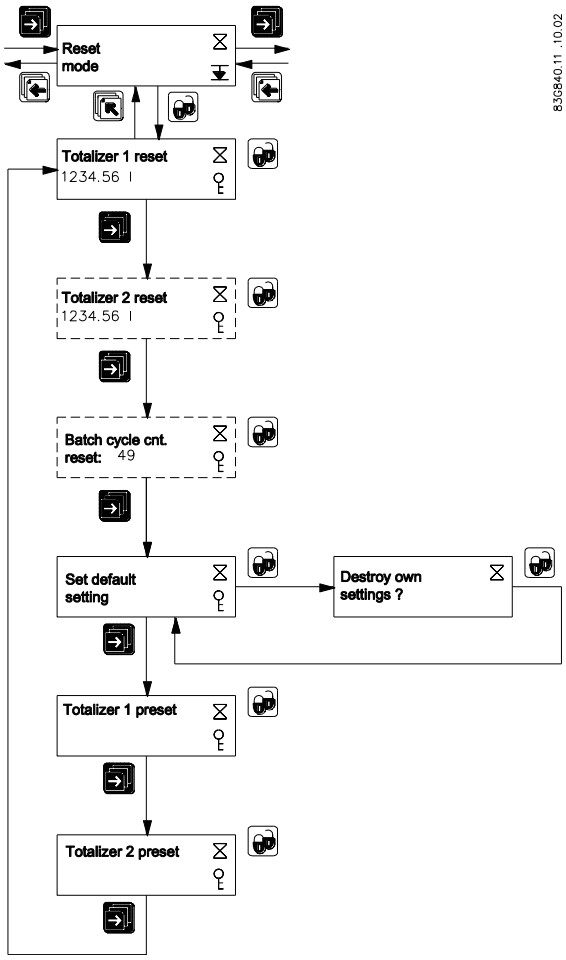
A.11 Sensor characteristics



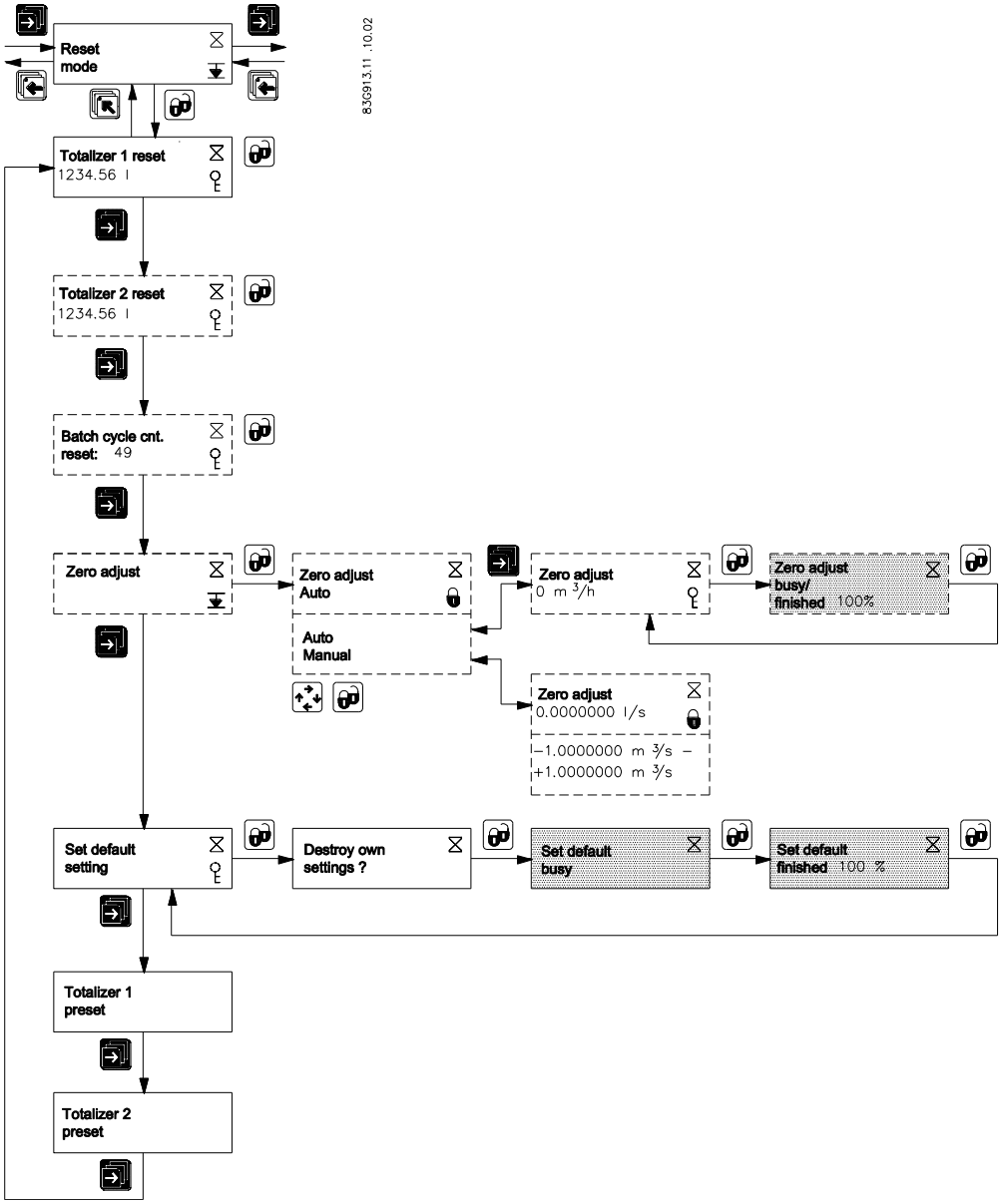
1) Error status (level or number) on an output is updated only at the time the error status changes (occurs or disappears). If P40 is suppressed after it has been detected (at power up), the output does not change state. In this case the power must be switched off/on to suppress the P40 error on the output.

2) The frequency can be set to 44 Hz in the MAG 6000 SV transmitter only.

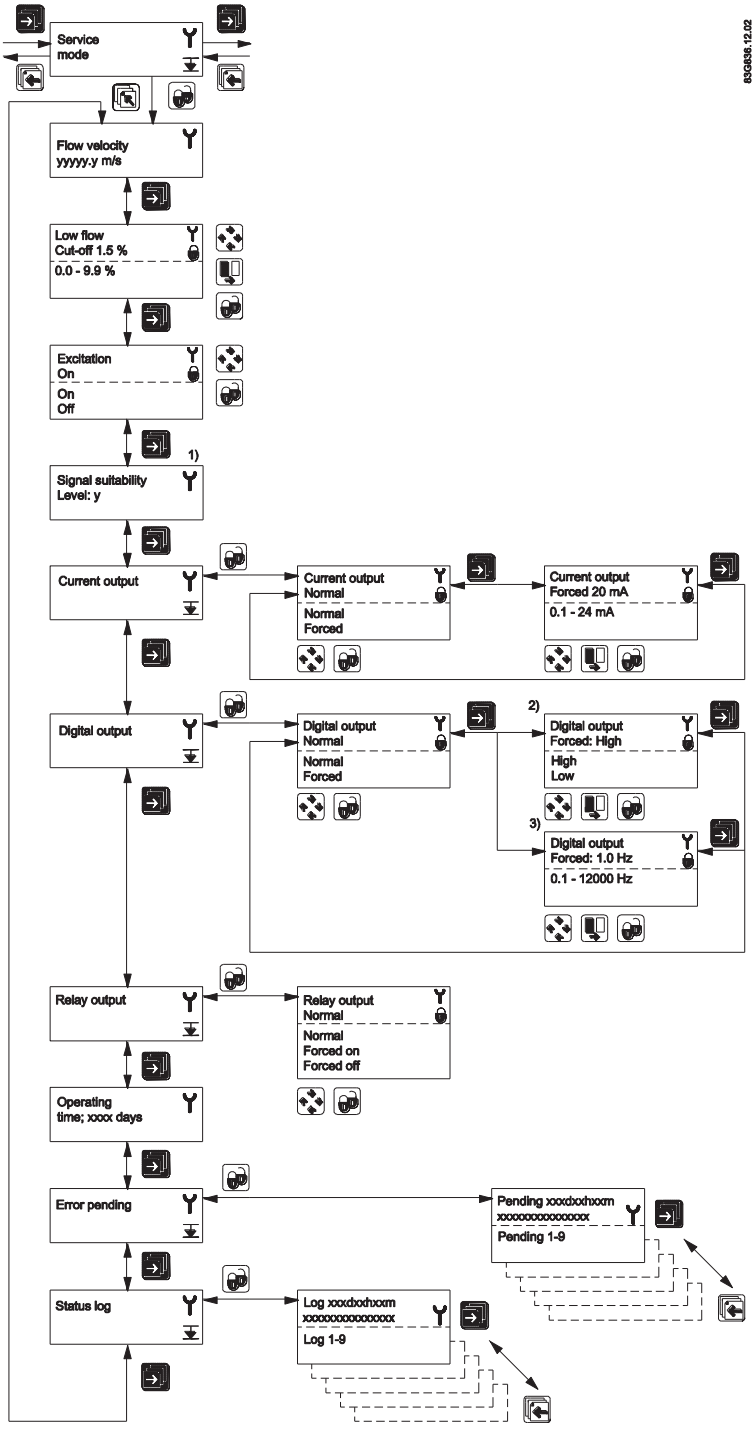
A.12 Reset mode



A.13 Reset mode - MAG 6000 SV



A.14 Service mode

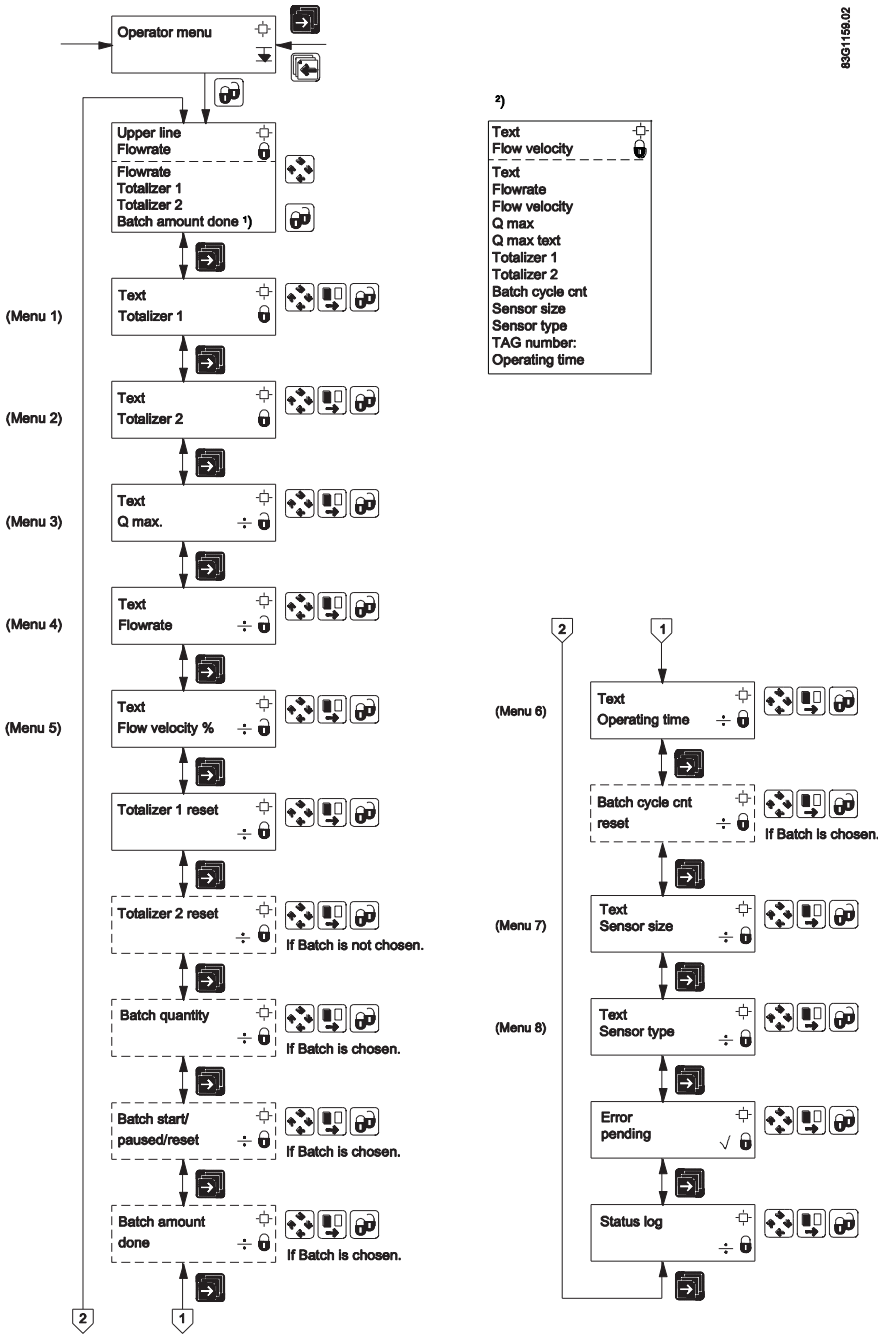


1) Signal suitability is a level from 0 to 9 of the electrode measured voltage. Level 0 is equal to the limit value that is set for empty pipe error detection, and level 9 is the best signal measured.

2) If digital output is set to pulse (standard).

3) If digital output is set to frequency.

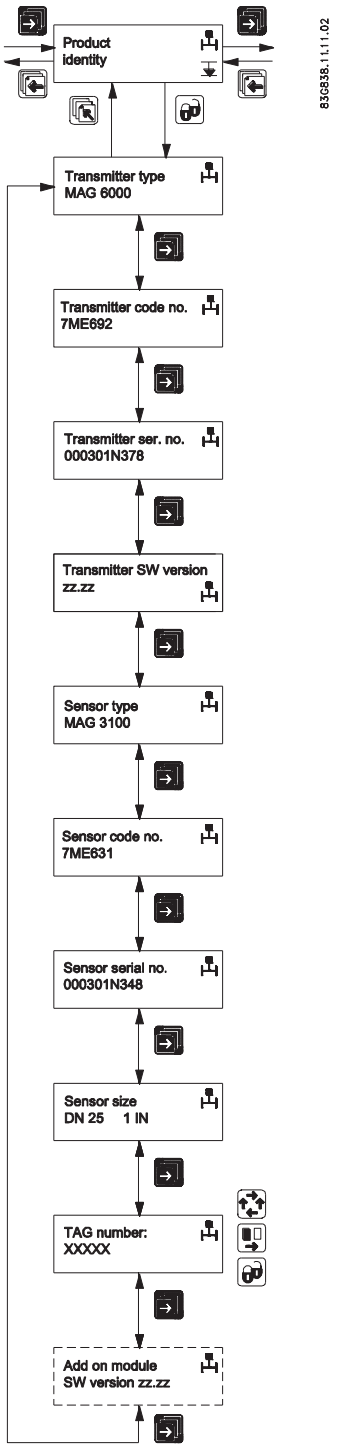
A.15 Operator menu setup



1) When selecting Batch amount for upper line, the upper line is initially blank. The amount done may not appear until the batch is started.

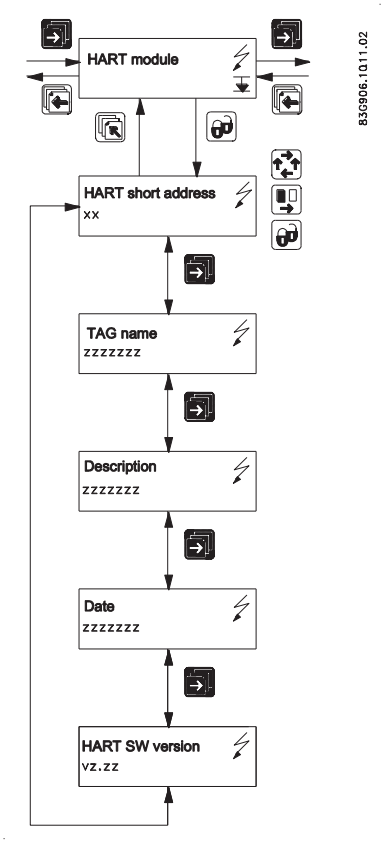
2) 'Text' means that the text for the chosen measured value is shown. For example, if textis chosen in line 2 and flow velocity is chosen in line 3, the text "Flow velocity " is shown in line2 and the measured flow velocity is shown in line 3.

A.16 Product identity



A.17 Add-on communication module

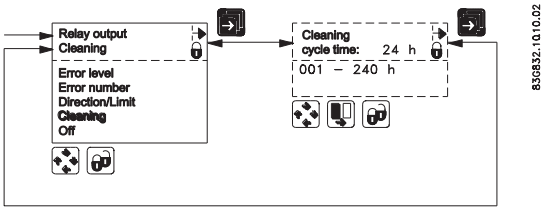
Example: HART



Note

Burst mode is not available with HART communication

A.18 Cleaning



Note

Relay outputs

If cleaning unit is installed, relay outputs must always be used to operate cleaning.

Relay outputs cannot be used for other purposes

A.19 MAG 5000/6000 CT menu overview

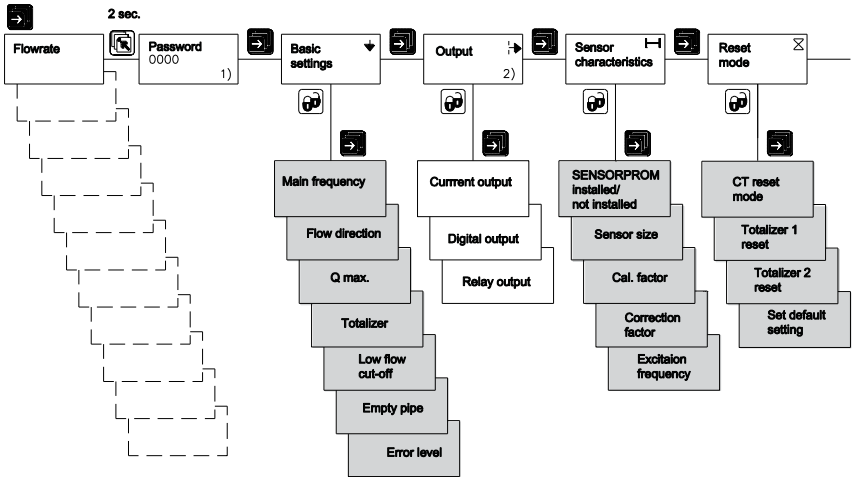
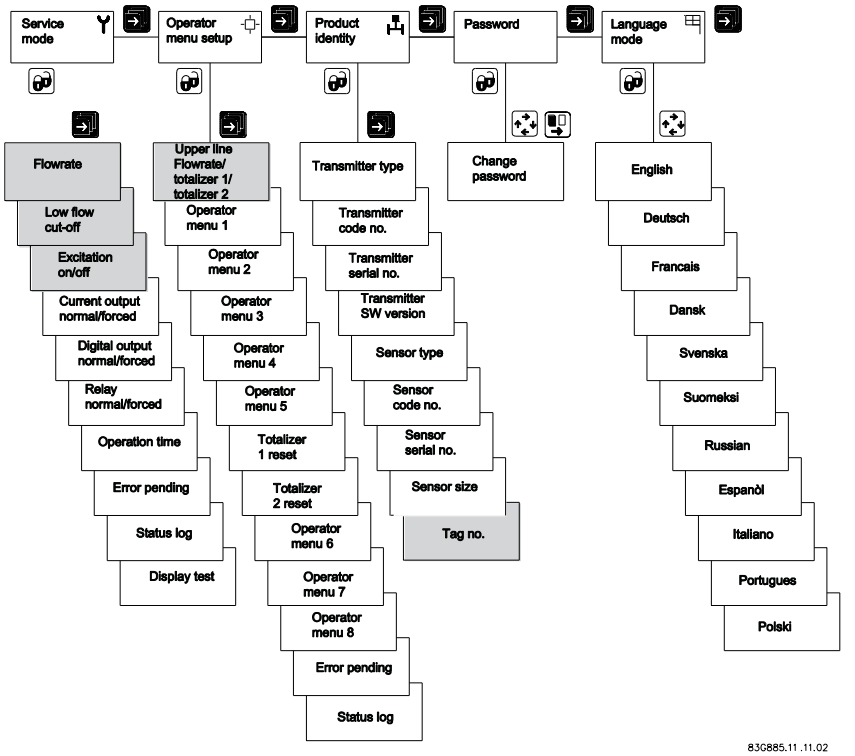


Figure A-1 Overview MAG 5000 CT and MAG 6000 CT (part 1)



1) Factory-set password: 1000

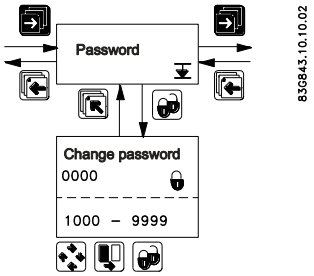
2) Not visible when CT mode is "Hot water"

Figure A-2 Overview MAG 5000 CT and MAG 6000 CT (part 2)

Note
Sealing

Menus marked with gray are locked when transmitter is sealed.

A.20 Change password



Factory settings

B

B.1 Transmitter factory settings

The factory settings shown on the following pages apply to MAG 5000/6000 as well as MAG 6000 I.

Menu item	Parameter	Factory settings	Options	More info
Password	Password	1000	1000 ... 9999	Changing password (Page 42) and Change password (Page 89)
Basic settings	Flow direction	Positive	Positive, negative	Changing basic settings (Page 43)
	Q_{max}	Sensor size dependent	Sensor size dependent	
	• *volume unit*	*Sensor size dependent*	*m^3, ml, l , hl, kl, Ml, ft^3, in^3, US G, US kG, US MG, US BBL, UK G, UK kG, UK MG, ? (customer unit)*	
	• *time unit*	*Sensor size dependent*	*Sec., min., hour, day, ? (customer unit)*	
	Totalizer 1	Forward	Forward, reverse, net	
	• *Totalizer 1 unit*	*Sensor size dependent*	*m^3, ml, l , hl, kl, Ml, ft^3, in^3, US G, US kG, US MG, US BBL, UK G, UK kG, UK MG, ? (customer unit)*	
	Totalizer 2	Reverse	Forward, reverse, net	
	• *Totalizer 2 unit*	*Sensor size dependent*	*m^3, ml, l , hl, kl, Ml, ft^3, in^3, US G, US kG, US MG, US BBL, UK G, UK kG, UK MG, ? (customer unit)*	
	Low flow cut-off	1.5%	0 ... 9.9%	
	Empty pipe	Off	On, Off	
	Velocity unit	m/s	m, mm, cm, dm, ft , in per s, min, h, d, ? (customer unit)	
	Error level	Warning	Fatal, permanent, warning	
Output	Current output	Off for MAG5000/ 6000 On for MAG6000I Namur	On/off, Unidirectional/bidirectional, 0...20 mA/4...20 mA/4...20 mA + Alarm	Output settings (Page 47)
	• *Alarm level*	*Low*	*High/Low*	
	• *Alarm diff.*	*No*	*Yes/No*	
	• *Time constant*	*5 s*	*0.1...30 s*	

Menu item	Parameter	Factory settings	Options	More info
	Digital output	Pulse	Error, direction/limit, batch, frequency, pulse, error number, off	Digital output - pulse (Page 78)
	Relay output	Error level	Error, direction/limit, cleaning, error number, off	Error level (Page 78)
	Direction/limit switch	Off	1 setpoint, 2 setpoints	Direction/limit (Page 79)
	• *Setpoints*	*0%*	*-100 ... +100%*	
	• *Hysteresis*	*5%*	*0.0 ... 100%*	
	Batch	Off		Batch (Page 79)
	• *Batch quantity*	*0*	*Sensor size dependent*	
	• *Batch compensation*	*0*	*-100 ... +100 m³*	
	• *Batch counter*	*Down*	*Up, down*	
	Frequency	Off	500 Hz, 1 kHz, 5 kHz, 10 kHz	Digital output - frequency (Page 78)
	• *Time constant*	*5 s*	*0.1 ... 30 s*	
	Pulse	On		Digital output - pulse (Page 78)
	• *Pulse polarity*	*Positive*	*Positive, negative*	
	• *Pulse width*	*66 ms*	*64 µs 130 µs, 260 µs, 510 µs, 1.0 ms, 2.0 ms, 4.1 ms, 8.2 ms, 16 ms, 33, ms, 66 ms, 130 ms, 260 ms, 520 ms, 1.0 s, 2.1 s, 4.2 s*	
	• *Volume/pulse*	*Sensor size dependent*	*Dimension-dependent*	
	• *Time constant*	*0.1 s*	*0.1 ... 30 s*	
External input	External input	Off	Batch, reset totalizer, freeze output, forced output, off	External input (Page 80)
	• *Batch*	*Start*	*Start, hold/continue, stop, Qmax 2*	

Menu item	Parameter	Factory settings	Options	More info
Sensor characteristics	Correction factor	1	0.85 ... 2.00	Sensor characteristics (Page 81)
Language	Language	English	English, German, French, Danish, Swedish, Finnish, Spanish, Russian, Italian, Portuguese, Polish	Changing language (Page 46)
Operator menu	Primary field	Flow rate	Flow rate, Totalizer 1, Totalizer 2	Changing operator menu setup (Page 45)
	Title/subtitle lines	Flow rate	Flow rate, Flow velocity, Qmax, Totalizer 1, Totalizer 2, Totalizer 1 reset, Totalizer 2 reset, Batch start/paused/stop, Batch cycle counter, Batch cycle counter reset, Sensor size, Sensor type, Error pending, Status log, Tag No.	

B.2 50 Hz Dimension dependent

50 Hz Dimension dependent factory settings MAG 1100, MAG1100F, MAG 3100, MAG 3100 P and MAG 5100W with M20 cable glands

DN	Q_{max}*					
	Factory settting	MAG 5100 W (Order no. 7ME6520)		MAG 1100, MAG 1100 F, 5100 W (Order no. 7ME6580) MAG 3100, 3100 P		unit
mm (inch)		min.	max.	min.	max.	
2 ($^1/_{12}$)	30	-	-	3.903623	156.1448	l/h
3 ($^1/_8$)	70	-	-	6.361726	254.469	l/h
6 ($^1/_4$)	300	-	-	25.44691	1017.876	l/h
10 ($^3/_8$)	900	-	-	70.68584	2827.433	l/h
15 (½)	2000	-	-	159.0432	6361.725	l/h
25 (1)	5000	441.7865	17671.45	441.7865	17671.45	l/h
40 (1½)	12	1.130974	45.23893	1.130974	45.23893	m^3/h
50 (2)	20	1.574527	62.98107	1.767146	70.68583	m^3/h
65 (2½)	30	2.499681	99.98723	2.986477	119.459	m^3/h
80 (3)	50	4.003646	160.1458	4.523894	180.9557	m^3/h
100(4)	120	6.252163	250.0864	7.068584	282.7433	m^3/h
125 (5)	180	10.00647	400.2585	11.04467	441.7864	m^3/h
150 (6)	250	15.74527	629.8107	15.90432	636.1725	m^3/h
200(8)	400	24.93797	997.5184	28.27434	1130.973	m^3/h
250(10)	700	40.00377	1600.15	44.17865	1767.145	m^3/h
300 (12)	1000	62.50395	2500.157	63.61726	254469	m^3/h
350 (14)	1200	86.59015	3463.605	86.59015	3463.605	m^3/h

DN	Q_{max}*					
	Factory settting	MAG 5100 W (Order no. 7ME6520)		MAG 1100, MAG 1100 F, 5100 W (Order no. 7ME6580) MAG 3100, 3100 P		unit
mm (inch)		min.	max.	min.	max.	
400 (16)	1800	113.0974	4523.893	113.0974	4523.893	m^3/h
450 (18)	2000	143.1389	5725.552	143.1389	5725.552	m^3/h
500 (20)	3000	176.7146	7068.583	176.7146	7068.583	m^3/h
600 (24)	4000	254.4691	10178.76	254.4691	10178.76	m^3/h
700 (28)	4500	346.3606	13854,42	346.3606	13854.42	m^3/h
750 (30)	5000	397.6079	15904.31	397.6079	15904.31	m^3/h
800 (32)	7000	452.3894	18095,57	452.3894	18095.57	m^3/h
900 (36)	9000	572.5553	22902,21	572.5553	22902.21	m^3/h
1000 (40)	12000	706.8584	28274.33	706.8584	28274.33	m^3/h
1050 (42)	12000	706.8584	28274.33	706.8584	28274.33	m^3/h
1100 (44)	14000	855.986	34211.94	855.2986	3421194	m^3/h
1200 (48)	15000	1017.877	40715.04	1017.877	40715.04	m^3/h
1400 (54)	25000	-	-	1385.443	55417.69	m^3/h
1500 (60)	30000	-	-	1590.432	63617.25	m^3/h
1600 (66)	35000	-	-	1809.558	72382.29	m^3/h
1800 (72)	40000	-	-	2290.222	91608.84	m^3/h
2000 (78)	45000	-	-	2827.434	113097.3	m^3/h
2200 (90)	50000	-	-	3421,195	136847.7	m^3/h
2400 (96)	55000	-	-	4071.505	162860.1	m3/h
2600 (102)	60000	-	-	4778.363	191134.4	m3/h
280 (114)	65000	-	-	5541.77	221670.7	m3/h
3000 (120)	70000	-	-	6361.726	254469	m3/h

* The min. and max. amount values show mathematical values and do not indicate measurement accuracy

B.3 60 Hz Dimension dependent

60 Hz Dimension dependent factory settings MAG 1100, MAG1100F, MAG 3100, MAG 3100 P and MAG 5100W with ½" NPT cable glands

DN	$Q_{max.}$					
	Factory setting*	MAG 5100 W (Order no. 7ME6520)		MAG 1100, MAG 1100 F, 5100 W (Order no. 7ME6580) MAG 3100, 3100 P		unit
mm (inch)		min.	max.	min.	max.	
2 ($^1/_{12}$)	0.14	-	-	0.01718714	0.6874852	US GPM
3 ($^1/_8$)	0.31	-	-	0.02800984	1.120393	US GPM
6 ($^1/_4$)	1.4	-	-	0.1120394	4.481573	US GPM
10 ($^3/_8$)	4	-	-	0.3112204	12.44881	US GPM
15 (½)	9	-	-	0.7002459	28.0	US GPM
25 (1)	23	1.945128	77.80509	1.945128	77.80509	US GPM
40 (1½)	53	4.979526	199.181	4.979526	199.181	US GPM
50 (2)	89	6.932434	277.2973	7.78051	311.2203	US GPM
65 (2½)	133	11.00577	440.2305	13.14907	525.9624	US GPM
80 (3)	221	17.62753	705.1008	19.91811	796.7241	US GPM
100(4)	529	27.52745	1101.097	31.12204	1244.881	US GPM
125 (5)	793	44.05714	1762.285	48.62819	1945.127	US GPM
150 (6)	1101	69.32434	2772.973	70.02459		
200 (8)	1762	109.7986	4391.941		4979.525	
250 (10)	3083	176.1313	7045.251	194.5128		
300 (12)	4403	275.1967	11007.86	280.0984	11203.93	US GPM
350 (14)	5284	381.245	15249.79	381.245	15249.79	US GPM
400 (16)	7926	497.9526	19918.1	497.9526	19918.1	US GPM
450 (18)	8806	630.2213	25208.84	630.2213	25208.84	US GPM
500 (20)	13209	778.051	31122.03	778.051	31122.03	US GPM
600 (24)	17612	1120.394	44815.73	1120.394	44815.73	US GPM
700 (28)	19813	1524.98	60999.19	1524.98	60999.19	US GPM
750 (30)	22015	1750.615	70024.58	1750.615	70024.58	US GPM
800 (32)	3082	1991.811	79672.4	1991.811	79672.41	US GPM
900 (36)	39626	2520.885	100835.3	2520.885	100835.3	US GPM
1000 (40)	52835	3112.204	124488.1	3112.204	124488.1	US GPM
1050 (42)	52835	3112.204	137248.1	3112.204	124488.1	US GPM
1100 (44)	61641	3765.767	150630.6	3765.767	150630.6	US GPM
1200 (48)	66044	4481.574	179262.9	4481.574	179262.9	US GPM
1400 (54)	110072	-	-	6099.92	243996.7	US GPM
1500 (60)	1320867	-	-	7002.459	280098.3	US GPM
1600 (66)	154101	-	-	7967.242	318689.6	US GPM

DN	$Q_{max.}$					
	Factory setting*	MAG 5100 W (Order no. 7ME6520)		MAG 1100, MAG 1100 F, 5100 W (Order no. 7ME6580) MAG 3100, 3100 P		unit
mm (inch)		min.	max.	min.	max.	
1800 (72)	176115	-	-	10083.54	403341.5	US GPM
2000 (78)	198130	-	-	12448.82	497952.5	US GPM
2200 (90)	220144	-	-	15063.07	602522.6	
	242158	-		17926.3	717051.7	
2600 (102)	264173	-	-	21038.5	841539.8	
2800 (114)	286187	-	-	24399.68	975987	
3000 (120)	308201	-	-	28009.84	1120393	

* Factory setting sets Qmax to a metric unit (see previous table). The values here are converted to rounded off US GPM.

B.4 50 Hz Dimension dependent batch and pulse output settings

50 Hz Dimension dependent factory settings MAG 1100, MAG1100F, MAG 3100, MAG 3100 P and MAG 5100W with ½" NPT cable glands

6DN	Volume/pulse or batch quantity*				Factory setting		
	MAG 5100 W (Order no. 7ME6520)		MAG 1100, MAG 1100 F, 5100 W (Order no. 7ME6580) MAG 3100, 3100 P		Volume/ pulse & batch amount	Pulse & batch unit	Totalizer unit
mm (inch)	min.	max.	min.	max.			
2 ($^1/_{12}$)	-	-	3.61466 µl	94.75103 l	0.1	ml	ml
3 ($^1/_8$)	-	-	5.890487 µl	154.4155 l	0.1	ml	ml
6 ($^1/_4$)	-	-	23.56195 µl	617.6622 l	1	l	l
10 ($^3/_8$)	-	-	65.44985 µl	1.715728 m^3	1	l	l
15 (½)	-	-	147.2622 µl	3.860389 m^3	1	l	l
25 (1)	409.0616 µl	10.7233 m^3	409.0616 µl	10.7233 m^3	10	l	l**
40 (1½)	1.047198 ml	27.45165 m^3	1.047198 ml	27.45165 m^3	10	l	l**
50 (2)	1.457896 ml	38.21785 m^3	1.636247 ml	42.89321 m^3	10	l	l**
65 (2½)	2.31452 ml	60.67373 m^3	2.765257 ml	72.48952 m^3	100	l	l**
80 (3)	3.70708 ml	97.17886 m^3	4.188791 ml	109.8066 m^3	100	l	l**
100(4)	5.789039 ml	151.7561 m^3	6.544985 ml	171.5728 m^3	100	l	l**
125 (5)	9.265244 ml	242.8828 m^3	10.22654 ml	268.0825 m^3	100	l	m^3
150 (6)	14.57896 ml	382.1785 m^3	14.72622 ml	386.0389 m^3	100	l	m^3
200 (8)	23.09071 ml	605.309 m^3	26.17994 ml	686.2913 m^3	1	m^3	m^3

6DN	Volume/pulse or batch quantity*				Factory setting		
	MAG 5100 W (Order no. 7ME6520)		MAG 1100, MAG 1100 F, 5100 W (Order no. 7ME6580) MAG 3100, 3100 P		Volume/ pulse & batch amount	Pulse & batch unit	Totalizer unit
mm (inch)	min.	max.	min.	max.			
250 (10)	37.04053 ml	970.995 m^3	40.90616 ml	1072.33 m^3	1	m^3	m^3
300 (12)	57.87403 ml	1517.132 m^3	58.90487 ml	1544.155 m^3	1	m^3	m^3
350 (14)	80.17607 ml	2101.767 m^3	80.17607 ml	210.7671 m^3	1	m^3	m^3
400 (16)	104.7198 ml	2745.165 m^3	104.7198 ml	2745.165 m^3	1	m^3	m^3
450 (18)	132.536 ml	3474.35 m^3	132.536 ml	3474.35 m^3	1	m^3	m^3
500 (20)	163.6247 ml	4289.321 m^3	163.6247 ml	4289.321 m^3	10	m^3	m^3
600 (24)	235.6195 ml	6176.622 m^3	235.6195 ml	6176.622 m^3	10	m^3	m^3
700 (28)	320.7043 ml	8407.069 m^3	320.7143 ml	8407.069 m^3	10	m^3	m^3
750 (30)	368.1554 ml	9650.972 m^3	368.1554 ml	9650.972 m^3	10	m^3	m^3
800 (32)	418.8791 ml	10980.66 m^3	418.8791 ml	10980.66 m^3	10	m^3	m^3
900 (36)	530.1438 ml	13897.4 m^3	530.1438 ml	13897.4 m^3	10	m^3	m^3
1000 (40)	654.4985 ml	17157.28 m^3	654.4985 ml	17157.28 m^3	10	m^3	m^3
1050 (42)	654.4985 ml	17157.28 m^3	654.4985 ml	17157.28 m^3	10	m^3	m^3
1100 (44)	79.94321 ml	20760.31 m^3	791.9432 ml	20760.31 m^3	10	m^3	m^3
1200 (48)	942.4778 ml	24706.48 m^3	942.4778 ml	24706.48 m^3	10	m^3	m^3
1400 (54)	-	-	1.282817 l	33628.27 m^3	10	m^3	m^3
1500 (60)	-	-	1.472622 l	38603.89 m^3	10	m^3	m^3
1600 (66)	-	-	1.675517 l	43922.64 m^3	10	m^3	m^3
1800 (72)	-	-	2.120576 l	55589.6 m^3	10	m^3	m^3
2000 (78)	-	-	2.617994 l	68629.13 m^3	10	m^3	m^3
2200 (90)	-	-	3.167773 l	83041.25 m^3	10	m^3	m^3
2400 (96)	-	-	3.769912 l	98825.9 m^3	10	m^3	m^3
2600 (102)	-	-	4.4241 l	115983. m^3	10	m^3	m^3
2800 (114)	-	-	5.131268 l	134513.1 m^3	10	m^3	m^3
3000 (120)	-	-	5.890487 l	154415.5 m^3	10	m^3	m^3

* The min. and max. amount values show mathematical values and do not indicate measurement accuracy.

** For CT devices the totalizer 1 unit is in m^3

B.5 60 Hz Dimension dependent batch and pulse output settings

60 Hz Dimension dependent factory settings MAG 1100, MAG1100F, MAG 3100, MAG 3100 P and MAG 5100W with ½" NPT cable glands

DN	Volume/pulse or batch quantity			
	MAG 5100 W (Order no. 7ME6520)		MAG 1100, MAG 1100 F, 5100 W (Order no. 7ME6580) MAG 3100, 3100 P	
mm (inch)	US G min.	US G max.	US G min.	US G max.
2 ($^1/_{12}$)	-	-	0.00000095484069	25.03057
3 ($^1/_8$)	-	-	0.000001556102	40.79227
6 ($^1/_4$)	-	-	0.000006224408	163.1691
10 ($^3/_8$)	-	-	0.00001729003	453.2475
15 (½)	-	-	0.00003890255	1019.806
25 (1)	0.0001080627	2832.796	0.0001080627	2832.796
40 (1½)	0.0002766404	7251.96	0.0002766404	7251.96
50 (2)	0.0003851353	10096.08	0.0004322506	11331.18
65 (2½)	0.0006114314	16028.3	0.0007305034	19149.7
80 (3)	0.0009793068	25671.93	0.001106562	29007.84
100(4)	0.001529303	40089.74	0.001729003	45324.75
125 (5)	0.002447619	64162.85	0.002701566	70819.92
150 (6)	0.003851353	100960.8	0.003890255	101980.6
200 (8)	0.00609992	159905.7	0.006916009	181299
250 (10)	0.009785071	256509.7	0.01080627	283279.6
300 (12)	0.01528871	400784.1	0.01556102	407922.7
350 (14)	0.02118028	555228.2	0.02118028	555228.2
400 (16)	0.02766404	725196	0.02766404	725196
450 (18)	0.0350123	917826.2	0.0350123	917826.2
500 (20)	0.04322506	1133118	0.04322506	1133118
600 (24)	0.06224408	1631691	0.06224408	1631691
700 (28)	0.0847211	2220912	0.0847211	2220912
750 (30)	0.09725637	2549517	0.09725637	2549517
800 (32)	0.1106562	2900784	0.1106562	2900784
900 (36)	0.1400492	3671304	0.1400492	3671304
1000 (40)	0.1729003	4532475	0.1729003	4532475
1050 (42)	0.1729003	4532475	0.1729003	4532475
1100 (44)	0.2092093	5484294	0.2092093	5484294
1200 (48)	0.2489763	6526764	0.2489763	6526764
1400 (54)	-	-	0.3388844	8883651
1500 (60)	-	-	0.3890255	10198060
1600 (66)	-	-	0.4426246	11603130
1800 (72)	-	-	0.5601967	14685210

DN	Volume/pulse or batch quantity			
	MAG 5100 W (Order no. 7ME6520)		MAG 1100, MAG 1100 F, 5100 W (Order no. 7ME6580) MAG 3100, 3100 P	
mm (inch)	US G min.	US G max.	US G min.	US G max.
2000 (78)	-	-	0.6916009	18129900
2200 (90)			0.836837	21937170
2400 (96)			0.995906	26107050
2600 (102)			1.168806	30639530
2800 (114)			1.355538	35534600
3000 (120)			1.556102	40792270

Approvals/Certificates

C

All certificates are posted on the Internet. Additionally, the CE Declaration of Conformity as well as ATEX approvals are available on the SITRANS F literature CD-ROM.

Certificates (http://support.automation.siemens.com/WW/view/en/10806951/134200)

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For more information

www.siemens.com/flow

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Electromagnetic flowmeters

SITRANS F M MAG 5100 W

Operating Instructions • 11/2010

SITRANS F

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Electromagnetic Flowmeters SITRANS F M MAG 5100 W

Operating Instructions

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Appendix A

Electromagnetic sensor type SITRANS F M MAG 5100 W for use with transmitter types SITRANS F M MAG 5000/6000/6000I

11/2010
A5E03063678-02

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be adhered to. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of the Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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GERMANY

order number: A5E03063678
℗ 11/2010

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Introduction

1

These instructions contain all the information you need for using the device.

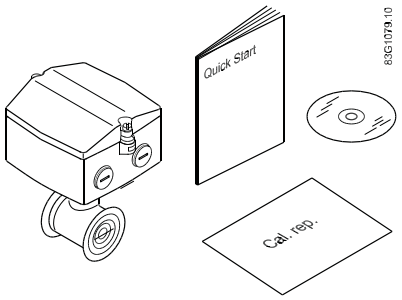
The instructions are aimed at persons mechanically installing the device, connecting it electronically, configuring the parameters and commissioning it as well as service and maintenance engineers.

Note

It is the responsibility of the customer that the instructions and directions provided in the manual are read, understood and followed by the relevant personnel before installing the device.

1.1 Items supplied

- SITRANS F M MAG 5100 W
- Calibration report
- SITRANS F M literature CD
- Quick Start guide



1.2 History

The contents of these instructions are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

The following table shows the most important changes in the documentation compared to each previous edition.

Edition	Remarks
11/2010	Minor updates
07/2010	First edition Replaces MAG 5100 W part of SITRANS F M Handbook (A5E02435647) and MAG 5100 W instruction (A5E00718677)

1.3 Further Information

The contents of these Operating Instructions shall not become part of or modify any prior or existing agreement, commitment or legal relationship. All obligations on the part of Siemens AG are contained in the respective sales contract which also contains the complete and solely applicable warranty conditions. Any statements contained herein do not create new warranties or modify the existing warranty.

Product information on the Internet

The Operating Instructions are available on the CD-ROM shipped with the device, and on the Internet on the Siemens homepage, where further information on the range of SITRANS F flowmeters may also be found:

Product information on the internet (http://www.siemens.com/flowdocumentation)

Worldwide contact person

If you need more information or have particular problems not covered sufficiently by the operating instructions, please get in touch with your contact person. You can find contact information for your local contact person on the Internet:

Local contact person (http://www.automation.siemens.com/partner)

See also

Technical support (Page 30)

Safety notes

2

⚠ CAUTION
Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance. Only qualified personnel should install or operate this instrument.

Note

Alterations to the product, including opening or improper repairs of the product, are not permitted.

If this requirement is not observed, the CE mark and the manufacturer's warranty will expire.

2.1 Laws and directives

General requirements

Installation of the equipment must comply with national regulations.

Instrument safety standards

The device has been tested at the factory, based on the safety requirements. In order to maintain this condition over the expected life of the device the requirements described in these Operating Instructions must be observed.

CAUTION
Material compatibility Siemens Flow Instruments can provide assistance with the selection of wetted sensor parts. However, the full responsibility for the selection rests with the customer and Siemens Flow Instruments can take no responsibility for any failure due to material incompatibility.

CE marked equipment

All meters carry either a CE mark or a CE mark followed by eg.200

- CE200: This indicates that the product conforms to:
  - PED 97/23/EC
  - LVD 2006/95/EC
  - EMC 2004/108/EC
- CE: This indicates that the product conforms to:
  - LVD 2006/95/EC
  - EMC 2004/108/EC

Compliance with PED directive

"Pressure Equipment Directive" (PED) is mandatory for all pressure equipment sold within the EU and EFTA.

Siemens Flow Instruments products confirms to PED by following the tables below.

Table 2- 1 MAG 5100 W (7ME6580 only DN15 ... 600 (½" ... 24"))

Flange mm	PN 10	PN 16	PN 40	150 lb	300 lb
15	N/A	N/A	SEP	SEP	N/A
25	N/A	N/A	SEP	SEP	N/A
40	N/A	N/A	SEP	SEP	N/A
50	N/A	SEP	N/A	SEP	N/A
65	N/A	SEP	N/A	SEP	N/A
80	N/A	SEP	N/A	SEP	N/A
100	SEP	SEP	N/A	SEP	N/A
125	N/A	SEP	N/A	PED	N/A
150	N/A	PED	N/A	PED	N/A
200	SEP	PED	N/A	PED	N/A
250	LVD	PED	N/A	PED	N/A
300	LVD	PED	N/A	PED	N/A
350	LVD	PED	N/A	PED	N/A
400	LVD	PED	N/A	PED	N/A
450	LVD	PED	N/A	PED	N/A
500	LVD	PED	N/A	PED	N/A
600	LVD	PED	N/A	PED	N/A
700	LVD	PED*	N/A	N/A	PED
750	N/A	N/A	N/A	N/A	PED

800	LVD	PED*	N/A	N/A	PED
900	LVD	PED*	N/A	N/A	PED
1000	LVD	PED*	N/A	N/A	PED
1050	N/A	N/A	N/A	N/A	PED
1100	N/A	N/A	N/A	N/A	PED
1200	LVD	PED*	N/A	N/A	PED

The key to the tables is as follows:

PED	Product covered by PED and only available as fully PED-conforming
PED*	Product covered by PED but available as either conforming or non-conforming to PED
SEP	Excluded from PED under Sound Engineering Practice
LVD	Excluded from PED under the Low Voltage Directive

2.2 Installation in hazardous area

⚠ WARNING

Equipment used in hazardous areas must be approved for use in hazardous area and marked accordingly. It is required that the special conditions for safe use provided in the manual and in the FM / CSA certificates are followed!

Hazardous area approvals

The device is approved for use in hazardous area and has the following approvals:

- MAG 5100 W DN 15 ... 1200: FM / CSA Class I, Div. 2

WARNING

Make sure the hazardous area approval is suitable for the environment in which the device will be installed.

WARNING

All approvals are based on non-flammable processes only!

WARNING

Potential equalization

In operation, the output is earthed through the conductive medium being measured and therefore potential equalisation is necessary throughout the hazardous area.

The apparatus housing shall be connected to the potential equalising conductor in the hazardous area.

WARNING

Laying of cables

Cables for use in hazardous area must satisfy the requirements for having a proof voltage < AC 500 V applied between the conductor/ground, conductor/shield and shield/ground.

Connect the devices that are operated in hazardous areas as per the stipulations applicable in the country of operation.

2.3 Certificates

Certificates are posted on the Internet and on the documentation CD-ROM shipped with the device.

See also

Technical data (Page 37)

Certificates on the Internet (http://www.siemens.com/processinstrumentation/certificates)

Description

3

The main applications of the SITRANS F M electromagnetic flow sensors can be found in the following fields:

- Process industry
- Chemical industry
- Steel industry
- Mining
- Utility
- Power generation & distribution
- Oil & gas / HPI
- Water & waste water
- Pulp & paper

3.1 System components

The SITRANS F M USM II flowmeter system includes:

- Transmitter (types: SITRANS F M MAG 5000/6000 or MAG 6000 I)
- Sensor (types: SITRANS F M MAG 1100/1100F, MAG 3100/3100 P or MAG 5100 W)
- Communication module (optional) (types: HART, PROFIBUS PA/DP, MODBUS RTU RS 485, Foundation Fieldbus H1, Devicenet)
- SENSORPROM memory unit

Communication solutions

The SITRANS F USM II range of add on modules, presently including HART, Foundation Fieldbus. MODBUS RTU RS 485, PROFIBUS PA / DP and Devicenet, are all applicable with the SITRANS F M MAG 6000 transmitter.

The SITRANS F M MAG 5100 W sensor housing and flanges are designed in carbon steel and terminal box in fibre glass reinforced polyamide. Measuring pipe is made of stainless steel (AISI 304) and liners are available in NBR Hard Rubber, Ebonite Hard Rubber, or EPDM, which makes the sensor highly resistant to a wide range of chemicals. Electrodes are made of Hastelloy.

MAG 5100W DN15 ... 40

MAG 5100W DN50 ... 300

MAG 5100W DN350 ... 1200 (7ME6520)

MAG 5100W DN25 ... 2000 (7ME6580)

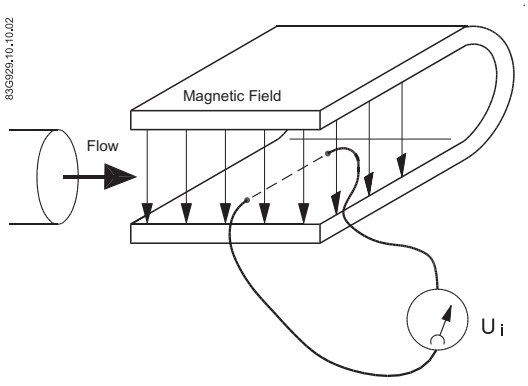
MAG 5100W compact installation with MAG 5000/6000 IP67

MAG 5100W compact installation with MAG 6000 I

The sensors carry a wide range of approvals, see Technical data (Page 37).

3.2 Theory of operation

The flow measuring principle is based on Faraday's law of electromagnetic induction.



U_i = When an electrical conductor of length L is moved at velocity v, perpendicular to the lines of flux through a magnetic field of strength B, the voltage Ui is induced at the ends of the conductor

$U_i = L \times B \times v$

- Ui = Induced voltage
- L = Conductor length = Inner pipe diameter = k_1
- B = Magnetic field strength = k_2
- v = Velocity of conductor (media)
- $k = k_1 \times k_2$

Ui = k x v, the electrode signal is directly proportional to the fluid velocity

Operating principle

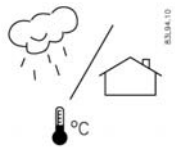
The coil current module generates a pulsating magnetizing current that drives the coils in the sensor. The current is permanently monitored and corrected. Errors or cable faults are registered by the self-monitoring circuit.

Input circuit amplifies the flow-proportional induced voltage signal from the electrodes. The input impedance is extremely high: $>10^{14}$ Ω which allows flow measurements on fluids with conductivities as low as 5 µS/cm. Measuring errors due to cable capacitance are eliminated due to active cable screening.

Digital signal processor converts the analog flow signal to a digital signal and suppresses electrode noise through a digital filter. Inaccuracies in the transmitter as a result of long-term drift and temperature drift are monitored and continuously compensated for via the self-monitoring circuit. The analog to digital conversion takes place in an ultra low noise ASIC with 23 bit signal resolution. This has eliminated the need for range switching. The dynamic range of the transmitter is therefore unsurpassed with a turn down ratio of minimum 3000:1.

Installing/Mounting

4



SITRANS F flowmeters with minimum IP67/NEMA 4X enclosure rating are suitable for in- and outdoor installations.

- Make sure that pressure and temperature specifications indicated on the device nameplate / label will not be exceeded.

WARNING

Installation in hazardous location

Special requirements apply to the location and interconnection of sensor and transmitter. See "Installation in hazardous area" (Page 9)

4.1 Installation safety precautions

WARNING

In applications with working pressures/media that can be dangerous to people, surroundings, equipment or others in case of pipe fracture, we recommend that special precautions such as special placement, shielding or installation of a security guard or a security valve are taken when the sensor is mounted.

- Ensure that stresses and loading caused by e.g. earthquakes, traffic, high winds and fire damage if appropriate are taken into account during installation.
- Ensure that the flowmeter is installed such that it does not act as a focus for pipeline stresses. External loadings are not taken into account in the flowmeter design.
- Provide adequate protection to minimise any risk of contact with hot surfaces.

WARNING

Prevent personal injuries by assuring that operation below pressure guards cannot take place, if working with vacuum or fluids boiling readily.

4.2 Determining a location

NOTICE
The sensor must always be completely filled with liquid.

- Locate the the flowmeter in u-shaped pipes if pipes are only partially filled or have free outlet

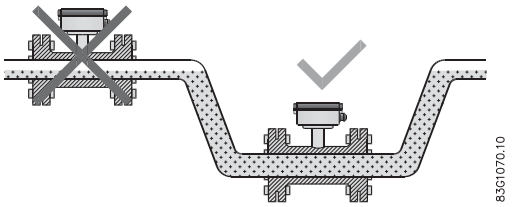


Figure 4-1 Correct installation in U-tube

- Avoid the following installations
  - Installation at the highest point in the pipe system
  - Installation in vertical pipes with free outlet

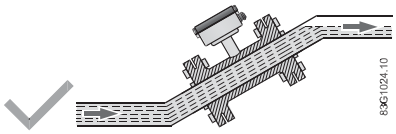


Figure 4-2 Correct installation with filled pipes

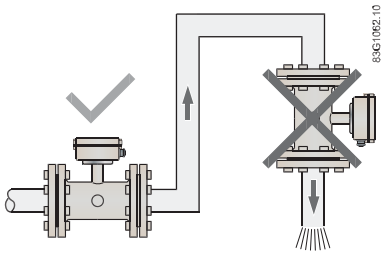


Figure 4-3 Correct installation at low point in system before outlet

Inlet and outlet conditions

To achieve accurate flow measurement it is essential to have straight lengths of inlet and outlet pipes and a certain distance to pumps and valves.

It is also important to centre the flowmeter in relation to pipe flanges and gaskets.

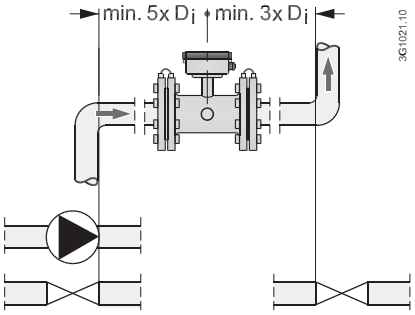
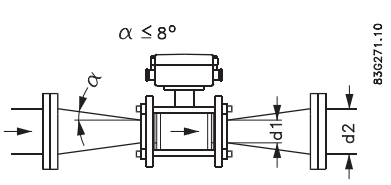
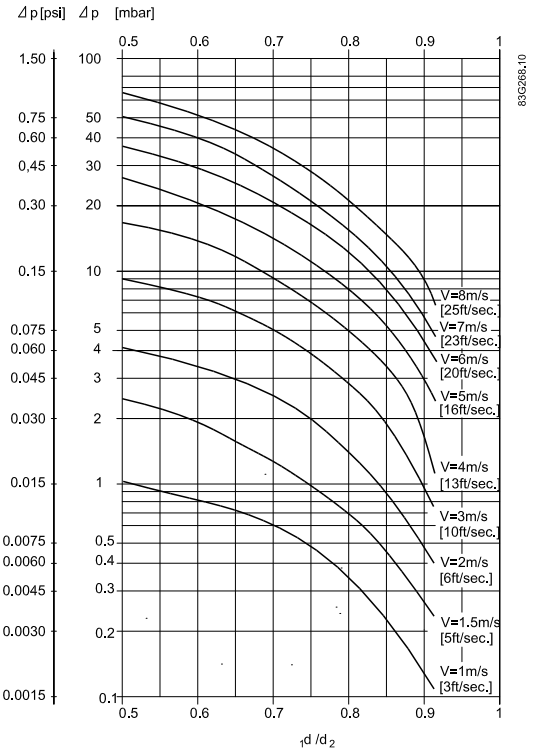


Figure 4-4 Inlet and outlet conditions

Installation in large pipes

The flowmeter can be installed between two reducers (e.g. DIN 28545). At 8° the following pressure drop curves apply. The curves are applicable to water.





Example:

A flow of 3 m/s (V) in a sensor with a diameter reduction from DN 100 to DN 80 (d_1/d_2 = 0.8) gives a pressure drop of 2.9 mbar.

4.3 Orienting the sensor

The sensor operates in all orientations, but Siemens has the following recommendations:

- Vertical installation with an upwards flow

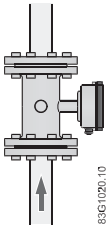


Figure 4-5 Vertical orientation, upwards flow

CAUTION
Abrasive liquids / liquids containing solid particles A vertical installation minimizes wear and deposits in the sensor

NOTICE
Gas/air bubbles in the liquid A vertical installation minimizes any negative effect of gas/air bubbles in the liquid

- Horizontal installation, terminal box upwards or downwards

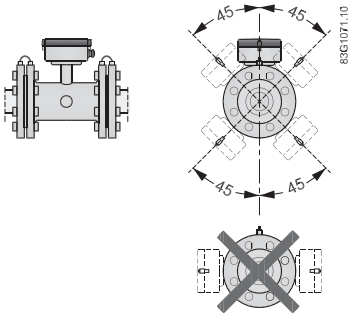


Figure 4-6 Horizontal installation, various terminal box positions

CAUTION
Do NOT mount the sensor with the terminal box sideways This will position the electrodes at the top where there is possibility for air bubbles and at the bottom where there is possibility for mud, sludge, sand etc.

NOTICE
Empty pipe detection For applications with empty pipe detection, the sensor can be tilted 45°, as shown above.

4.4 Mounting

- Install the sensor in rigid pipelines in order to support the weight of the meter.
- Center the connecting pipelines axially in order to avoid turbulent flow profiles.
- Use proper gaskets according to liner type

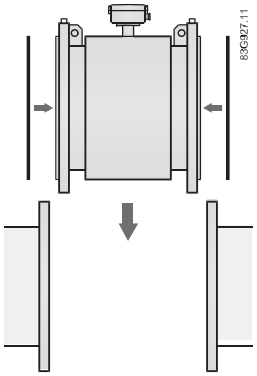


Figure 4-7 Correct installation with gaskets

Vibrations

Avoid strong vibrations.

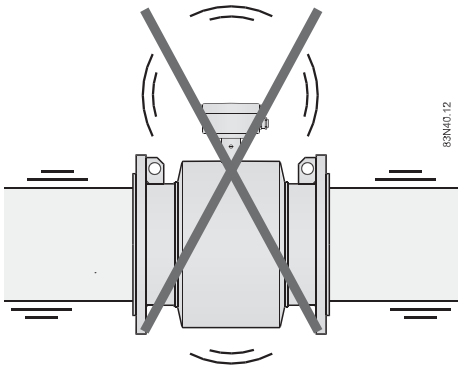


Figure 4-8 Avoid vibrations

⚠ CAUTION
In applications with strong vibrations, Siemens recommend remote mounting of the transmitter!

Torques

Fasten screws according to the torques values below

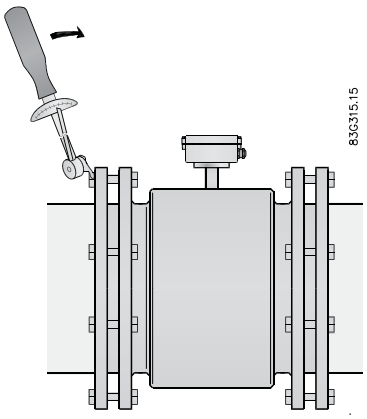


Figure 4-9 Torques values

NOTICE
Torque values are calculated on the basis of use of gaskets.

Table 4- 1 Maximum allowable torques

DN		PN 10		PN 16		PN 40		Class 150		AWWA	
Mm	Inch	Nm	F/lbs	Nm	F/lbs	Nm	F/lbs	Nm	F/lbs	Nm	F/lbs
15	½	N/A	N/A	N/A	N/A	10	7	6	5	N/A	N/A
25	1"	N/A	N/A	N/A	N/A	10	7	7	5	N/A	N/A
40	1½"	N/A	N/A	N/A	N/A	16	12	9	7	N/A	N/A
50	2"	N/A	N/A	N/A	N/A	N/A	N/A	25	18	N/A	N/A
65	2½"	N/A	N/A	25/25	18/18	N/A	N/A	25	18	N/A	N/A
80	3"	N/A	N/A	25/25	18/18	N/A	N/A	34	25	N/A	N/A
100	4"	N/A	N/A	25/25	18/18	N/A	N/A	26	19	N/A	N/A
125	5"	N/A	N/A	29/32	21/24	N/A	N/A	42	31	N/A	N/A
150	6"	N/A	N/A	50/50	37/37	N/A	N/A	57	42	N/A	N/A
200	8"	50/50	37/37	50/52	37/38	N/A	N/A	88	65	N/A	N/A
250	10"	50/50	37/37	82/88	61/65	N/A	N/A	99	73	N/A	N/A
300	12"	57/62	42/46	111/117	82/86	N/A	N/A	132	97	N/A	N/A
350	14"	60/60	44/44	120/120	89/89	N/A	N/A	225	166	N/A	N/A
400	16"	88/88	65/65	170/170	125/125	N/A	N/A	210	155	N/A	N/A
450	18"	92/92	68/68	170/170	125/125	N/A	N/A	220	162	N/A	N/A
500	20"	103/103	76/76	230/230	170/170	N/A	N/A	200	148	N/A	N/A
600	24"	161/161	119/119	350/350	258/258	N/A	N/A	280	207	N/A	N/A
700	28"	200/200	148/148	304/304	224/224	N/A	N/A	N/A	N/A	200	148
750	30"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	240	177

DN		PN 10		PN 16		PN 40		Class 150		AWWA	
800	32"	274/274	202/202	386/380	285/285	N/A	N/A	N/A	N/A	260	192
900	36"	288/288	213/213	408/408	301/301	N/A	N/A	N/A	N/A	240	177
1000	40"	382/382	282/282	546/546	403/403	N/A	N/A	N/A	N/A	280	207
1050	42"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	280	207
1100	44"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	290	214
1200	48"	395/395	292/292	731/731	539/538	N/A	N/A	N/A	N/A	310	229
1400	54"	-/503	-/317	-/736	-/543	N/A	N/A	N/A	N/A	528	389
1600	66"	-/684	-/505	-/913	-/674	N/A	N/A	N/A	N/A	698	515
1800	72"	-/771	-/569	-/937	-/692	N/A	N/A	N/A	N/A	700	516
2000	78"	-/867	-/640	-/1128	-/832	N/A	N/A	N/A	N/A	890	656

4.5 Potential equalization

To obtain optimum results from the measuring system, the sensor must have the same electrical potential as the liquid being measured.

This is achieved by means of built-in grounding electrodes.

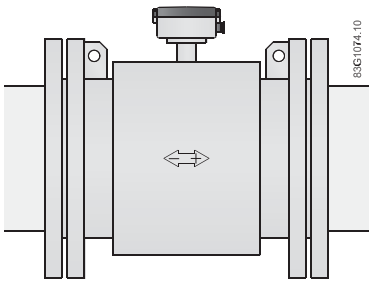


Figure 4-10 Potential equalization with earthing electrodes

Cathodic protected piping

Special attention must be paid to systems with cathodic protection

⚠ WARNING

Use in hazardous area!

Cathodic pipe protection is not allowed in hazardous areas

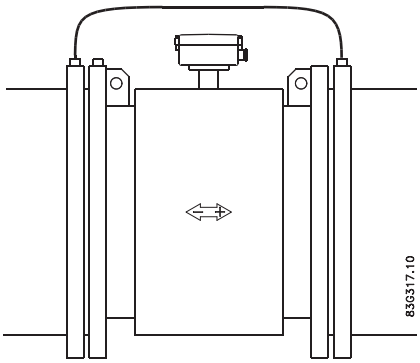


Figure 4-11 Cathodic protection

- Isolate the sensor from cathodic protected pipes using insulated bolts.
- Use bypass cable between the mating flanges

NOTICE
Remote mounted sensor versions If the above is not acceptable, remote mounted sensors can alternatively be connected as follows: • Connect coil current cable shield at sensor end via a 1.5 µF condensator • Make sure that electrode cable shield is not connected at both ends

Connecting

5

The following contains a short description of how to connect a remote mounted sensor to a transmitter type SITRANS F M MAG 5000 / 6000 or MAG 6000 I. For more information, e.g. about wiring of power supply and outputs, refer to the Operating Instructions for the respective transmitters.

Before connecting

- Check that serial numbers on sensor and SENSORPROM® unit are identical.

⚠ WARNING

The pertinent regulations must be observed for electrical installation.

- Never install the device with the mains voltage switched on!
- Danger of electric shock!
- The electrodes and magnetic current line may only be connected when the device is not connected to the power supply.
- If the housing is under voltage (power supply), the cover may be unscrewed by qualified personnel only.

⚠ WARNING

Mains supply from building installation Class II

A switch or circuit breaker (max. 15 A) must be installed in close proximity to the equipment and within easy reach of the operator. It must be marked as the disconnecting device for the equipment.

Cable specifications

- Only use cables with at least the same degree of protection as the sensor to install the sensor.
- The line length from the cable gland to the terminals must be kept as short as possible. Line loops in the terminal box must be avoided.

- To guarantee the IP 67 degree of protection, use cables with the required specifications.

⚠ WARNING
Protective conductor terminal The required cable is min. AGW16 or 1.5 Cu.

⚠ WARNING
Wire insulation The insulation between the connected mains supply and 24 V AC/DC supply for the flowmeter must at least be rated with double or reinforced insulation at mains voltage. For field wiring installation: Ensure that the **National Installation Code** of the country in which the flowmeters are installed is met.

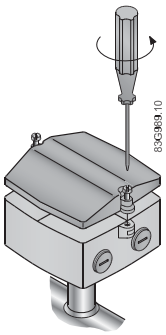
See also

Cable data (Page 40)

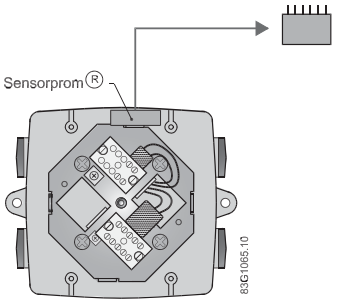
5.1 Remote installation

NOTICE
Remote installation only The following applies to remote installation of MAG 5000 / 6000 or MAG 6000 I.

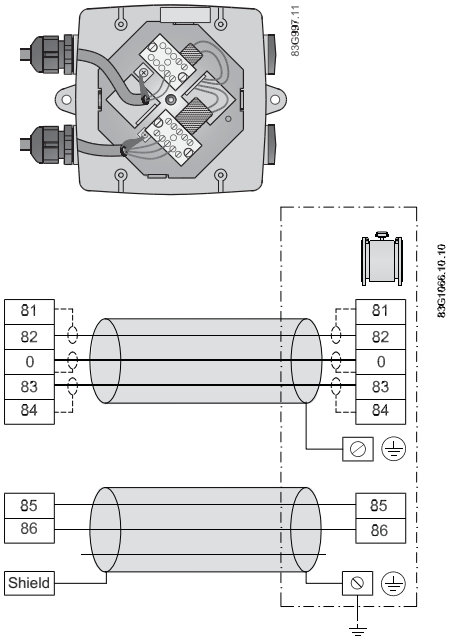
1. Unscrew and remove terminal box lid.



2. Remove SENSORPROM® unit from sensor and mount it on connection plate in transmitter, see relevant transmitter operating instructions.



3. Fit the ½" NPT or M20 cable glands for supply and output cables.
4. Fit and connect electrode and coil cables as shown below.



CAUTION

Unshielded cable ends

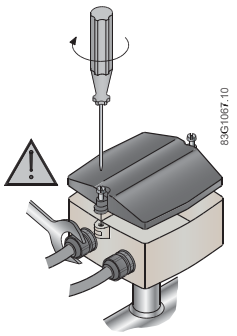
Keep unscreened cable ends as short as possible.

CAUTION

Prevent interference

Separate electrode and coil cables to prevent interference.

5. Tighten cable glands well to obtain optimum sealing.



WARNING
Mount terminal box lid before power up.

5.2 Installation check

The meter is now ready to go into normal operation - for commissioning and setting of parameters refer to the relevant transmitter manual.

Before commissioning it must be checked that:

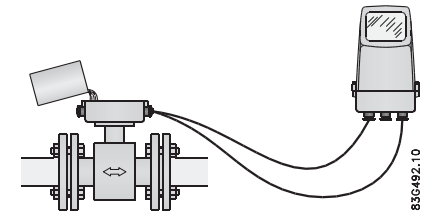
- The device has been installed and connected in accordance with the guidelines provided in chapter 4 Installing/mounting (Page 15) and 5 Connecting (Page 23)

5.3 Potting

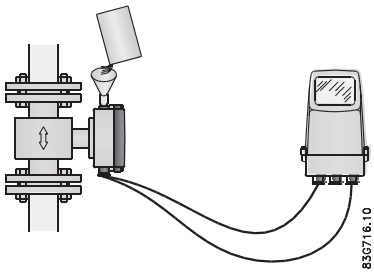
If sensor is buried or permanently submerged, terminal box must be encapsulated with silicon dielectric gel (non-toxic, transparent and self-healing gel)

CAUTION
Do **not** pot meter before electrical connections have been made.

- Mix the two components of the potting kit well and pour into terminal box.
- Let cure for approximately 24 hours at approximately 25°C (77°F). Curing time increases by 100% per -10°C (-18°F).



Horizontal orientation



Vertical orientation

NOTICE
Gel can be penetrated with test instruments or be removed in case of cable replacement.

5.4 Direct burial

Recommendations for direct burial of remote sensor:

- Check for visible damages in paint finish !
- Use protection conduit !
- Protect sensor with pea gravel at least 3000 mm around sensor. This provides some drainage and also avoids caking sensor with earth. It also helps to locate sensor in case excavation takes place.

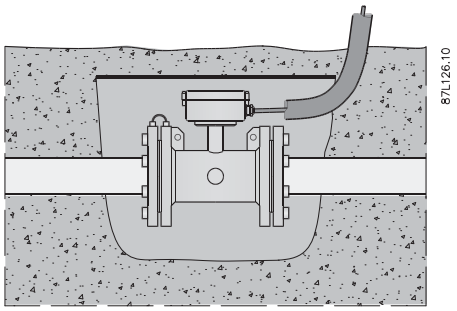


Figure 5-1 Direct burial of sensor

⚠ CAUTION

Sensor should not be subject to heavy vehicles applying excessive weight above sensor or pipeline

CAUTION

SENSORPROM® memory unit

Remove the SENSORPROM® from terminal box on sensor and relocate in remote transmitter prior to burying sensor.

All sensor data plate information and serial number should be recorded for each sensor prior to burying. This will ensure correct matching with SENSORPROM® unit.

⚠ WARNING

Electrical cable identification

Use suitable coil and electrode cables

Lay electrical cable identification tape above pea gravel before it is covered with earth.

Service and maintenance 6

6.1 Maintenance

The device is maintenance-free, however, a periodic inspection according pertinent directives and regulations must be carried out.

An inspection can include check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover screws
- Reliability of power supply, lightning protection, and grounds

6.2 Recalibration

Siemens A/S Flow Instruments offers to recalibrate the sensor. The following calibrations are offered as standard:

- Standard matched pair calibration

Note

For recalibration the memory unit must always be returned with the sensor

6.3 Transportation/storage

The sensor is a fragile piece of equipment. Impact and shock can cause measuring inaccuracy. Therefore during transportation it must be placed in the transportation box delivered by Siemens Flow Instruments. If this is not possible, the alternative sensor packaging must be able to withstand the hazards from transportation.

Handling

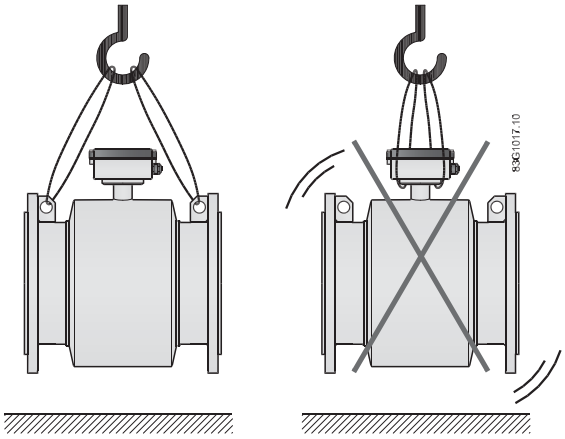


Figure 6-1 Handling of sensor

6.4 Unit repair

CAUTION
Repair and service must be carried out by Siemens authorized personnel only.

Note

Siemens Flow Instruments defines sensors as non-repairable products.

6.5 Technical support

If you have any technical questions about the device described in these Operating Instructions and do not find the right answers, you can contact Technical Support:

- Via the Internet using the **Support Request:**
  Support request (http://www.siemens.com/automation/support-request)
- Via Phone:
  - Europe: +49 (0)911 895 7222
  - America: +1 423 262 5710
  - Asia-Pacific: +86 10 6475 7575

Further information about our technical support is available in the Internet at Technical support (http://support.automation.siemens.com/WW/view/en/16604318)

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base online on the Internet at:

Service and support (http://www.siemens.com/automation/service&support)

There you will find:

- The latest product information, FAQs, downloads, tips and tricks.
- Our newsletter, providing you with the latest information about your products.
- A Knowledge Manager to find the right documents for you.
- Our bulletin board, where users and specialists share their knowledge worldwide.
- You can find your local contact partner for Industry Automation and Drives Technologies in our partner database.
- Information about field service, repairs, spare parts and lots more under "Services."

Additional Support

Please contact your local Siemens representative and offices if you have additional questions about the device

Find your contact partner at:

Local contact person (http://www.automation.siemens.com/partner)

6.6 Return procedures

Enclose the delivery note, the cover note for return delivery together with the declaration of decontamination form on the outside of the package in a well-fastened clear document pouch.

Required forms

- **Delivery Note**
- **Cover Note for Return Delivery** with the following information

  Cover note (http://support.automation.siemens.com/WW/view/en/16604370)
  - product (ordering number)
  - number of devices or spare parts returned
  - reason for the return

- **Declaration of Decontamination**

  Declaration of Decontamination (http://pia.khe.siemens.com/efiles/feldg/files/Service/declaration_of_decontamination_en.pdf)

  With this declaration you certify *that the returned products/spare parts have been carefully cleaned and are free from any residues.*

  If the device has been operated together with toxic, caustic, flammable or water-damaging products, clean the device before return by rinsing or neutralizing. Ensure that all cavities are free from dangerous substances. Then, double-check the device to ensure the cleaning is completed.

  We shall not service a device or spare part unless the declaration of decontamination confirms proper decontamination of the device or spare part. Shipments without a declaration of decontamination shall be cleaned professionally at your expense before further proceeding.

You can find the forms on the Internet and on the CD delivered with the device.

Troubleshooting/FAQs 7

7.1 Sensor check

Requirement

To check the SITRANS F M sensors the following test instruments will be required:

- Digital Meter/Multimeter
- Megger
- (Moving Coil Meter)

Sensor check

Remove the transmitter from the sensor or remote position before making the following checks.

Coil resistance check

- Measure the coil resistance between connection numbers 85 and 86 using a digital meter.
  Resistance should be around 100 ohms ±10 ohms. (See Coil resistence table)

A low reading may indicate moisture within the coil housing or shorted coil tums.

A high reading would indicate an open circuit coil.

NOTICE
In case of deviation from nominal coil values, the sensor is damaged and must be replaced

Coil insulation check

⚠ WARNING
Potential hazard!
Only carry our a coil insulation check in non-hazardous area!

- Megger between connection number 85 and the sensor body.
  The resistance should be above 20 Megohms.

A low megger reading would indicate the coil insulation is braking down. This is normally due to fluid ingress into the coil housing.

Sensors with an insulation resistance down to 1 Megohms may still work satisfactorily but this is not guaranteed.

Electrode resistance check

- Measure the electrode resistance between connections 82 and Zero with a moving coil meter.
  With a sensor full of fluid the resistance should be between 5Kohms and 50Kohms.
  If the sensor is empty the resistance will be infinite.
- Repeat the resistance measurements between connections 83 and Zero.
  The results should be the same.

If the resistance is low there may be a short on the electrodes or wiring (in the case of a remote mounted transmitter). Alternatively there may be water ingress or moisture in the terminal box.

If the resistance is high and the pipe is completely full of fluid check the following:

1. The fluid is electrically conductive.
2. Electrodes are not coated with grease or any deposit.
3. Electrode circuit is not open
4. The remote mounted transmitter has a 3 core cable with an overall shield continuously from the sensor to the transmitter, including junction boxes and terminal rails inside panels.
5. The shield is connected to the Zero or to the earth terminal (PE) on the sensor.

NOTICE
Sensors removed from line For sensors removed from line with dry bore, use megger between terminal 82 and compression plate, and 83 and compression plate to show any water ingress behind electrodes or within enclosure.

7.2 Fluctuating process values

Question

Why do the displayed process values fluctuate when the electrode cable is moved?

Answer

There are several causes to the fluctuating process values:

- Deposits on electrodes
  - Clean the electrodes.
- Defect electrode cable
  - Replace the cable
- Incorrect cable connection
  - Connect the electrode cable (82, 83, 0 and shield) according to the instructions in chapter Connecting (Page 23)

NOTICE
Vibrating environments It is recommended to use special low noise cables for sensor sizes DN 2 and 3 installed in vibrating environments.

Technical data

8

8.1 MAG 5100 W

Table 8- 1 Technical data

Version	MAG 5100W (7ME6520)	MAG 5100W (7ME6580)
Product characteristic	Mainly for the European market EPDM or NBR lining	Mainly for the non-European market Ebonite lining
Design and nominal size	*Coned sensor:* • DN 15 ... 300 (½" ... 12") *Full bore sensor:* • DN 350 ... 1200 (14" ... 48")	*Full bore sensor:* • DN 25 ... 2000 (1" ... 78")
Measuring principle	Electromagnetic induction	
Excitation frequency (Mains supply: 50 Hz/60 Hz)	*DN 15 ... 65 (½" ... 2½"):* • 12.5 Hz / 15 Hz *DN 80 ... 150 (3" ... 6"):* • 6.25 Hz / 7.5 Hz *DN 200 ... 300 (8" ... 12"):* • 3.125 Hz / 3.75 Hz *DN 350 ... 1200 (14" ... 48"):* • 1.5625 Hz / 1.875 Hz	*DN 25 ... 65 (1" ... 2½"):* • 12.5 Hz / 15 Hz *DN 80 ... 150 (3" ... 6"):* • 6.25 Hz / 7.5 Hz *DN 200 ... 1200 (8" ... 48"):* • 3.125 Hz / 3.75 Hz *DN 1400 ... 2000 (54" ... 78"):* • 1.5625 Hz / 1.875 Hz

Table 8- 2 Process connections

Version	MAG 5100W (7ME6520)	MAG 5100W (7ME6580)
EN 1092-1	*PN 10 (145 psi):* • DN 200 ... 300 (8" ... 12") Flat face flanges *PN 10 (145 psi):* • DN 350 ... 1200 (14" ... 48") Raised face flanges *PN 16 (232 psi):* • DN 50 ... 300 (2" ... 12") Flat face flanges *PN 16 (232 psi):* • DN 350 ... 1200 (14" ... 48") Raised face flanges *PN 40 (580 psi):* • DN 15 ... 40 (½" ... 1½") Flat face flanges	Raised face (EN 1092-1, DIN 3501 and BS4504 have the same mating dimensions) PN 16 (87 psi): • DN 1400 ... 2000 (54" ... 78") PN 10 (145 psi): • DN 200 ... 2000 (8" ... 78") PN16 (232 psi): • DN 65 ... 600 (2½" ... 24") PN 40 (580 psi): • DN 25 ... 50 (1" ... 2")
ANSI B16.5	Class 150 lb: ½" ... 24"	Class 150 lb: 1" ... 24"

Version	MAG 5100W (7ME6520)	MAG 5100W (7ME6580)
AWWA C-207	Class D: • 28" ... 48", Flat face flanges	Class D: • 28" ... 78", Flat face flanges
AS4087	*PN 16 (230 psi):* • DN 50 ... 1200 (2" ... 48")	*PN 16 (230 psi):* • DN 50 ... 1200 (2" ... 48")
JIS B 2220:2004	-	K10 (1" ... 24")

Table 8- 3 Rated operating conditions

Version	MAG 5100W (7ME6520)	MAG 5100W (7ME6580)
Ambient temperature • Sensor	-40 ... +70 °C (-40 ... +158 °F)	-40 ... +70 °C (-40 ... +158 °F)
• With compact transmitter		
MAG 5000/6000	-20 ... +60 °C (-4 ... +140 °F)	-20 ... +60 °C (-4 ... +140 °F)
MAG 6000 I	-20 ... +60 °C (-4 ... +140 °F)	-20 ... +60 °C (-4 ... +140 °F)
Operating pressure [abs. bar][1]	DN 15 ... 40 (½" ... 1½") 0.01 ... 40 bar (0.15 ... 580 psi) DN 50 ... 300 (2" ... 12") 0.03 ... 20 bar (0.44 ... 290 psi) DN 350 ... 1200 (14" ... 48") 0.01 ... 16 bar (0.15 ... 232 psi)	DN 25 ... 50 (1" ... 2") 0.01 ... 40 bar (0.15 ... 580 psi) DN 65 ... 1200 (2½" ... 48") 0.01 ... 16 bar (0.15 ... 232 psi) DN 1400 ... 2000 (54" ... 78") 0.01 ... 10 bar (0.15 ... 145 psi)
Enclosure rating		
Standard	IP67 to EN 60529 / NEMA 4X/6 (1 mH_2O for 30 minutes)	IP67 to EN 60529 / NEMA 4X/6 (1 mH_2O for 30 minutes)
Option	IP68 to EN 60529 / NEMA 6P (10 mH_2O continuously)	IP68 to EN 60529 / NEMA 6P (10 mH_2O continuously)
Corrosive category	C4 according to ISO 12944-2	C4 according to ISO 12944-2
Pressure drop	DN 15 and 25 (½" and 1"): • Max. 20 mbar (0.29 psi) at 1 m/s (3 ft/s) DN 40 ... 300 (1½" ... 12"): • Max. 25 mbar (0.36 psi) at 3 m/s (10ft/s) DN 350 ... 1200 (14" ... 48"): • Insginificant	Insignificant
Test pressure	1.5 x PN (where applicable)	1.5 x PN (where applicable)
Mechanical load (vibration)	18 ... 1000 Hz random in x,y, z directions for 2 hours according to EN 60068-2-36 Sensor: 3.17 grms Sensor with compact MAG 5000/6000 transmittter mounted: 3.17 grms Sensor with compact MAG 6000 I transmitter mounted: 1.14 grms	18 ... 1000 Hz random in x,y, z directions for 2 hours according to EN 60068-2-36 Sensor: 3.17 grms Sensor with compact MAG 5000/6000 transmittter mounted: 3.17 grms Sensor with compact MAG 6000 I transmitter mounted: 1.14 grms

Version	MAG 5100W (7ME6520)	MAG 5100W (7ME6580)
Process fluid temperature		
NBR	-10 ... +70 °C (14 ... 158 °F)	-
EPDM	-10 ... +70 °C (14 ... 158 °F)	-
EPDM (MI-001)	+0.1 ... +30 °C (32 ... 76 °C)	-
Ebonite	-	-10 ... +70 °C (14 ... 158 °F)
EMC	EMC 2004/108/EC	EMC 2004/108/EC

Maximum operating pressure decreases with increasing operating temperature

Table 8- 4 Design

Version	MAG 5100W (7ME6520)	MAG 5100W (7ME6580)
Housing and flange material	Carbon steel, with corrosion-resistant two-component epoxy coating (min. 150 µm) Corrosive category C4, according to ISO 12944-2	Carbon steel ASTM A 105, with corrosion-resistant two-component epoxy coating (min. 150 µm)
Measuring pipe	AISI 304 (1.4301)	AISI 304 (1.4301)
Electrodes	Hastelloy	Hastelloy
Grounding electrodes (standard	Hastelloy	Hastelloy
Terminal box	Fibre glass reinforced polyamide	Fibre glass reinforced polyamide

Table 8- 5 Certificates and approvals

Version	MAG 5100W (7ME6520)	MAG 5100W (7ME6580)
Calibration Standard production calibration, calibration report shipped with sensor	DN 15 ... 300: • Zero-point, 2 x 25 % and 2 x 90 % DN 350 ... 1200: • Zero-point, 1 x 25 % and 1 x 90 %	Zero-point, 2 x 25 % and 2 x 90 %
Custody transfer (only with MAG 5000/6000 CT)	*OIML R 49 pattern approval cold water (Denmark and Germany):* • DN 50 ... 300 (2" ... 12") *MI 001 cold water (EU):* • DN 50 ... 300 (2" ... 12")	-

Version	MAG 5100W (7ME6520)	MAG 5100W (7ME6580)
Drinking water approvals	*EPDM liner:* • ANSI/NSF 61 Standard (Cold water, US) • WRAS (WRc, BS6920 cold water, GB) • ACS (F) • DVGW W270 (D) • Belgaqua (NBR) *NBR liner:* • ANSI/NSF 61 Standard (Cold water, US), only ANSI and AWWA flanges)	• NSF/ANSI Standard 61 (Cold water, US) • WRAS (WRc, BS6920 cold water, GB)
Other approvals	• MCERTS • PED - 97/23 EC[1)], CRN • FM Class 1, Div 2 • CSA Class 1, Div 2	• PED - 97/23 EC[1)] (only < DN 600 (< 24")) • FM Class 1, Div 2 • CSA Class 1, Div 2

[1)] : For sizes larger than 600 mm (24") in PN 16, PED conformity is available as cost-added option. The basic unit will carry the LVD (Low Voltage Directive) and EMC approval.

8.2 Cable data

Description

Cable for standard electrode or coil	
Electrode cable, double shielded	
Cable kit with standard coil cable and electrode cable double shielded (also available as low noise cable for MAG 1100 sensor)	

Standard applications

Table 8- 6 Technical data, standard application cables

		Coil cable	Standard electrode cable
Basic data	No. of conductors	2	3
	Min. sqr. area	0.5 mm^2	0.2 mm^2
	Shield	Yes	Yes
	Max. capacitance	N/A	350 pF/m

		Coil cable	Standard electrode cable
Max. cable loop resistance	Media temperature:		
	< 100 °C	40 Ω	N/A
	> 200 °C	6 Ω	N/A
Cable glands on sensor and transmitter	M20x1.5 gland - Cable ø 5 ... 13 mm (0.20 ... 0.51 inches)		
	½ NPT gland - cable ø 5 ... 9 mm (0.20 ... 0.35 inches)		

Special applications, e.g. low conductivity or electrical noise

Table 8- 7 Technical data, special application cables

		Coil cable	Special electrode cable
Basic data	No. of conductors	3	3
	Sqr. area	1.5 mm^2	0.25 mm^2
	Shield	Yes	Double
	Color code	Brown, blue, black	Brown, blue, black
	Outside color	Grey	Grey
	Ext. diameter	7.8 mm	8.1 mm
	Conductor	Flexible CU	Flexible CU
	Isolation material	PVC	PVC
Ambient temperature	Flexible installation	-5 ... +70°C (23 ... 158°F)	-5 ... +70°C (23 ... 158°F)
	Non-flexible installtaion	-30 ... +70°C (-22 ... 158°F)	-30 ... +70°C (-22 ... 158°F)
Cable parameter	Capacity	161.50 pF/m	N/A
	Inductance	0.583 µH/m	N/A
	L/R	43.83 þH/Ω	N/A

8.3 Effect of temperature on working pressure

Effect of temperature on working pressure.

Table 8- 8 Metric measures (pressure in bar)

Flange specifications	Flange rating	Temperature (°C)			
		-5	10	50	90
Sizes DN25 ... 2000					
EN 1092-1	PN 10	10.0	10.0	9.7	9.4
	PN 16	16.0	16.0	15.5	15.1
	PN 40	40.0	40.0	38.7	37.7
ANSI B16.5	150 lb	19.7	19.7	19.3	18.0
AWWA C-207	Class D	10.3	10.3	10.3	10.3

Flange specifications	Flange rating	Temperature (°C)			
		-5	10	50	90
Sizes DN 15 ... 300 (order no. 7ME6520 only)					
EN 1092-1	PN 10	10.0	10.0	10.0	8.2
	PN 16	10.0	16.0	16.0	13.2
	PN 40	40.0	40.0	38.7	37.7
ANSI B16.5	150 lb	10.0	19.7	19.7	16.2

Table 8- 9 Imperial measures (pressure in psi)

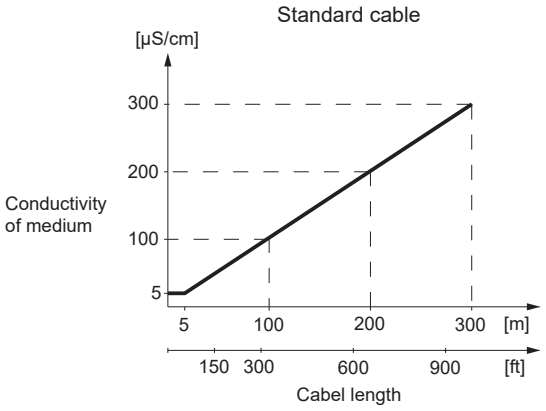
Flange specifications	Flange rating	Temperature (°F)			
		23	50	120	200
Sizes 1" ... 78"					
EN 1092-1	PN 10	145	145	141	136
	PN 16	232	232	225	219
	PN 40	580	580	561	547
ANSI B16.5	150 lb	286	286	280	261
AWWA C-207	Class D	150	150	150	150l
Sizes ½"... 12" (order no. 7ME6520 only)					
EN 1092-1	PN 10	145	145	145	119
	PN 16	145	232	232	191
ANSI B16.5	150 lb	145	286	286	235

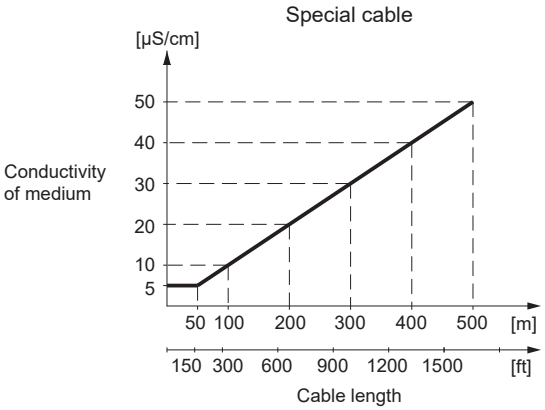
8.4 Process fluid conductivity

Compact installation

Liquids with an electrical conductivity ≥ 5 µS/cm.

Remote installation





WARNING

For detection of empty sensor the min. conductivity must always be >50 µS/cm and the max. length of the electrode cable when remote mounted is 50 meters (164 ft). Special cable must be used!

For remote MID installations the max. cable length is 3 meters (9.8 ft). For other CT application standard requirements are applicable.

8.5 Liner selection

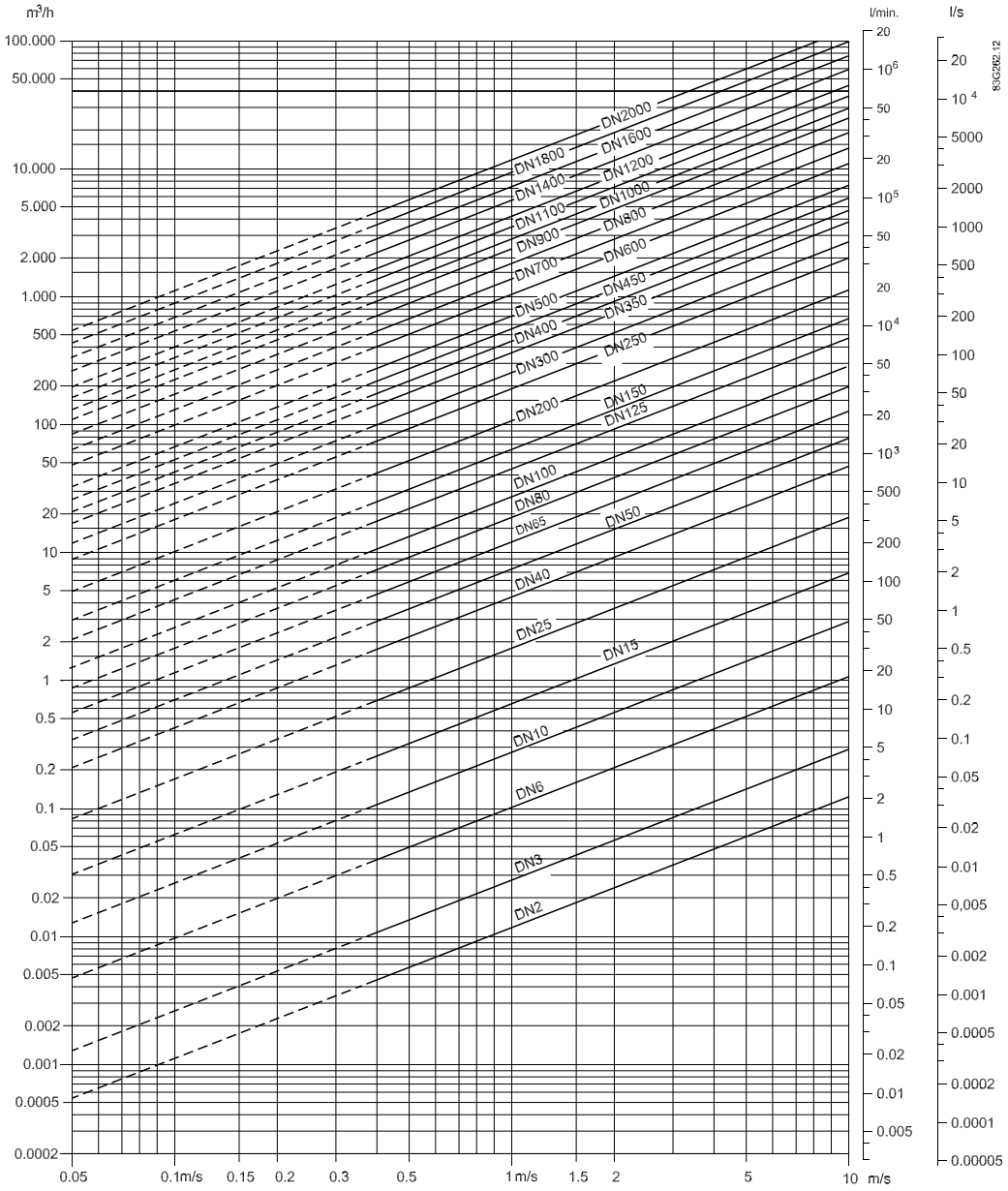
Liner	Applications
EPDM	Drinking water applications (not hydrocarbons)
Ebonite	Drinking water applications wastewater applications and certain chemicals applications
NBR	General purpose. Drinking water, sea waters

8.6 Electrode selection

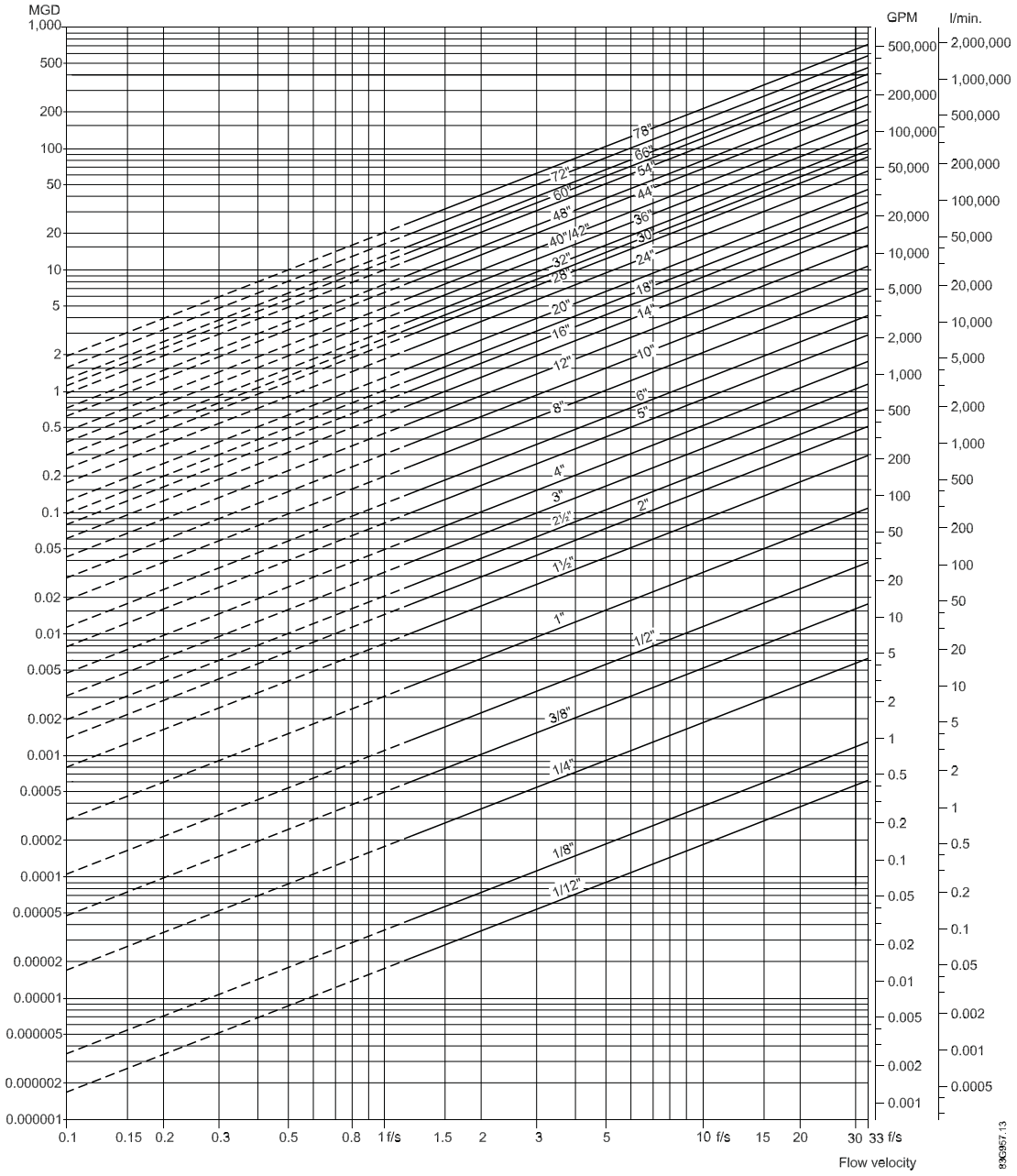
Electrodes	
Hastelloy C	The preferred choice for water and wastewater, chemicals, food and beverage, and pharmaceutical industries

8.7 Sizing tables

Sizing table (DN 2 ... DN 2000)



Sizing table (DN 1/12" ... DN 78")



The tables show the relationship between flow velocity v, flow quantity Q and sensor dimension DN.

Guidelines for selection of sensor

Min. measuring range: 0 ... 0.25 m/s (0 ... 0.8 ft/s)

Max. measuring range: 0 ... 10 m/s (0 ... ft/s)

Normally the sensor size is selected so that the nominal flow velocity v lies within the measuring range 1 ... 3 m/s (1 ... 15 ft/s).

Flow velocity calculation formula:

(metric measures)

$$V = \frac{1273.24 \times Q\ [l/s]}{DN^2\ [mm]}\ [m/s] \text{ or } V = \frac{353.68 \times Q\ [m^3/h]}{DN^2\ [mm]}\ [m/s]$$

(imperial measures)

$$V = \frac{0.408 \times Q\ [GPM]}{(\text{Pipe ID})^2\ [inch]}\ [ft/s] \text{ or } V = \frac{283.67 \times Q\ [MGD]}{(\text{Pipe ID})^2\ [inch]}\ [ft/s]$$

8.8 Dimensions and weight

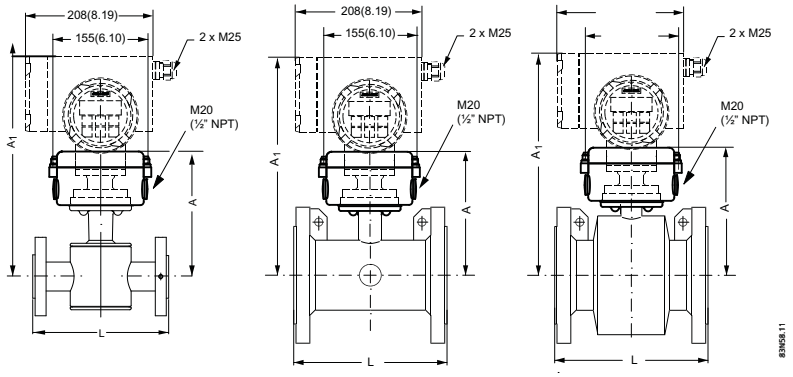


Figure 8-1 MAG 5100 W with MAG 6000 I / MAG 6000 I Ex d

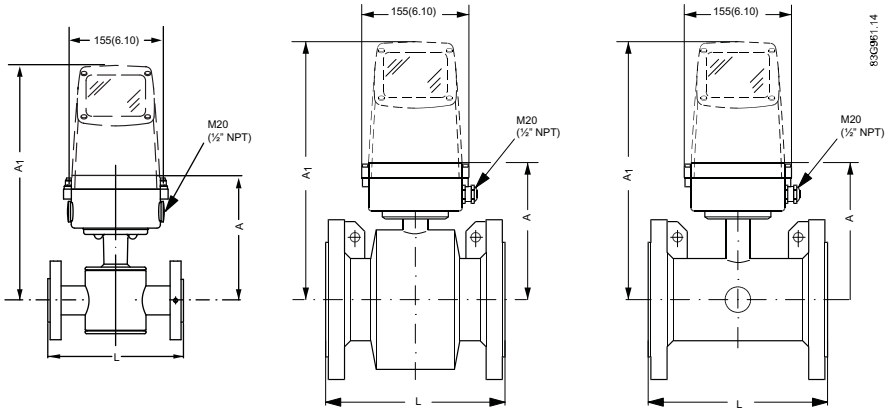


Figure 8-2 MAG 5100 W with MAG 5000 / 6000

Dimensions

Table 8- 10 Nominal size A

Nominal size		**A**			
		Order no. 7ME6520 NBR or EPDM liner		**Order no. 7ME6580 Ebonite liner**	
mm	inch	mm	inch	mm	inch
15	½	177	7	-	-
25	1	187	7.4	187	7.4
40	1½	202	8	197	7.8
50	2	188	7.4	205	8.1
65	2½	194	7.6	212	8.3
80	3	200	7.9	222	8.7
100	4	207	8.1	242	9.5
125	5	217	8.5	255	10.0
150	6	232	9.1	276	10.9
200	8	257	10.1	304	12.0
250	10	284	11.2	332	13.1
300	12	310	12.2	357	14.1
350	14	382	15.0	362	14.3
400	16	407	16.0	387	15.2
450	18	438	17.2	418	16.5
500	20	463	18.2	443	17.4
600	24	514	20.2	494	19.4
700	28	564	22.2	544	21.4
750	30	591	23.3	571	22.5
800	32	616	24.3	606	23.9
900	36	663	26.1	653	25.7
1000	40	714	28.1	704	27.7
1050	42	714	28.1	704	27.7
1100	44	765	30.1	755	29.7
1200	48	820	32.3	810	31.9
1400	54	N/A	N/A	925	36.4
1500	60	N/A	N/A	972	38.2
1600	66	N/A	N/A	1025	40.4
1800	72	N/A	N/A	1123	44.2
2000	78	N/A	N/A	1223	48.1

Table 8- 11 Nominal size L

Nominal size		L											
		PN 10		PN 16		PN 16 non-PED		PN 40		Class 150 AWWA		AS / JIS10K	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
15	½	N/A	N/A	N/A	N/A	N/A	N/A	200	7.9	200	7.9	N/A	N/A
25	1	N/A	N/A	N/A	N/A	N/A	N/A	200	7.9	200	7.9	200	7.9
40	1½	N/A	N/A	N/A	N/A	N/A	N/A	200	7.9	200	7.9	200	7.9
50	2	N/A	N/A	200	7.9	N/A	N/A	N/A	N/A	200	7.9	200	7.9
65	2½	N/A	N/A	200	7.9	N/A	N/A	N/A	N/A	200	7.9	200	7.9
80	3	N/A	N/A	200	7.9	N/A	N/A	N/A	N/A	200	7.9	200	7.9
100	4	N/A	N/A	250	9.8	N/A	N/A	N/A	N/A	250	9.8	250	9.8
125	5	N/A	N/A	250	9.8	N/A	N/A	N/A	N/A	250	9.8	250[1)]	9.8[1)]
150	6	N/A	N/A	300	11.8	N/A	N/A	N/A	N/A	300	11.8	300	11.8
200	8	350	13.8	350	13.8	N/A	N/A	N/A	N/A	350	13.8	350	13.8
250	10	450	17.7	450	17.7	N/A	N/A	N/A	N/A	450	17.7	450	17.7
300	12	500	19.7	500	19.7	N/A	N/A	N/A	N/A	500	19.7	500	19.7
350	14	550	21.7	550	21.7	N/A	N/A	N/A	N/A	550	21.7	550	21.7
400	16	600	23.6	600	23.6	N/A	N/A	N/A	N/A	600	23.6	N/A	23.6
450	18	600	23.6	600	23.6	N/A	N/A	N/A	N/A	600	23.6	600	23.6
500	20	600	23.6	600	23.6	N/A	N/A	N/A	N/A	600	23.6	600	23.6
600	24	600	23.6	600	23.6	N/A	N/A	N/A	N/A	600	23.6	600	23.6
700	28	700	27.6	700	27.6	N/A	N/A	N/A	N/A	700	27.6	700[2)]	27.6[2)]
750	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	750	29.5	750[2)]	N/A
800	32	800	31.5	800	31.5	N/A	N/A	N/A	N/A	800	31.5	800[2)]	31.5[2)]
900	36	900	35.4	900	35.4	N/A	N/A	N/A	N/A	900	35.4	900[2)]	35.4[2)]
1000	40	1000	39.4	1000	39.4	N/A	N/A	N/A	N/A	1000	39.4	1000[2)]	39.4[2)]
1050	42	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1000	39.4	N/A	N/A
1100	44	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1100	43.3	N/A	N/A
1200	48	1200	47.2	1200	47.2	N/A	N/A	N/A	N/A	1200	47.2	1200[2)]	47.2[2)]
1400	54	1400	55.1	N/A	N/A	1400	55.1	N/A	N/A	1200	47.2	N/A	N/A
1500	60	1500	59.1	N/A	N/A	1500	59.1	N/A	N/A	1200	47.2	N/A	N/A
1600	66	1600	63.0	N/A	N/A	1600	63.0	N/A	N/A	1200	47.2	N/A	N/A
1800	72	1800	70.9	N/A	N/A	1800	70.9	N/A	N/A	1200	47.2	N/A	N/A
2000	78	2000	78.7	N/A	N/A	2000	78.7	N/A	N/A	1200	47.2	N/A	N/A

1) Not available with AS flange

2) Not available with JIS 10K flange

Weight

Table 8- 12 Weight

Nominal size		Order no. 7ME6520										Order no. 7ME6580	
		PN 10		PN 16		PN 40		Class 150 / AWWA		AS		PN / ANSI / AWWA / AS	
mm	inch	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs
15	½	N/A	N/A	N/A	N/A	4	9	4	9	N/A	N/A	-	-
25	1	N/A	N/A	N/A	N/A	6	12	5	11	N/A	N/A	5	11
40	1½	N/A	N/A	N/A	N/A	8	18	7	15	N/A	N/A	8	17
50	2	N/A	N/A	9	20	N/A	N/A	8	20	N/A	N/A	9	20
65	2½	N/A	N/A	10.7	24	N/A	N/A	11	24	N/A	N/A	11	24
80	3	N/A	N/A	11.6	26	N/A	N/A	13	28	N/A	N/A	12	24
100	4	N/A	N/A	15.2	33	N/A	N/A	19	41	N/A	N/A	16	35
125	5	N/A	N/A	20.4	45	N/A	N/A	24	52	N/A	N/A	19	42
150	6	N/A	N/A	26	57	N/A	N/A	29	64	N/A	N/A	27	60
200	8	48	106	48	106	N/A	N/A	56	124	N/A	N/A	40	68
250	10	64	141	69	152	N/A	N/A	79	174	N/A	N/A	60	132
300	12	76	167	86	189	N/A	N/A	110	243	N/A	N/A	80	176
350	14	104	229	125	274	N/A	N/A	139	307	N/A	N/A	110	242
400	16	119	263	143	314	N/A	N/A	159	351	N/A	N/A	125	275
450	18	136	299	173	381	N/A	N/A	182	400	N/A	N/A	175	385
500	20	163	359	223	491	N/A	N/A	225	495	N/A	N/A	200	440
600	24	236	519	338	744	N/A	N/A	320	704	N/A	N/A	187	633
700	28	270	595	314	692	N/A	N/A	273	602	320	70	330	728
750	30	N/A	N/A	N/A	N/A	N/A	N/A	329	725	N/A	N/A	360	794
800	32	346	763	396	873	N/A	N/A	365	804	428	944	450	992
900	36	432	951	474	1043	N/A	N/A	495	1089	618	1362	53	1168
1000	40	513	1130	600	1321	N/A	N/A	583	1282	636	1399	66	1455
1050	42	N/A	N/A	N/A	N/A	N/A	N/A	687	1512	N/A	N/A	N/A	N/A
1100	44	N/A	N/A	N/A	N/A	N/A	N/A	763	1680	N/A	N/A	1140	2513
1200	48	643	1415	885	1948	N/A	N/A	861	1896	813	1789	1180	2601
1400	54	1592	3510	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1600	3528
1500	60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2460	5423
1600	66	2110	4652	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2525	5566
1800	72	2560	5644	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2930	6460
2000	78	3640	8025	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3665	8080

Appendix

A

A.1 Flange mating dimensions (metric)

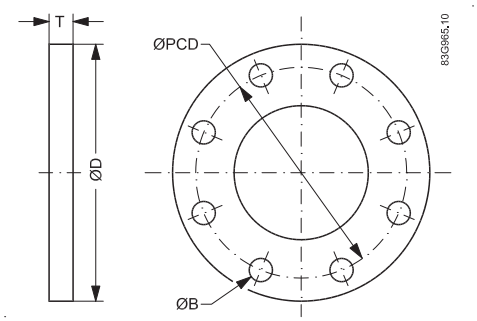


Figure A-1 Flange mating dimensions

Table A- 1 Flange mating dimensions (metric)

	Dimensions (mm)				Bolting	
mm	D	PCD	T	B	Holes	Bolts
PN10						
200	340	295	24	22	8	M20
250	395	350	26	22	12	M20
300	445	400	26	22	12	M20
350	505	460	28	22	16	M20
400	565	515	32	26	16	M24
450	615	565	36	26	20	M24
500	670	620	38	26	20	M24
600	780	725	42	3	20	M27
700	895	840	30	30	24	M27
800	1015	950	32	33	24	M30
900	1115	1050	34	33	28	M30
1000	1230	1160	34	36	28	M33
1200	1455	1380	38	39	32	M36
PN16						
50	165	125	19	18	4	M16
65	185	145	20	18	8	M16
80	200	160	20	18	8	M16
100	220	180	22	18	8	M16
125	250	210	22	18	8	M16
150	285	240	24	22	8	M20
200	340	295	26	22	12	M20
250	405	355	29	26	12	M24

	Dimensions (mm)				Bolting	
mm	**D**	**PCD**	**T**	**B**	**Holes**	**Bolts**
300	460	410	32	26	12	M24
350	520	470	35	26	16	M24
400	580	525	38	30	16	M27
450	640	585	42	30	20	M27
500	715	650	46	33	20	M30
600	840	770	52	36	20	M33
700	910	840	36	36	24	M33
800	1025	950	38	39	24	M36
900	1125	1050	40	39	28	M36
1000	1255	1170	42	42	28	M39
1200	1485	1390	48	48	32	M45
PN40						
15	95	65	14	14	4	M12
25	115	85	16	14	4	M16
40	150	110	18	18	4	M16
150 lb						
15	89	60	12	16	4	M12
25	108	79	16	16	4	M16
40	127	98	18	16	4	M16
50	152	121	19	19	4	M16
65	178	140	22	19	4	M16
80	190	152	24	19	4	M16
100	229	191	24	19	8	M16
125	254	216	24	22	8	M20
150	279	241	25	22	8	M20
200	343	298	29	22	8	M20
250	406	362	30	25	12	M24
300	483	432	32	25	12	M24
350	533	476	35	28	12	M27
400	597	540	36.5	28	16	M27
450	635	578	40	32	16	M30
500	699	635	43	32	20	M30
600	813	749	48	35	20	M33

	Dimensions (mm)				Bolting	
mm	D	PCD	T	B	Holes	Bolts
AWWA						
700	927	864	33	35	28	M33
750	984	914	35	35	28	M33
800	1060	978	38	41	28	M39
900	1168	1068	41	41	32	M39
1000	1289	1200	41	41	36	M39
1050	1346	1257	44	41	36	M39
1200	1511	1422	48	41	44	M39

A.2 Factory settings

Dimension-dependent factory settings

Table A- 2 50 Hz version

DN			Qmax				Unit	Volume/ pulse	Pulse unit	Totalizer unit
			Order no. 7ME6520		Order no. 7ME6580					
mm	Inch	Fac settings	Min.	Max.	Min.	Max.				
15	½	**2000**	159	6361	-	-	l/h	1	l	l
25	1	**5000**	441	17671	441	17671	l/h	10	l	l
40	1½	**12**	1.1	45	1.1	45	m^3/h	10	l	l
50	2	**20**	1.7	63	1.7	70	m^3/h	10	l	l
65	2½	**30**	2.9	100	2.9	119	m^3/h	100	l	l
80	3	**50**	4.0	160	4.5	180	m^3/h	100	l	l
100	4	**120**	6.2	250	7	282	m^3/h	100	l	l
125	5	**180**	10.0	400	11	441	m^3/h	100	l	m^3
150	6	**250**	15.7	629	15.9	636	m^3/h	100	l	m^3
200	8	**400**	24.9	997	28.2	1130	m^3/h	1	m^3	m^3
250	10	**700**	40.0	1600	44.1	1767	m^3/h	1	m^3	m^3
300	12	**1000**	62.5	2500	63.6	2544	m^3/h	1	m^3	m^3
350	14	**1200**	86.5	3463	86.5	3463	m^3/h	1	m^3	m^3
400	16	**1800**	113	4523	113	4523	m^3/h	1	m^3	m^3
450	18	**2000**	143.1	5725	143.1	5725	m^3/h	1	m^3	m^3
500	20	**3000**	176.7	7068	176.7	7068	m^3/h	1	m^3	m^3
600	24	**4000**	254.4	10178	254.4	10178	m^3/h	10	m^3	m^3
700	28	**5000**	346.3	13854	346.3	13854	m^3/h	10	m^3	m^3
750	30	**6000**	397.6	15904	397.6	15904	m^3/h	10	m^3	m^3
800	32	**7000**	452.3	18095	452.3	18095	m^3/h	10	m^3	m^3

DN			Qmax				Unit	Volume/ pulse	Pulse unit	Totalizer unit
			Order no. 7ME6520		Order no. 7ME6580					
900	36	**9000**	572.5	22902	572.5	22902	m^3/h	10	m^3	m^3
1000	40	**12000**	706.8	28274	706.8	28274	m^3/h	10	m^3	m^3
1050	42	**12000**	706.8	28274	706.8	28274	m^3/h	10	m^3	m^3
1100	44	**14000**	855.2	34211	855.2	34211	m^3/h	10	m^3	m^3
1200	48	**15000**	1017.8	40715	1017.8	40715	m^3/h	10	m^3	m^3
1400	54	**25000**	-	-	1385.4	55417	m^3/h	10	m^3	m^3
1500	60	**30000**	-	-	1590.4	63617	m^3/h	10	m^3	m^3
1600	66	**35000**	-	-	1809.5	72382	m^3/h	10	m^3	m^3
1800	72	**40000**	-	-	2290.2	91608	m^3/h	10	m^3	m^3
2000	78	**45000**	-	-	2827.4	113097	m^3/h	10	m^3	m^3

Table A- 3 60 Hz version

DN			Qmax				Unit	Volume/ pulse	Pulse unit	Totalizer unit
			Order no. 7ME6520		Order no. 7ME6580					
mm	Inch	**Fac. settings**	Min.	Max.	Min.	Max.				
15	½	9	0.7	28	-	-	US GPM	1	US G	US G
25	1	**22**	1.9	77.8	1.9	77.8	US GPM	1	US G	US G
40	1½	**52**	4.9	199.1	4.9	199.1	US GPM	1	US G	US G
50	2	**88**	6.9	277.2	7.7	311.2	US GPM	1	US G	US G
65	2½	**132**	11.0	440.2	13.1	525.9	US GPM	1	US G	US G
80	3	**220**	17.6	705.1	19.9	796.7	US GPM	1	US G	US MG
100	4	**528**	27.5	1101	31.1	1244.8	US GPM	1	US G	US MG
125	5	**793**	44.0	1762.2	48.6	1945.1	US GPM	1	US G	US MG
150	6	**1101**	69.3	2772.9	70	2800.9	US GPM	1	US G	US MG
200	8	**1761**	109.7	4391.9	124.4	4979.5	US GPM	1	US G	US MG
250	10	**3082**	176.1	7045.2	194.5	7780.5	US GPM	1	US G	US MG
300	12	**4402**	275.1	11007.8	280	11203.9	US GPM	1	US G	US MG
350	14	**5283**	381.2	15249.7	381.2	15249.7	US GPM	1	US G	US MG
400	16	**7925**	497.9	19918.1	497.9	19918.1	US GPM	1	US G	US MG
450	18	**8806**	630.2	25208.8	630.2	25208.8	US GPM	1	US G	US MG
500	20	**13209**	778	31122	778	31122	US GPM	1	US G	US MG
600	24	**17611**	1120.3	44815.7	1120.3	44815.7	US GPM	10	US G	US MG
700	28	**19812**	1524.9	60999.1	1524.9	60999.1	US GPM	10	US G	US MG
750	30	**22014**	1750.6	70024.5	1750.6	70024.5	US GPM	10	US G	US MG
800	32	**30820**	1991.8	79672.4	1991.8	79672.4	US GPM	10	US G	US MG
900	36	**39626**	2522.8	100835.3	2522.8	100835.3	US GPM	10	US G	US MG
1000	40	**52834**	3112.2	124488.1	3112.2	124488.1	US GPM	10	US G	US MG
1050	42	**52834**	3431.2	137248.1	3431.2	137248.1	US GPM	10	US G	US MG
1100	44	**61640**	3765.7	150630.6	3765.7	150630.6	US GPM	10	US G	US MG

DN			Qmax				Unit	Volume/ pulse	Pulse unit	Totalizer unit
			Order no. 7ME6520		Order no. 7ME6580					
1200	48	**66043**	4481	179262.9	4481	179262.9	US GPM	10	US G	US MG
1400	54	**110072**	-	-	6099.9	243993.7	US GPM	1000	US G	US MG
1500	60	**132086**	-	-	7002.4	280098.3	US GPM	1000	US G	US MG
1600	66	**154100**	-	-	7967.2	318689.6	US GPM	1000	US G	US MG
1800	72	**176115**	-	-	10083.5	403341.5	US GPM	1000	US G	US MG
2000	78	**198129**	-	-	12448.8	497952.5	US GPM	1000	US G	US MG

A.3 Coil resistance

Table A- 4 Coil resistance

		MAG 1100, MAG 1100F		MAG 3100, MAG 3100P, MAG 5100 W (Order no. 7ME6580)		MAG 5100 W (Order no. 7ME6520)	
DN	Inch	Resistance	Tolerance	Resistance	Tolerance	Resistance	Tolerance
2	1/12	104 Ω	+/− 5	104			
3	1/8	104 Ω	+/− 5	104			
6	1/4	99 Ω	+/− 17	104			
10	3/8	99 Ω	+/− 17	104			
15[1)]	1/2	91 Ω	+/− 9	104			
25	1	91 Ω	+/− 17	104	+/− 2	104	+/− 10
40	11/2	91 Ω	+/− 9	92	+/− 2	92	+/− 10
50	2	91 Ω	+/− 9	92	+/− 2	119.4	+/− 10
65	21/2	99 Ω	+/− 17	100	+/− 2	127	+/− 10
80	3	91 Ω	+/− 17	94	+/− 2	126	+/− 10
100	4	91 Ω	+/− 9	92	+/− 2	125	+/− 10
125	5	92	+/− 2	126	+/− 10		
150	6	94	+/− 2	116	+/− 10		
200	8	90	+/− 2	109	+/− 10		
250	10	92	+/− 2	104	+/− 10		
300	12	100	+/− 2	108	+/− 10		
350	14	112	+/− 2	100	+/− 6		
400	16	100	+/− 4	100	+/− 6		
450	18	108	+/− 4	100	+/− 6		
500	20	122	+/− 4	100	+/− 6		
600	24	115	+/− 4	98	+/− 6		
700	28	128	+/− 4	98	+/− 6		
750	30	133					
800	32	128	+/− 4	98	+/− 6		
900	36	131	+/− 4	98	+/− 6		

		MAG 1100, MAG 1100F		MAG 3100, MAG 3100P, MAG 5100 W (Order no. 7ME6580)		MAG 5100 W (Order no. 7ME6520)	
1000	40	131	+/− 4	88	+/− 6		
1100	44	126					
1200	48	130	+/− 4	88	+/− 6		
1400	54	130					
1500	60	124					
1600	66	133					
1800	72	133					
2000	78	147					

1) On MAG 1100 DN 15 produced as from May 1999 the coil resistance must be 86 ohm, +8/−4 ohm.

NOTICE
Reference values • All resistance values are at 20 °C • The resistance changes proportionally 0.4% / °C

Spare parts

Description	
Cable glands, 2 pcs. M20 ½" NPT	
Sealing screws for sensor/transmitter, 2 pcs.	
Terminal box, in polyamide, inclusive of lid M20 ½" NPT	

Description	
Terminal box lid, in polyamide	
Terminal box, in stainless steel, inclusive of lid M20 ½" NPT	
Potting kit for terminal box of MAG sensors for I P68/NEMA 6P (not for EX)	

A.4 Ordering

In order to ensure that the ordering data you are using is not outdated, the latest ordering data is always available on the Internet: Catalog process instrumentation (http://www.siemens.com/processinstrumentation/catalogs)

Glossary

ASIC

Application-Specific Integrated Circuit is an integrated circuit (IC) customized for a particular use, rather than intended for general-purpose use.

EMC

Electromagnetic compatibility (EMC) is the branch of electrical sciences which studies the unintentional generation, propagation and reception of electromagnetic energy with reference to the unwanted effects (Electromagnetic Interference, or EMI) that such energy may induce. The goal of EMC is the correct operation, in the same electromagnetic environment, of different equipment which use electromagnetic phenomena, and the avoidance of any interference effects.

IP

An IP (Ingress Protection) number is used to specify the environmental protection of enclosures around electronic equipment. These ratings are determined by specific tests. The IP number is composed of two numbers, the first referring to the protection against solid objects and the second against liquids. The higher the number, the better the protection. For example, in IP67 the first Number (6) means that the device is totally protected against dust, and the second (7) that it is protected against the effect of immersion between 15cm and 1m

PED

The Pressure Equipment Directive (97/23/EC) is the legislative framework on European level for equipment subject to a pressure hazard. It was adopted by the European Parliament and the European Council in May 1997 and has been obligatory throughout the European Union since May 2002.

SENSORPROM

All sensor related settings/data saved on an EPROM. SENSORPROM technology automatically configures the transmitter at start up providing calibration data, pipe size, sensor type, and output settings. The SENSORPROM automatically stores values or settings changed by users, and automatically re-programs any new transmitter without loss of accuracy.

USM

USM II is a Communication Platform. The Siemens USM II concept enables fitting of add-on bus modules without loss of functionality:

1. All modules can be fitted as true "plug & play"
2. Module and transmitter are automatically configured through the SENSORPROM

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For more information

www.siemens.com/flow

Siemens A/S
Flow Instruments
DK-6430 Nordborg
Denmark

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www.siemens.com/processautomation

AUTOMATION PRODUCTS GROUP, INC.

Tab - 2.04

Operator's Manual

KA Series
Liquid Level Controls

9004020
Rev. B, 08/14

Automation Products Group, Inc.
APG...Providing tailored solutions for measurement applications
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• Warranty and Warranty Restrictions

APG warrants its products to be free from defects of material and workmanship and will, without charge, replace or repair any equipment found defective upon inspection at its factory, provided the equipment has been returned, transportation prepaid, within 24 months from date of shipment from factory.

THE FOREGOING WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES NOT EXPRESSLY SET FORTH HEREIN, WHETHER EXPRESSED OR IMPLIED BY OPERATION OF LAW OR OTHERWISE INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

No representation or warranty, express or implied, made by any sales representative, distributor, or other agent or representative of APG which is not specifically set forth herein shall be binding upon APG. APG shall not be liable for any incidental or consequential damages, losses or expenses directly or indirectly arising from the sale, handling, improper application or use of the goods or from any other cause relating thereto and APG's liability hereunder, in any case, is expressly limited to the repair or replacement (at APG's option) of goods.

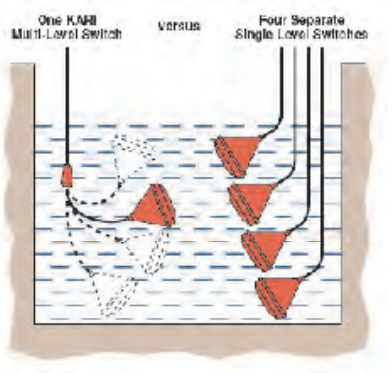
Warranty is specifically at the factory. Any on site service will be provided at the sole expense of the Purchaser at standard field service rates.

All associated equipment must be protected by properly rated electronic/ electrical protection devices. APG shall not be liable for any damage due to improper engineering or installation by the purchaser or third parties. Proper installation, operation and maintenance of the product becomes the responsibility of the user upon receipt of the product.

Returns and allowances must be authorized by APG in advance. APG will assign a Return Material Authorization (RMA) number which must appear on all related papers and the outside of the shipping carton. All returns are subject to the final review by APG. Returns are subject to restocking charges as determined by APG's "Credit Return Policy".

• Introduction

KA series controls consist of a free-floating switch enclosure to which a protected multiconductor cable is attached. Inside the float there are a number of microswitches set at different angles. A control weight is fixed at a point along the cable to keep the cable immersed in the liquid. The suspended float switch follows the movement of the liquid level. As the liquid level rises and falls, the weight on the cable causes the inclination of the float to change. This tilting action results in microswitches opening and closing, sequentially, at different elevations. The switch-operating levels are easily adjusted by moving the weight along the cable and/or altering the height of the cable fixing point.



The switch enclosure is conical in shape and the required number of microswitches are cast at predetermined angles inside it. The hermetically sealed float housing is filled with plastic foam and is weighted on one side. This rugged float and the weight are made of chemically resistant polypropylene while the standard cable is PVC coated.

There are three versions of the KA series switch. The standard S Series units are the largest, with a diameter of 6.7 inches, the C Series units have a diameter of 3.9 inches, and the smallest, M series units, are 3.0 inches in diameter.

Alarms					Control Plus Alarms							
Level	IL (1LE)	IH (1HE)	IC	2HL	2L	3L (3LE)	2H	3H (3HE)	4L	4H	4L5E	4H5E
HH	—	—	—	High Alarm	—	—	—	High Alarm			Stop Both Pumps	High Alarm
H	—	—	—	—	Pump Stop		Pump Start		Pump Stop	Pump Start	Start Pump No.1	Start Pump No.2
L	—	—	—	—	Pump Start		Pump Stop		Pump Start	Pump Stop	Start Pump No.2	Start Pump No.1
LL	Low Alarm	High Alarm	High/Low Alarm	Low Alarm	—	Low Alarm	—	—	Low Alarm			Stop Both Pumps
O	Height of Face of Float in Free-Hanging Position											

	S Series	C Series	M Series
Contact Rating:			
Max.Voltage	250 V AC/DC	250 V AC/DC	250 V AC/DC
Max. AC Current			
(Resistive)	6 A	6 A	6A
(Inductive)	3 A	3 A	3A
Max. DC Power	75 VA	75 VA	75 VA
(75 VA = 0.3 A @ 250 V)			
Max. liquid Temp	60°C (140°F)	60°C (140°F)	60°C (140°F)
Max. pressure (at 20°C)	28 PSI	28 PSI	28 PSI
Min. Fluid Specific Gravity	0.7	0.7	0.95
Standard Cable Length	16 ft.	16 ft.	16 ft.
Switching Differential:			
Min.	10 in.	10 in.	10 in.
Max.	50 in.	50 in.	40 in.
Max. No. of Switching Levels	4	3	2
Max. No. of wires in Cable	5	4	3
Standard Weight Type	G (black-3/4 lb.)	G (black-3/4 lb.)	B (red-3/4 lb.)

- **Dimensions - in./mm**

S Series

C Series

M Series

• Options

Higher working temperature to 80°C (175°F): Model K
Longer cables to specified lengths
Smaller switching differentials down to 1.25 in.
Greater switching differentials to 75 in. (S series) or 60 in. (M series)
Alternative logic at switching points (normally open vs. normally closed)
Alternative cables in rubber and urethane
Alternative cables in teflon (max. 5 conductors = 4 or less switch points)
Lead weight in place of polypropylene-covered weight
Strain Relief Connector, Part #SRCG

• Chemical Compatibility — Corrosion Resistance of Materials

With a standard KA float switch, the only materials in contact with the liquid are the polypropylene covered float and weight, the heavy duty PVC coated cable, and the polypropylene wedge. Consequently, these switches are unaffected by a wide range of liquids. However, there are some liquids that are not compatible with these materials. For such applications, alternative construction materials are available as indicated in the Options section above. In assessing corrosion, key factors are the liquid's temperature and concentration, and the amount of time the float is immersed. Even if periodic replacement of KA float switches is necessary, they still may be the most economical choice. Rubber cables are preferred for applications where freezing conditions can occur, because PVC-coated cables tend to stiffen in such situations.

• Cable Weights

Single level switches (high or low alarm) are not supplied with weights. All multiple level switches are supplied with standard weights. Heavier weights may be needed if there is a danger of caking, thick crusts developing and/or the liquid is very dense and viscous. Alternative weights available are:

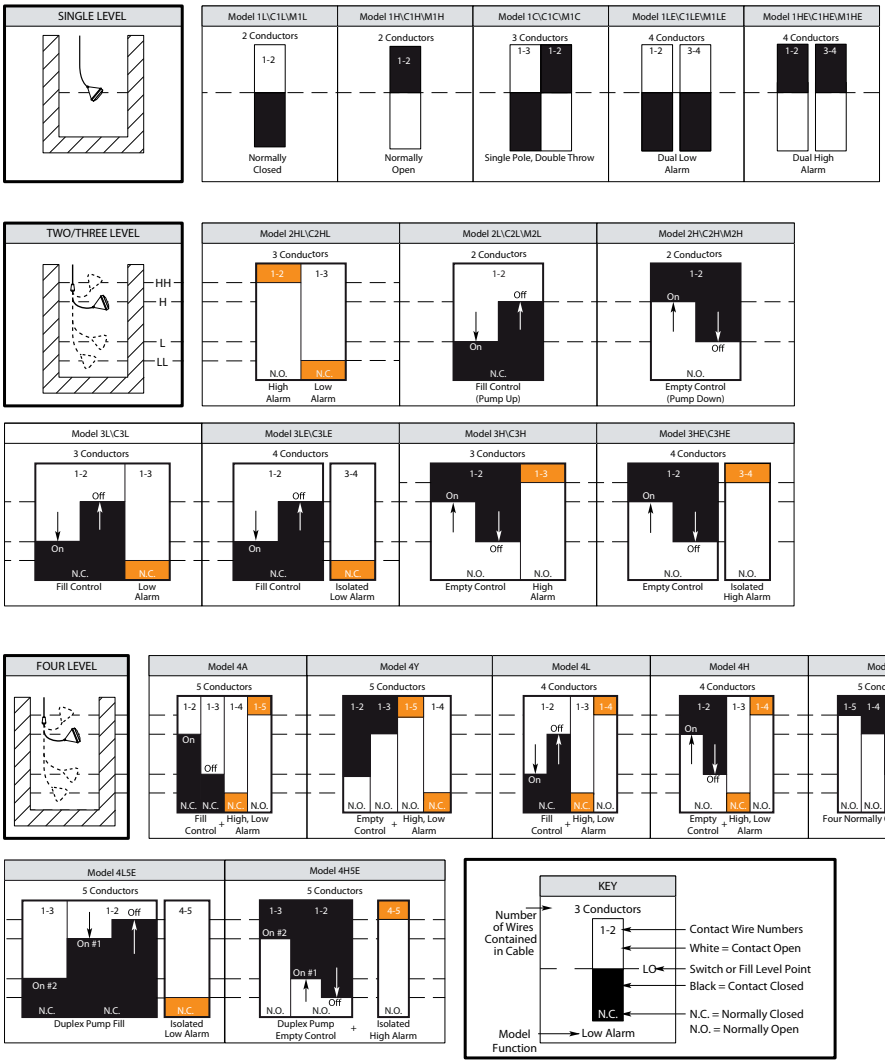
Standard: S & C series - Type A (black) 3/4 lb. M series - Type B (red) 1/2 lb.
Special: Type K (black) 1-1/2 lb. Type L (black) 2-1/2 lb.

Standard units have heavy duty cables with PVC covering. Typical diameters of the cables are:

2-Wires (1L, C1L, M1L, 2L, C2L, M2L, etc.): 0.25 in.
3-Wires (3L, C3L, 3H, C3H, etc.): 0.27 in.
4-Wires (4L, 4H, 3LE, C3LE, etc.): 0.31 in.
5-Wires (4L5E, 4H5E, etc.): 0.34 in.
(Dimensions may vary ±10%)

An integral cable, without splices, or greater length than the standard 16 feet may be needed for some situations, and this can be supplied by special order. It is not possible to modify the cable length (nor repair damaged cables) on existing units. Once the cable is outside the liquid, it can, however, be easily extended through a waterproof junction box or liquid-tight connector.

• Switch Wiring and Type Detail Table for KA Float Switches



• Selecting the Right Switch

The following procedure should be used to select the optimum switch or switch combination:

1. Determine the number of control points needed; for example, one point for alarm, two points for empty/fill, etc.
2. Select required model(s) from the Type Detail Table (previous page). If necessary, special switches may be ordered with non-standard switching logic.
3. The smaller, lower cost C series switches may be used if no more than a four conductor cable is needed.
4. The smallest, lowest cost M series switches may be used if the three following conditions are met:
    a. No solid floating materials are present.
    b. The specific gravity of the liquid is greater than 0.95.
    c. No more than a two conductor cable is needed.
5. Note that if a special material compatibility situation exists, there are a number of options available as indicated in the Options section on page 6.

The next several sections describe how the switching levels are related to each other and how they are adjusted. If it is found that the required levels cannot be accommodated by standard units, a special switch can be ordered. For use in still liquids, a two level switch with a smaller differential than the standard minimum (10 inches) may be ordered. Sometimes a combination of switches needs to be used to achieve the required switching heights or range of adjustment capabilities. For example a Model 3HE can be replaced by a model 2H plus a separate model 1H, or a model 2LH by a model 1H plus model 1L. Our Applications Engineering Department is pleased to assist users to select the best models for their particular needs.

• Understanding the Switch Action/Terminology

In order to understand the operation of KA liquid level controls, imagine them operating like pushbutton switches. A normally open (NO) switch is one that is open when there is no liquid present and closes as the liquid rises. Such a switch is symbolized as in Diagram 1. The opposite action normally closed (NC) switch operates as in Diagram 2. Note that the term "normally" means the switch state when there is *no* liquid present — it does not mean the "usual" operating state of the switch.

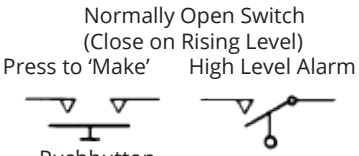


Diagram 1

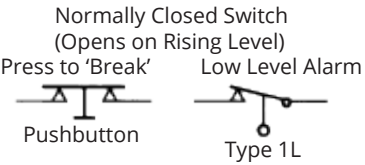


Diagram 2

• Single Versus Dual Point Control

The simplest single level KA float switches (types 1L or 1H) have no deadband (differential or hysteresis). They switch ON and OFF at one level point. Such switches work well as alarm point indicators but are unsuitable for automatic maintenance of the level of liquids in containers.

Usually, tank levels are maintained by pumps or electrically controlled solenoid valves in the supply or drain lines. Holding the level exactly at one point is difficult if there is flow in and out of the container, because it would involve the control switch going on and off constantly. This leads to excessive wear of the components. Thus, the normal practice is to have two control levels involved. At one level the pump or valve is turned ON and at the other level it is turned OFF.

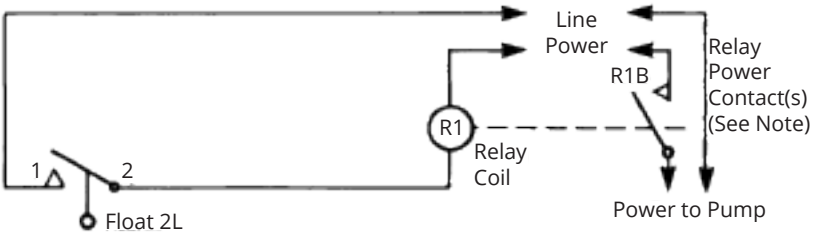
These situations can take advantage of the unique capabilities of the KA float switches. Rather than using two separate single level float switches, one float switch (type 2L or 2H) can provide ON and OFF level controls. The absolute height and separation (deadband) of these points can be easily adjusted. The ON control is a "make" in the circuit and the OFF is a "break" in the circuit. The deadband is supplied by the float switch. Other KA float switches provide additional facilities for high and low alarms as well as control of duplex pump systems.

• Single Point with Timed Relay Control

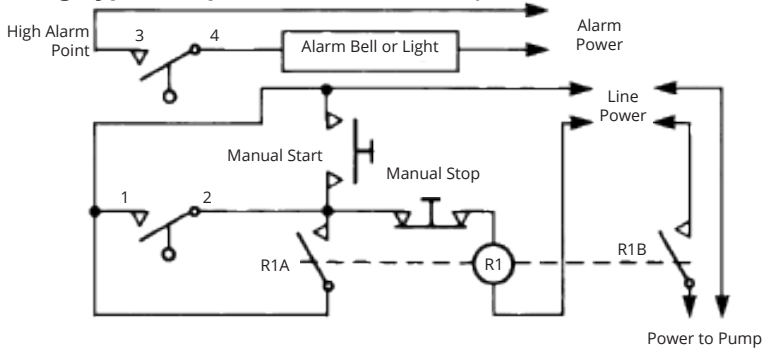
There may be some situations where it is not possible to produce any form of dual level control. In such cases an effective deadband can be produced with a single level switch by using it in conjunction with a time delay relay. When the switch operates, it turns on the relay which stays on for a predetermined period so that the pump or valve operates for that set period each time that it is turned ON.

• Emptying/Filling Pump Control Circuits

Simple Filling (Pump up) Control (Using Type 2L)

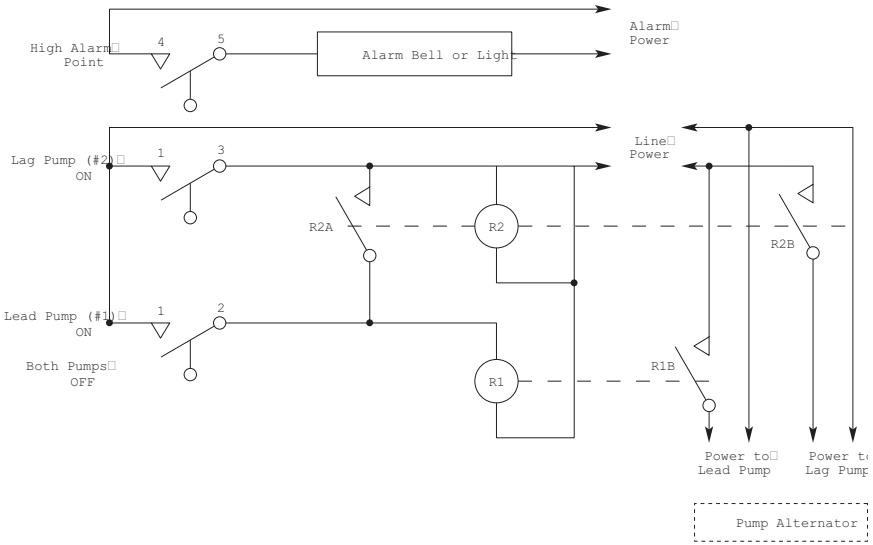


Simple Emptying (Pump down) Control with High Level Alarm (Using Type 3HE plus manual override)



Note: In the above examples, the relay contact R1A is used to electrically latch the relay ON in manual use. If the pump is manually started the float switch will not turn OFF. (The relay/contactor R1 used should be a DPST type with suitable ratings on one contact (R1B) able to carry the voltage and current required by the pump motor horsepower rating. If the pump motor requires three phase power, the relay contact R1B would have to be composed of three poles of heavy duty NO switches capable of carrying the pump motor power as well as there being an auxiliary NO switch contact R1A for latching purposes. Heavy duty relay contactors of this type are readily available at most electrical supply houses.

• Duplex Pump Control Circuit (Using Type 4H5E)



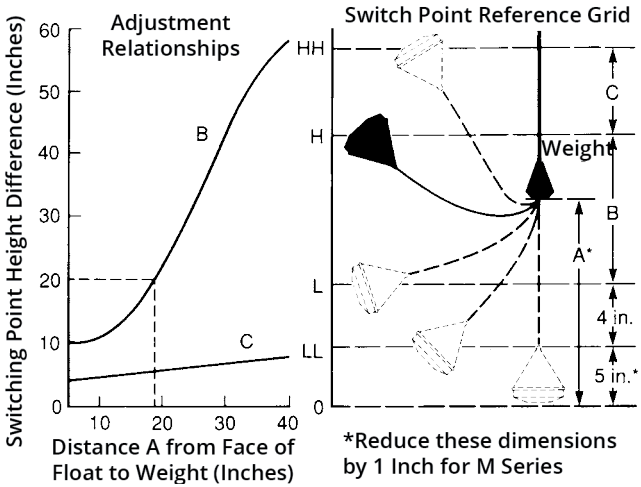
Note: Usually an alternator control is added to the lead and lag pump control circuits. This control automatically alternates the order in which the two pumps come on. In this way the wear on the pumps is evened out. If this is not done, in the course of time, the user will have one (lead) pump that is well worn and one (lag) pump that is barely used. If the pumps use three phase power, the single pole switch contacts, R1B and R2B, would need to be heavy duty three pole switch contacts.

• Operating Level Adjustment

Switch operating levels depend on the height at which the float is positioned in the tank by the cable fastening and the distance along the cable between the float and the weight. The Termination and Height Fixing section on the next page of this manual discusses the methods for securing the cable at the required height. The height of the face of the float in the free hanging position, with no liquid present, is used as a zero reference for adjusting all switch point operating levels per the graph and diagram below. Level settings may vary slightly between switches. Final adjustments should be made under actual pumping conditions. If there is surface wave motion, some variation in actual switching levels may occur.

For single level types (1L, 1H, 1C, 1LE and 1HE), the float should be hung so that the desired switching point is 5 inches above the zero reference. This represents the difference in height between levels 0 and LL. Note that these single level switches do not require a weight on the cable for their tilting operation.

For multi level types, the distance A (from 0 to weight) must be adjusted to obtain the desired switching differential. For most switches the differential height B between levels H and L is the crucial dimension. The required value for B, together with the corresponding value of A, is selected from the graph shown on the next page. Then, if the weight is wedged at that distance and the float hung in accordance with the diagram, the switch points will operate with the correct differential. The graph gives the distance C between levels H and HH for the determined value of A. It will be seen that switching levels HH and LL bear a specific relationship to A and B and cannot be independently adjusted. Thus, if it is essential to be able to adjust these levels separately, two floats will be required rather than just one.

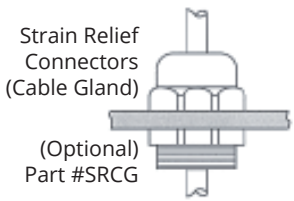


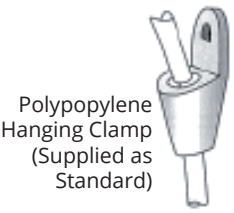
As a working example, consider a type 4H needing a pump operating differential of 20 inches (= dimension B). From the graph it can be seen that the corresponding value for A is approximately 19 inches. Now suppose that the float is to operate in a tank so that the pump "off" position (level L) is 15 inches from the bottom of the tank. This means that the float must be hung so that the zero reference height (free-hanging face of the float) is 6 inches from the bottom of the tank. The high and low alarm points HH and LL will then be, respectively, close to 41 and 11 inches from the bottom of the tank.

For type 2HL, the difference between the high and low alarm points is the difference between levels LL and HH in the graph. Note that this corresponds to distance B + C + 4 inches and the distance A for weight positioning must be selected accordingly.

• Termination and Height Fixing

There are several methods that can be used to fasten the cable so that the float is positioned at the right level in the tank. The three most commonly used are illustrated below. Very frequently, the cable will need to be led into a standard NEMA box with terminals for extension to the control panel. The liquid tight (70 psi) Strain Relief Connector (Part# SRCG) can be used to lead the cable through the wall of the box.

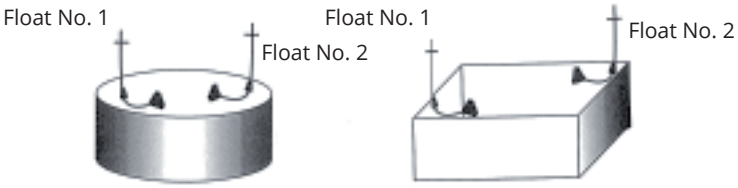




• Position in Tank/Swing Distance Allowance

KA float switches should hang freely in the tank and not be tightly tethered. If more than one float switch is to be installed in the tank, the cable fixing points should be separated to prevent the cables from tangling. The float switches do not need to be hung in the center of the tank — the cable can run down a wall or corner of the tank as illustrated below.

The float switches need a certain free surface to operate in. As a rule of thumb, the swing radius to be allowed should be the same as the distance of the weight from the bottom of the float. If necessary, baffles or stilling wells may have to be provided to prevent interference with other equipment. Contact our Applications Engineering Department for alternative suggestions if any difficulties in this regard are foreseeen or encountered.



• Control Contact Ratings

The contacts used in the KA float switches are high performance microswitches. Although they are capable of carrying quite high currents at up to 250 VAC, it is not a good practice to put pump motor currents directly through these contacts because they are immersed in the liquid. Thus, it is usually just low sensing currents for relay coil operation that are applied to the float switch contacts.

Relays with heavy duty contacts are known as contactors. Pump motor manufacturers often provide suitable contactors with control circuits on their motors. These allow the KA float switches to be connected directly. If contactors are not provided, the contact ratings needed to start and stop a pump should be approached with caution: when pump motors start and stop, they can produce a momentary surge current several times greater than the steady running current. Suppliers of the relays and contactors usually provide maximum ratings for their contacts in terms of allowable pump motor horsepower figures. If there are any concerns in this regard, consult our Applications Engineering Department for advice.

• Verifying Operation

KA float switches are highly reliable. However, if a check on the operation of a particular switch is needed, it is first necessary to ascertain where the bias weight is located in order to find the top point when the float is in the liquid. A good way to do this is to put the float switch on a flat surface so that it can roll freely to the working orientation (just like it does in the liquid). A continuity meter should then be attached to the circuit to be tested. Testing is then performed by tilting the float up and down in the vertical plan determined by the working orientation. At the appropriate angle, the switch circuit being tested should open or close.

• Valuable Tips

1. Do not be concerned if you hear a clacking sound when the float is shaken — it is only the microswitch acting. It is extremely unusual to find any leakage in these floats.
2. Do not put the full line power voltage across a contact without a load attached. Shorting out the power across the microswitch will destroy it.
3. Do not tether the floats tightly on a short cable or make them jiggle and dance in a high pressure washdown hose stream. The continuous flexing at a particular point in the cable will break the wires.

Certificate of Compliance

Certificate: 1358188 **Master Contract:** 237484

Project: 2721544 **Date Issued:** July 24, 2014

Issued to: **Automation Products Group Inc**

1025 West 1700 North
Logan, UT 84321
USA
Attention: Karl Reid

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Virali Shah

Issued by: Virali Shah

PRODUCTS

CLASS 3211 86 - INDUSTRIAL CONTROL EQUIPMENT-Motor Controllers - Miscellaneous-Certified to U.S. Standards

CLASS 3211 06 - INDUSTRIAL CONTROL EQUIPMENT - Motor Controllers - Miscellaneous

Float switches Model No. KA-C, KA-M and KA-S Series:

Rated 250 Vac, 6 A max (resistive), 3 A max (inductive) or 250 V dc, 0.3 A max.

Note: These devices are Certified as components for use only in other Certified equipment where the suitability of the combination is determined by CSA.

APPLICABLE REQUIREMENTS

CSA Standard C22.2 No 14-13 - Industrial Control Equipment

ANSI/UL 508 (17th Edition) - Industrial Control Equipment

DQD 507 Rev. 2012-05-22 Page: 1

AUTOMATION PRODUCTS GROUP, INC.

Operator's Manual

Automation Products Group, Inc.
APG...Providing tailored solutions for measurement applications
Tel: 1/888/525-7300 • Fax: 1/435/753-7490 • www.apgsensors.com • E-mail: sales@apgsensors.com

ASHCROFT®
Trust the shield.™

1290 Direct Drive Process Pressure Gauge

Tab - 2.05

FEATURES

- Accuracy complies with ±0.5% (ASME B40.1, Grade A)
- Gearless design
- Ideal for shock and vibration applications
- External dial adjustment

TYPICAL USES

- Refineries
- Offshore / Power - Power Plants

1290
4½″ dial size

SPECIFICATIONS

Accuracy:	±0.5% of span (ASME B40.100, Grade 2A)
Size:	4½″
Range:	15 to 2,000 psi
Process Connection Location:	Lower
Process Connection Size:	¼ NPT Male, ½ NPT Male
Case Style:	Solid front with pressure relief back
Movement:	Adjustable
Movement Materials:	300 SS
Window Material:	Acrylic
Dial:	Aluminum, white background, black scale
Pointer:	Aluminum
Weather Protection:	Dry Case: IP54
Mounting:	Stem or Surface
Approvals:	CRN

WETTED COMPONENTS

Bourdon Tube	Process Connection	Joints
Inconel® 750X, 304 SS capillary	316L SS	Welded

NON-WETTED COMPONENTS

Case	Ring	Back Cover
ABS Thermoplastic	302 SS	Polypropylene

KEY BENEFITS

- **Low volumetric displacement - compatible with mini diaphragm seal**
- **Selection of Measurement Units (psig and dual scale, kg/cm²/psi)**
- **Optional NIST Traceable Calibration Chart**

MIN/MAX TEMPERATURE LIMITS (1259 ONLY)

Version	Ambient	Process	Storage
Dry	-20°F to 200°F (-29°C to 93°C)	-20°F to 250°F (-29°C to 121°C)	-40°F to 250°F (-40°C to 121°C)
Glycerin Fill	20°F to 150°F (7°C to 66°C)	20°F to 200°F (7°C to 66°C)	0°F to 150°F (-18°C to 66°C)
Silicone Fill	-40°F to 150°F (-40°C to 66°C)	-40°F to 200°F (-40°C to 93°C)	-40°F to 150°F (-40°C to 66°C)

All specifications are subject to change without notice.
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1290 Direct Drive Process Pressure Gauge

ORDERING CODE Example:	451290	W	D	02	L	XC4	15#
Dial Size/Model Code							
451290 - 4½″ ABS thermoplastic case, solid front. Direct drive	451290						
System (tube and process connection)							
W - Inconel® direct drive coil X750, SS process connection		W					
Case Design							
D - Dry (IP54)			D				
Process Connection Sizes							
02 - ¼ NPT Male				02			
04 - ½ NPT Male							
Process Connection Location							
L - Lower					L		
Options (If choosing an option(s) must include an "X")						X__	
C4 - Individual calibration chart in accordance with ASME B40.100:2013. Accuracy traceable to N.I.S.T						C4	
6B - Cleaned for gasses, oxygen service							
NH - SS tag wired to case							
RG - Regular glass							
Range (coding examples only, see range table on page 3 for all standard ranges)							
Single Scales							
15# - 15 psi							15#
1BR - 1 bar							
1KG - 1 kg/cm^2							
100KP - 100 kilopascal							
Dual Scales							
2KSC/# - 2 bar inner scale, 30 psi outer scale							

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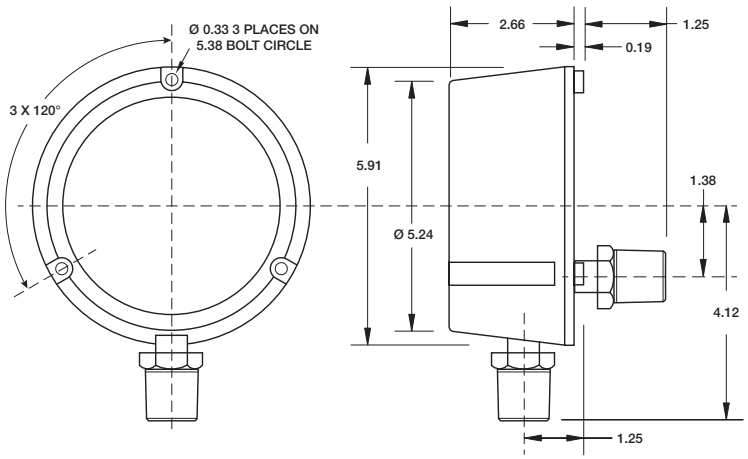
1290 Direct Drive Process Pressure Gauge

Single Scale	Dual Scale	
psi	KSC - inner	psi - outer
15#	2	0/30
30#	7	0/100
60#	11	0/160
100#	14	0/200
150#	21	0/300
160#	28	0/400
200#	35	0/500
300#	42	0/600
400#	70	0/1000
500#	105	0/1500
600#	120	0/2000
800#		
1000#		
1500#		
2000#		

DIMENSIONS

For reference only, consult Ashcroft for specific dimensional drawings



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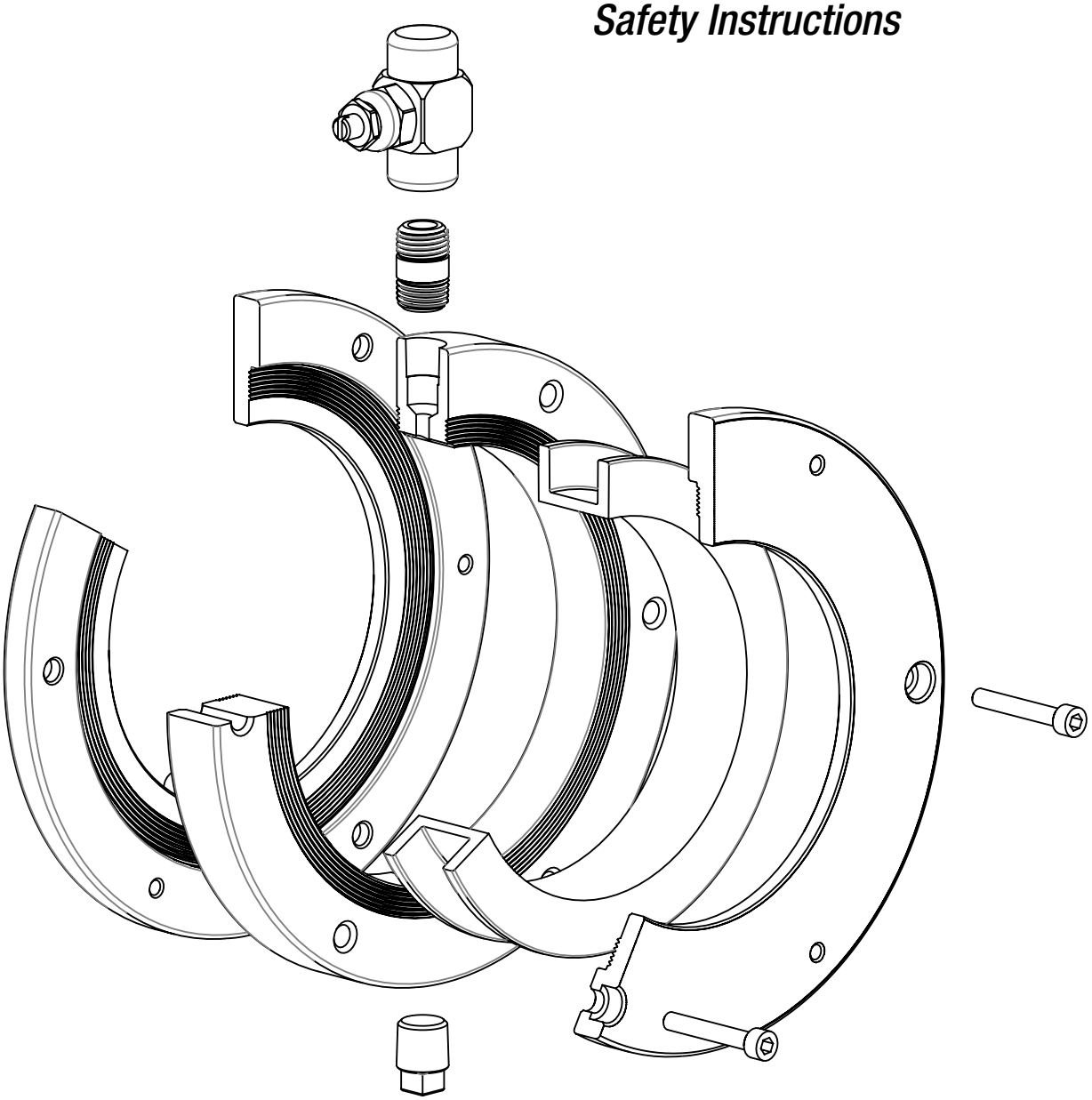
Tab - 2.06

Type 80 Wafer and Type 81 Bolt-Thru Isolation Rings

Installation, Maintenance and Safety Instructions



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7. PRODUCT MAINTENANCE / IN-SERVICE REPLACEMENT
8. STORAGE

1 - SAFETY INFORMATION

SAFETY INFORMATION

To assure safe operation and maintenance procedures, read and follow these instructions.

⚠ **WARNING:** Serious injury or equipment damage can result from failure to properly install, maintain or operate these components:

- Follow all instructions in these instructions to avoid exposure to pressurized fluid.
- Use proper tools and safety equipment in installing or maintaining components.
- Assure that process pressures and temperatures are properly monitored and maintained, and that process fluid is appropriate and compatible with system.
- If Safe Quick Release (SQR) option is used with isolation ring, avoid projection hazard by always using two hands to install or remove gauge, and stand clear from the gauge and coupling.

2 - OVERVIEW

OVERVIEW

Isolation rings are designed to protect measuring devices, e.g. pressure gauges, switches, and transducers, from direct contact with the process media. Using a 360-degree flexible liner that eliminates the potential for clogging and/or fouling, while transmitting pressure hydraulically to the instrument. Offered in two styles, Type 80 (Wafer) and Type 81 (Bolt-thru), each is mounted between customer-supplied flanges of process piping; available in nominal pipe sizes from 2″ to 20″ and 1″ to 10″, respectively.

3 - PRODUCT SPECIFICATIONS

PRODUCT SPECIFICATIONS

Type/Size:

Type 80 Wafer: 2″ to 20″

Type 81 Bolt-Thru: 1″ to 10″

Liner Materials: Buna-N, Teflon®, EPDM, Natural Rubber, Viton®

Liner Process Temeperature Limits:

Buna-N	–30/225°F
Teflon®	–15/350°F
Viton®	–15/350°F
Natural Rubber	–30/225°F
EPDM	–40/300°F

End Plate: 316L SS, Carbon Steel, CPVC

Pressure Class (Type 81 Bolt-Thru only): ANSI/ASME Class 150 / 300 (Type 80 wafer applicable to both 150 and 300 class)

Body: 316L SS, Carbon Steel

Instrument Connection Size: ¼, ½ Female NPT

Fill Fluid: Glycerin, Silicone (10 CST), Silicone (5 CST), Halocarbon.

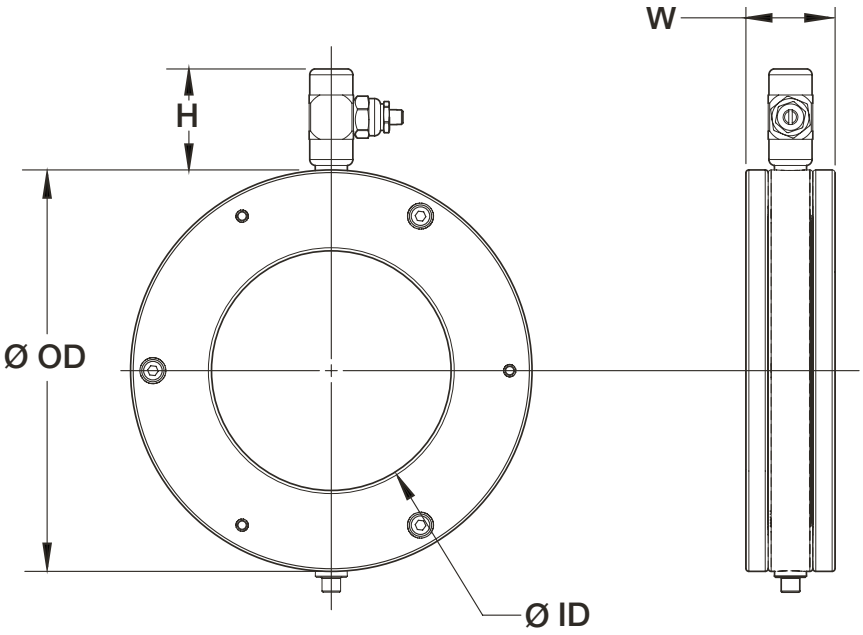
AVAILABLE PRODUCT OPTIONS

Safe Quick Release Instrument Removal Option: (SQR)

- All Welded Assembly (XDU) – Not available with Safe Quick Release (SQR) and/or Needle Valve
- Retrofit end plates (XIR)
- Wired Stainless Steel Tag (XNH)
- Calibration Chart (XC4) – Measuring instrument attached
  Consult factory for additional options

DIMENSION DRAWINGS

Type 80 Wafer Isolation Ring

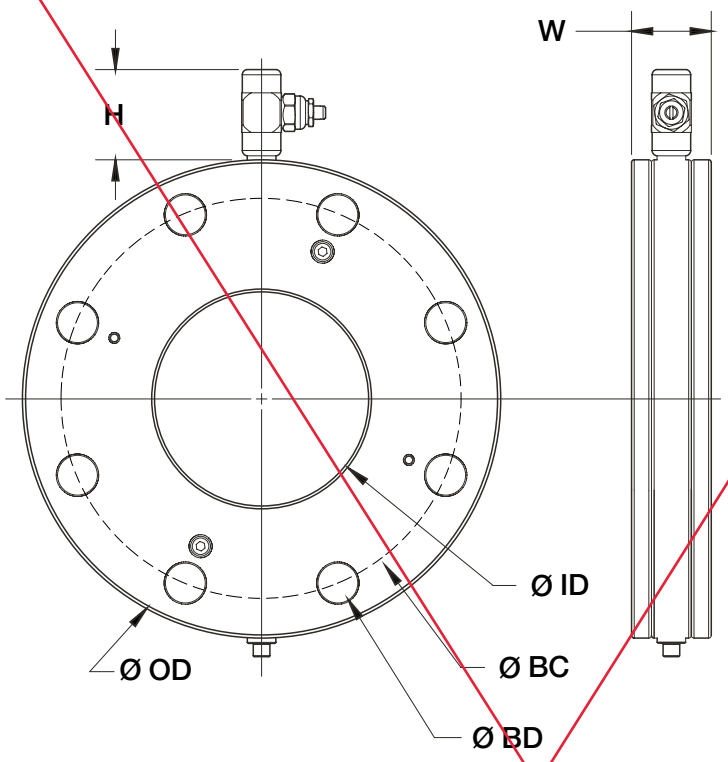


Nominal Pipe Size	Inner Diameter (ID)	Outer Diameter (OD)	Retrofit Width (XIR)	Width (W)	Instrument Removal (H)			
					None	Safe Quick Release	Needle Valve	Weight Lbs.
2″	2.07	4.00	2.13	2.00	1.89	2.04	1.70	4.0
3″	3.07	5.25	2.13	2.00	1.89	2.04	1.70	6.3
4″	4.03	6.75	2.13	1.50	1.89	2.04	1.70	8.0
5″	5.05	7.63	2.25	1.50	1.89	2.04	1.70	
6″	6.07	8.63	2.25	1.50	1.89	2.67	2.32	10.2
8″	7.98	10.88	2.50	1.50	2.39	2.67	2.32	14.9
10″	10.02	13.25	2.75	1.50	2.39	2.67	2.32	21.3
12″	12.00	16.00	3.00	1.75	2.39	2.67	2.32	39.1
14″	13.25	17.63	3.00	1.75	2.89	3.17	2.82	47.8
16″	15.25	20.13	3.00	1.75	2.89	3.17	2.82	61.8
18″	17.25	21.50	3.00	1.75	2.89	3.67	3.32	58.0
20″	19.25	23.75	3.00	1.75	2.89	3.67	3.32	68.6

All dimensions shown in inches.

DIMENSION DRAWINGS (cont.)

Type 81 Bolt-Thru Isolation Ring



ANSI ASME Class	Nom. Pipe Size	Inner Dia. (ID)	Outer Dia. (OD)	Width (W)	Bolt Circle (BC)	Bolt Dia. (BD)	No. Of Bolt Holes	Instrument Removal (H)			Weight Lbs.
								Direct	Safe Quick Release	Needle Valve	
150	1″ SS/CS	1.05	4.25	2.00	3.12	0.625	4	0	2.04	1.70	5.7
	1″ CPVC	1.05	4.25	2.25	3.12	0.625	4	0	2.04	1.70	4.0
	1.5″ SS/CS	1.61	5.00	2.00	3.88	0.625	4	0	2.04	1.70	7.9
	1.5″ CPVC	1.61	5.00	2.25	3.88	0.625	4	0	2.04	1.70	5.6
	2″	2.07	6.00	2.00	4.75	0.75	4	0	2.04	1.70	12.0
	3″	3.07	7.50	2.00	6.00	0.75	4	0	2.04	1.70	18.4
	4″	4.03	9.00	1.50	7.50	0.75	8	0	2.04	1.70	18.6
	5″	5.05	10.00	1.50	8.50	0.88	8	0	2.04	1.70	21.0
	6″	6.07	11.00	1.50	9.50	0.88	8	0	2.04	1.70	23.9
	8″	7.98	13.50	1.50	11.75	0.88	8	0	2.04	1.70	34.5
	10″	10.02	16.00	1.50	14.25	1.00	12	0	2.04	1.70	44.5
300	2″	2.07	6.50	2.00	5.00	0.75	8	0	2.04	1.70	13.8
	3″	3.07	8.25	2.00	6.62	0.88	8	0	2.04	1.70	22.0
	4″	4.03	10.00	1.50	7.88	0.88	8	0	2.04	1.70	24.5
	5″	5.05	11.0	1.50	9.25	0.88	8	0	2.04	1.70	32.0
	6″	6.07	12.50	1.50	10.62	0.88	12	0	2.04	1.70	34.9
	8″	7.98	15.00	1.50	13.00	1.00	12	0	2.04	1.70	47.1
	10″	10.02	17.50	1.50	15.25	1.13	16	0	2.04	1.70	58.8

All dimensions shown in inches.

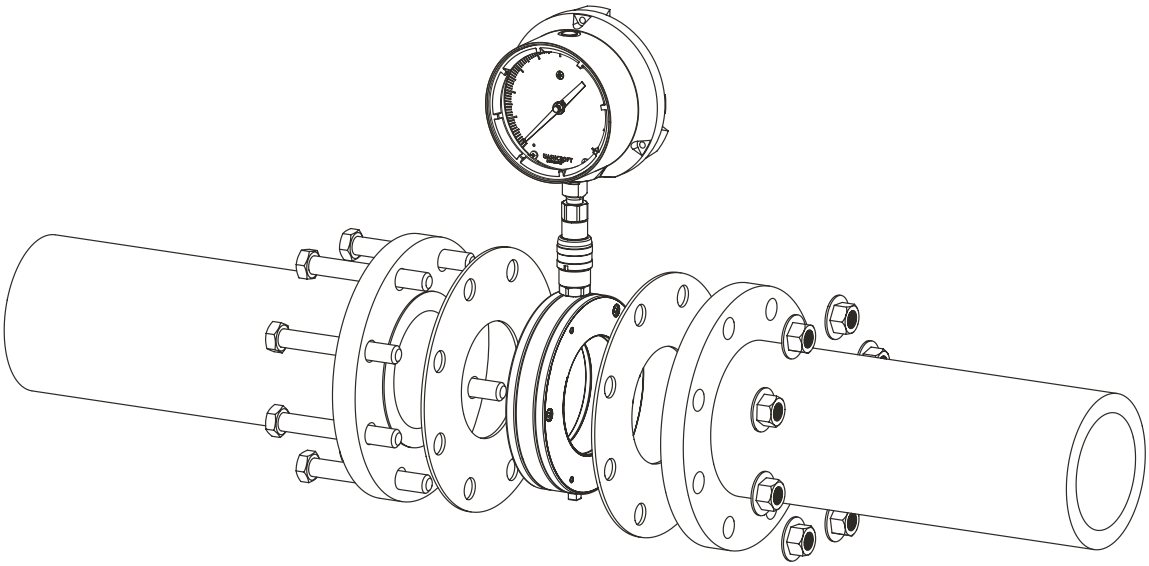
PRODUCT INSTALLATION

MATERIAL COMPATIBILITY: Wetted material selection is critical to the product's life cycle and reliability. In order to ensure proper material selection, elements to consider are:

- Process Fluid
- Process Fluid Concentration (%)
- Process Pressure and Temperature
- Assembly Fill Fluid – check compatibility

Isolation Ring Styles:

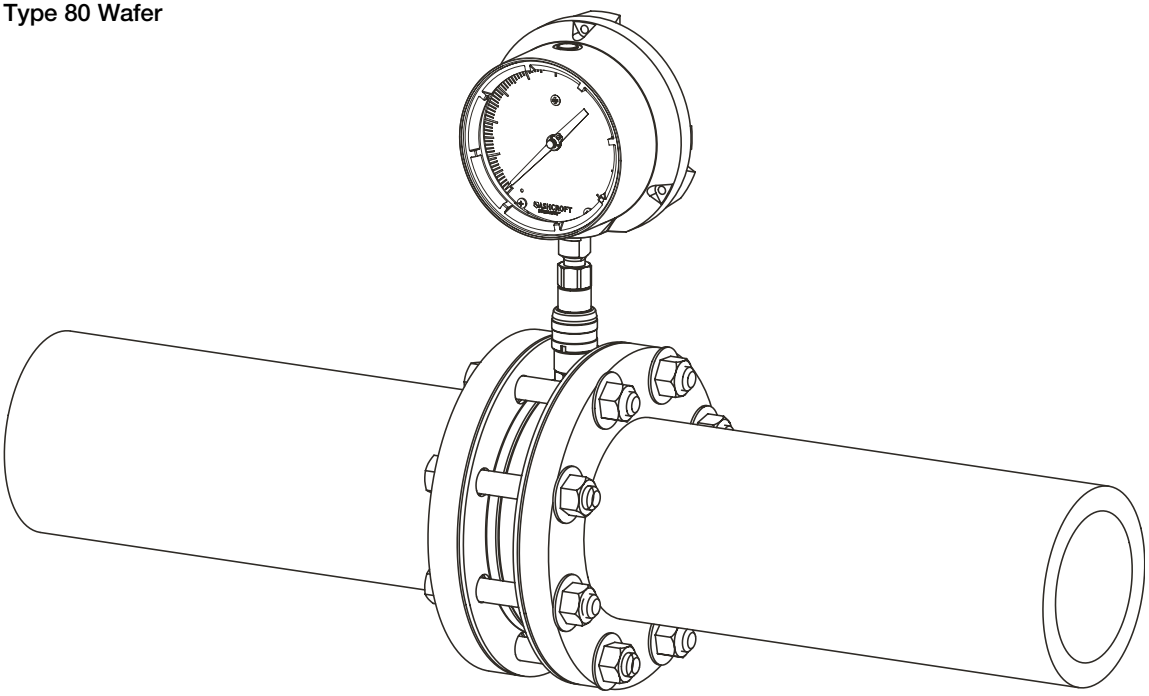
Type 80 Wafer:



(Exploded View)

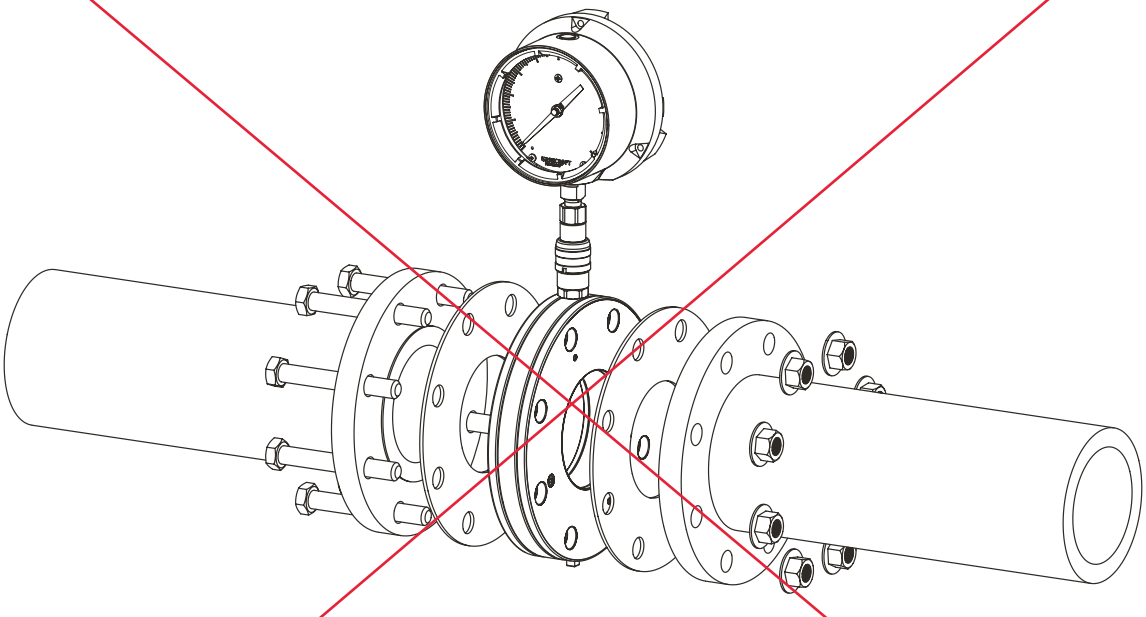
Gaskets, nuts, bolts and flanges provided by USER

Type 80 Wafer



(Installed View)

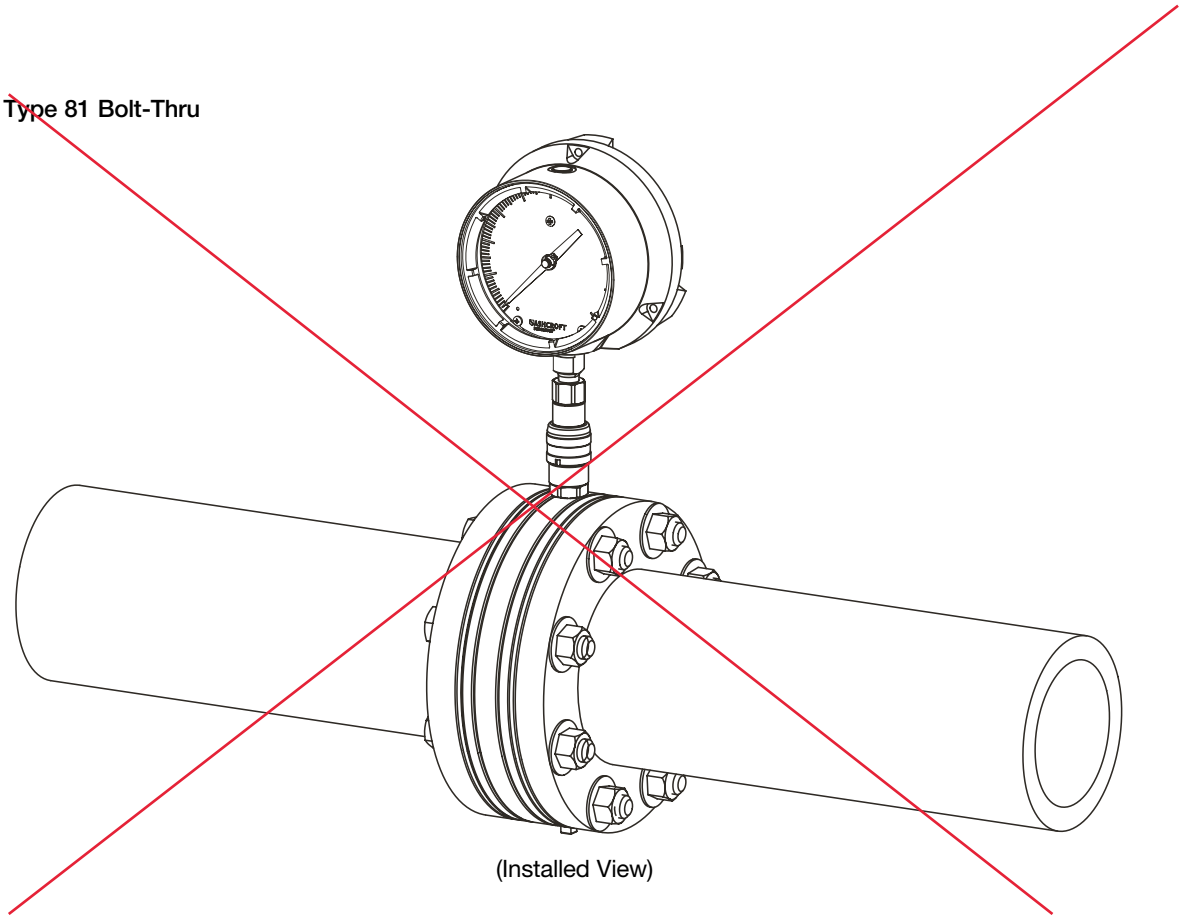
Type 81 Bolt-Thru



(Exploded View)

Gaskets, nuts, bolts and flanges provided by USER

Type 81 Bolt-Thru



(Installed View)

Prior to installation, please follow the recommended manufacturer procedure:

A. Confirm process has been shut down with process pressure relieved and piping drained.

B. Provide pipe flange gasketing, mounting bolts, lockwashers and nuts (not supplied by Ashcroft).

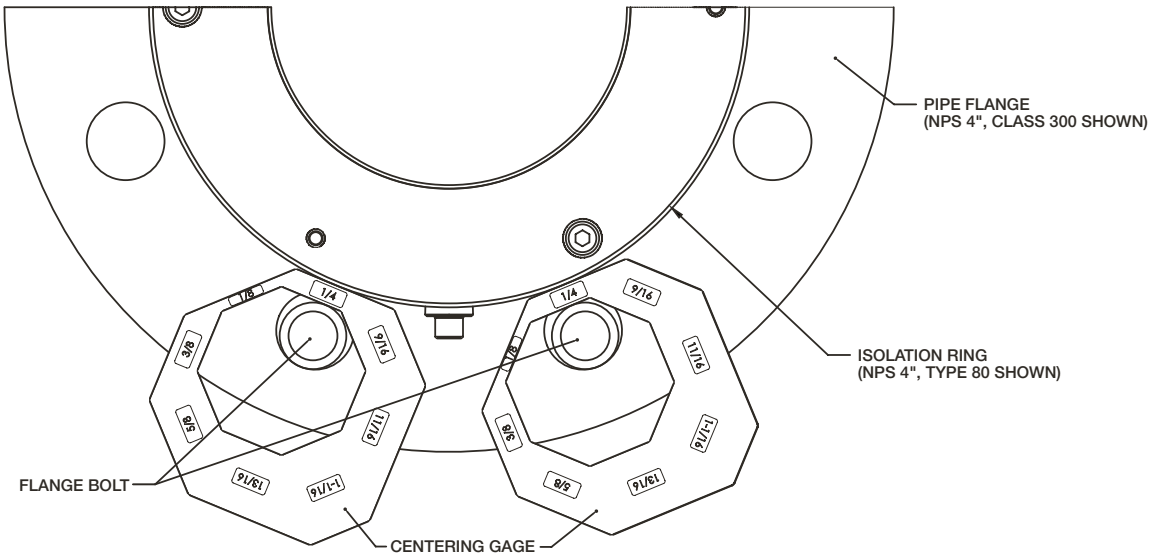
Step 1: Isolation ring and flange gaskets should be centered between process piping flanges.

For Type 80 Wafer: Assembly is installed by placing centering gages (shims) on the two bottom-most flange bolts; these are supplied by Ashcroft with each isolation ring assembly. Refer to the following table for centering gage size based on ANSI/ASME class rating. Note: Centering gauges may be removed afterwards by breaking.

ANSI/ASME CLASS	NPS	CENTERING GAGE SIZE
Class 150	All Sizes	1/8″
Class 300	2″	1/4″
	3″	3/8″
	4″	1/4″
	6″	11/16″
	8″	11/16″
	10″	9/16″
	12″	3/8″
	14″	13/16″
	16″	5/8″
	18″	1-1/16″
	20″	1-1/16″

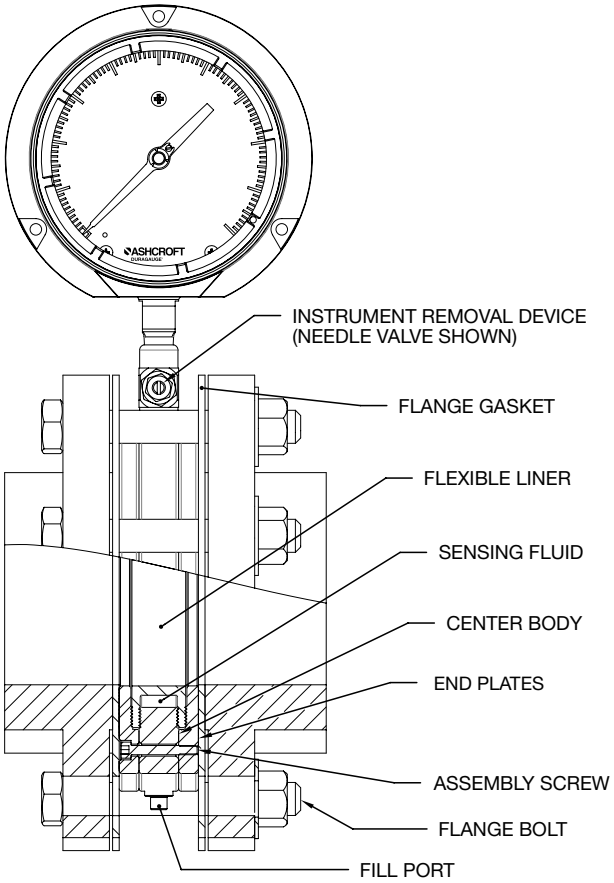
Step 2: Position Type 80 Wafer isolation ring with centering-gages or Type 81 Bolt-Thru using two bottom-most bolts through unit and process flanges. Take care to ensure that any attached instruments are directed in a vertical (upward) configuration, while measuring devices (e.g. gauge, switch, transducer) are also positioned between the two upper-most flange bolts to prevent obstruction with the process piping.

Step 3: Tighten the piping flange bolts to the locking nuts / washers on the opposite flange. Each should be tightened by cross-bolting with the proper torque based as described in ASME PCC-1 on NPS, ANSI/ASME Class rating, and gasketing used.



6- ASSEMBLY REMOVAL

ASSEMBLY REMOVAL



IMPORTANT: In the event the assembly needs to be removed from process, follow the manufacturer's recommended procedure to prevent possible injury and/or damage.

A. Confirm process has been shut down with process pressure relieved and piping drained, cleaned and dried before installation and/or removal of product assembly.

B. Ensure the assembly is supported prior to removal of bolts/flanges.

C. Loosen flange bolts securing the isolation ring assembly to the process pipe flange.

D. Upon separation of pipe flanges, remove assembly and flange gaskets from the piping.

In the event only instrument removal is required, use a wrench to unthread the instrument. Use container to catch the fill fluid when draining from the isolation ring.

7 - PRODUCT MAINTENANCE / IN-SERVICE REPLACEMENT

PRODUCT MAINTENANCE / IN-SERVICE REPLACEMENT

The following provides the user with th necessary instructions to service this product. This will allow the customer to perform routine maintenance that may involve in-service instrument replacement.

IN-SERVICE INSTRUMENT REMOVAL / REPLACEMENT (Dependent upon type of assembly connection listed below)

1) Direct Mount Instrument Removal: Measuring instrument should never be removed from the isolation ring while in service. For instrument replacement, complete removal of the isolation ring assembly from service is required.

2) Needle Valve Instrument Removal Option:

a) Shut down process and fully vent/relieve pressure to the assembly. While it is possible that pressure may be retained in the process when the instrument is removed, it is imperative that the process pressure MUST be at Zero (0 psi) when reinstalling the replacement instrument.
IMPORTANT: Residual pressure may cause potential injury/damage, and replacing an instrument with residual pressure could result in fill fluid imbalance, thereby causing accuracy errors.

b) Using a flathead screwdriver, turn the adjustment on the needle valve until fully closed (clockwise).

c) Secure the needle valve body using a ¾″ wrench, and remove the attached measuring instrument (e.g. gauge, switch, transducer) with a second wrench applied to the instrument's wrench flats.

d) Position and secure the measuring instrument so that the pressure port is facing upwards. Then utilizing an ordinary syringe, fill the internal cavity of the process connection with compatible fill fluid. Place finger on the port and tilt side-to-side to dislodge any trapped air. Continue filling until air bubbles no longer appear. Note: Improper fill can result in accuracy errors or damage to the flexible isolation ring liner. Highly viscous fill fluids may require 10 to 15 minutes until air has been completely dislodged.

e) Apply Teflon tape or sealant to instrument fitting while unit is still upside down and place aside while retaining this position.

f) Pour fill fluid into instrument until fill fluid is overflowing.

g) Using the flathead screwdriver, open the needle valve. Fill needle valve port until fluid is overflowing.

h) Once steps e, f and g have been completed, take the filled measuring instrument and quickly "flip" over to install (thread) into the top port of the needle valve. This needs to be performed to lose as little fill fluid as possible.

i) Secure both instruments utilizing the two wrenches previously used for disassembly.

3) Safe Quick Release (SQR) Option: This option provides the end-user with a flexible approach to remove/replace an existing instrument once the isolation ring has been installed. Prior to removal, it will be necessary to obtain a pre-filled instrument to allow continued operation and limit downtime. Record the product model number and pressure at which the instrument has been removed; this is important as it ensures that an exact replacement is "pre-charged" at the factory to retain accuracy. Safe Quick Release (SQR) removal procedure is as follows:

a) Ensure process pressure has been relieved to the proper intended removal pressure of the lesser of 300 psi or half-scale of any attached gauge. Recommended removal/replacement of product is 0 psi.

b) Twist the instrument so that the coupling sleeve-relief lines up with the sleeve-lock key.

c) While holding the instrument securely, pull sleeve downward to disengage coupling.

d) Place newly "pre-charged" instrument on the coupling and pressure downward to engage the coupling.

8 - STORAGE

STORAGE

Store in a cool, dry area.

Ashcroft Inc.,
250 East Main Street
Stratford, CT 06614-5145
U.S.A.
Tel: 203-378-8281
Fax: 203-385-0408 (Domestic)
Fax: 203-385-0357 (International)
email: info@ashcroft.com
www.ashcroft.com
80-81_rings_im_RevA_(008-10223) 06-18

Visit our web site www.ashcroft.com

KELLER

LEVELGAGE

GENERAL PURPOSE SUBMERSIBLE LEVEL TRANSMITTER

CUSTOM RANGE ANALOG LEVEL TRANSMITTER

The Levelgage by KELLER America provides standard features that far exceed those of comparably priced instruments, including standard ±1% FS Total Error Band $(TEB)_3$ or optional ±0.5% FS TEB_3 accuracy. This level transmitter is approved to NSF 61 and NSF 372_6 standards for water quality and includes KELLER America's guaranteed lightning protection, making the Levelgage an outstanding value for liquid level measurement.

The ability of the Levelgage to provide this level of sustained performance over a wide range of operating conditions makes it ideally suited to an equally wide range of applications, including drinking water, stream and reservoir level, environmental monitoring, tank level, wastewater, and for installations in areas prone to chronic damage due to transients caused by lightning.

For more information on the Levelgage, or any other KELLER product, please contact KELLER America, or view the entire KELLER catalog at kelleramerica.com

FEATURES

NSF 61 / NSF 372 approved construction for use in drinking water applications$_6$

4...20mA models include guaranteed lightning protection at no additional cost

16-bit internal digital error correction for cost-effective low Total Error Band $(TEB)_3$

316L stainless steel construction

2-year warranty covers defects in materials and workmanship

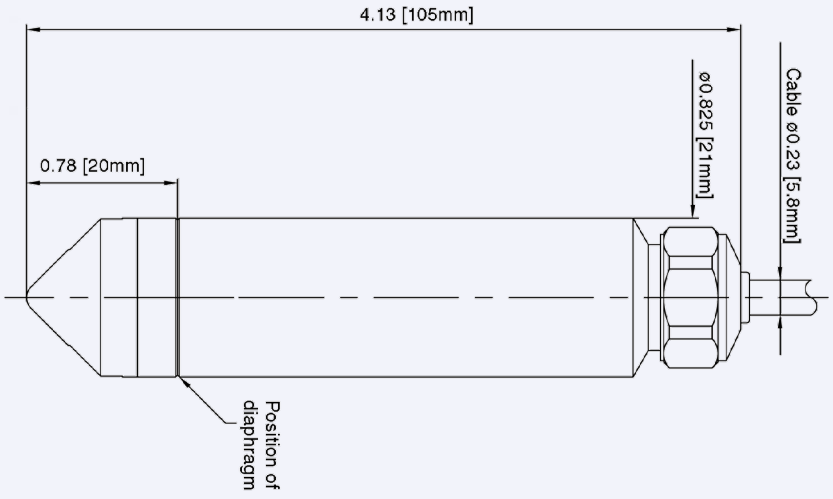
Industry standard analog outputs simplify interface to controls, data collection, and telemetry systems

Built in the U.S.A. ARRA Section 1605 Compliant

Standard 3-day lead time

CE

CLASSIFIED UL WATER QUALITY



Output	White	Black	Red
2-wire (mA)	OUT / GND	+Vcc	N/A
3-wire (VDC)	GND	+VCC	+OUT

Colors refer to 26AWG PE-jacketed cable conductors.

Braided shield wire connected to transmitter housing. For lightning protection to function properly (4-20mA only) the shield wire must be connected to a good earth ground.

Min. pipe bend radius	1" IPS	1.5" IPS	2" IPS
Schedule 40	22"	4"	3"
Schedule 80	22"	6"	4"

KELLER America Inc.
Newport News, Virginia
www.kelleramerica.com
sales@kelleramerica.com

Edition 03/2021
Subject to alterations
877-253-5537
757-596-6659

Pressure Ranges[1,2]

Relative	Infinite between 0...3 and 0...900 ft W.C
Absolute	Infinite between 0...2 and 0...11 bar

1.The Levelgage can be provided with custom calibration at no extra cost. For fluids other than water, the specific gravity must be given at the time the order is placed.

2. Intermediate ranges are realized by deranging the analog output from the next highest basic range: 1, 3, 10, and 30 bar (relative) 2, 4, and 11 bar (absolute). Level range may be specified in units of lb/in2(psi), inches WC or feet WC. KELLER America uses the International Standard conversion of 2.3067 feet WC/psi.

Accuracy[3]

Static	Standard ±0.25% FS
Total Error Band	Standard ±1% BR, Optional ±0.5% BR

3.Static accuracy includes the combined effects of non-linearity, hysteresis, and non-repeatability at room temperature (25°C). Total Error Band (TEB) includes the combined effects of non-linearity, hysteresis, and non-repeatability as well as thermal dependencies, over the compensated temperature range, expressed as a percentage of the basic range (BR).

The calculation for maximum TEB on intermediate ranges (IR) is: $TEB_{IR} = (BR/IR) \times TEB_{BR}$

Output

Current	4...20mA
Voltage	0...5, 0...10VDC[4]

4. Other voltage output options available on request.

Certifications

CE	EN50081-1, EN50082-2
NSF / ANSI[6]	61, 372

Electrical[5]

Supply (4-20mA)	11...28 VDC
Supply (0-5VDC)	8...28 VDC
Supply (0-10VDC)	13...28 VDC
Load Resistance (mA)	<(Supply-11V)/0.022A
Load Resistance (VDC)	>4k ohm

5. Nominal values may be higher depending upon cable length. Internal lightning protection increases the minimum-required supply voltage from 8VDC to 11VDC, due to internal resistance of the surge protectors. In addition, cable resistance (~70Ω / 1000ft) adds to the supply requirement. In order to insure proper system operation, calculate the minimum required supply voltage (at the source) as follows:

For two-part (internal+external) system (recommended):
MINIMUM SUPPLY VOLTAGE = 11.6 + 0.022 (CABLE LENGTH x 0.07) VDC

For internal only protector (standard with 4-20mA output):
MINIMUM SUPPLY VOLTAGE = 11 + 0.022 (CABLE LENGTH x 0.07) VDC

Environmental

Protection Rating	IP68
Operating Temp.	-10...60° C
Compensated Temp.	-10...80° C
Wetted Materials	316 L Stainless Steel
	Polyamide
Cable & Sealing	PE & EPDM for water / wastewater[6]
	Hytrel & Viton for hydrocarbons
	Tefzel & Viton or EPDM as required for chemical interaction

6. NSF 61 and NSF 372 approval applies only to PE & EPDM contruction material option, which is standard on this instrument unless otherwise specified.

Optional Accessories

1/2" NPT Conduit Fitting

Drying Tube Assembly

Bellows Assembly

Cable Hanger

Termination Enclosure

Stabilizing Weight

Process Meter

Open-faced Nose Cap

Signal Line Surge Protector

Pressure Test Adapter

KELLER America Inc.
Newport News, Virginia
www.kelleramerica.com
sales@kelleramerica.com

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Subject to alterations
877-253-5537
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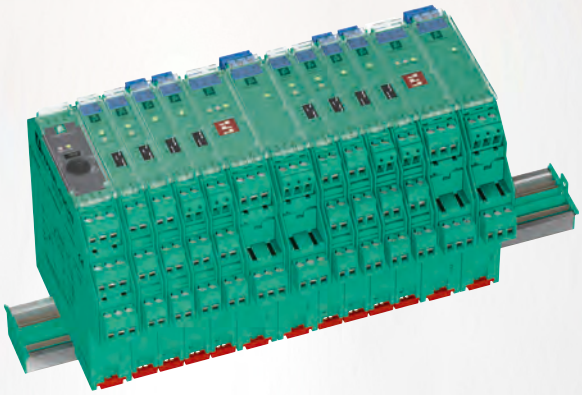
K-System

Isolated Barriers

Manual

Tab - 2.08



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PEPPERL+FUCHS

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The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

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2021-03

1 Introduction

1.1 Content of this Document

This document contains information that you need in order to use your product throughout the applicable stages of the product life cycle. These can include the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal

Note

This document does not substitute the instruction manual.

Note

For full information on the product, refer to the instruction manual and further documentation on the Internet at www.pepperl-fuchs.com.

The documentation consists of the following parts:

- Present document
- Instruction manual
- Datasheet

Additionally, the following parts may belong to the documentation, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Additional documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols

Note

This symbol brings important information to your attention.

Action

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

2021-03

2 Product Specifications

2.1 Function

Isolated barriers are isolators used for protection of intrinsically safe circuits in hazardous areas. In addition to the required current, voltage and power limitation, the isolated barriers have a galvanic isolation between the field circuit and the controller.

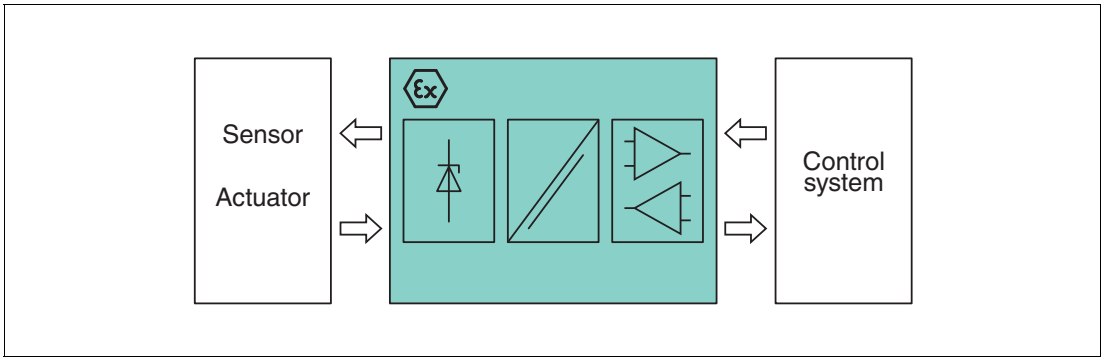


Figure 2.1 Function – isolating, amplifying and transforming signals

The K-System consists of wide range of isolated barriers suitable for mounting on 35 mm DIN mounting rail. K-System is easy to specify, integrate and expand. Our extensive line of intrinsic safe isolators for hazardous location applications contains over 150 different devices.

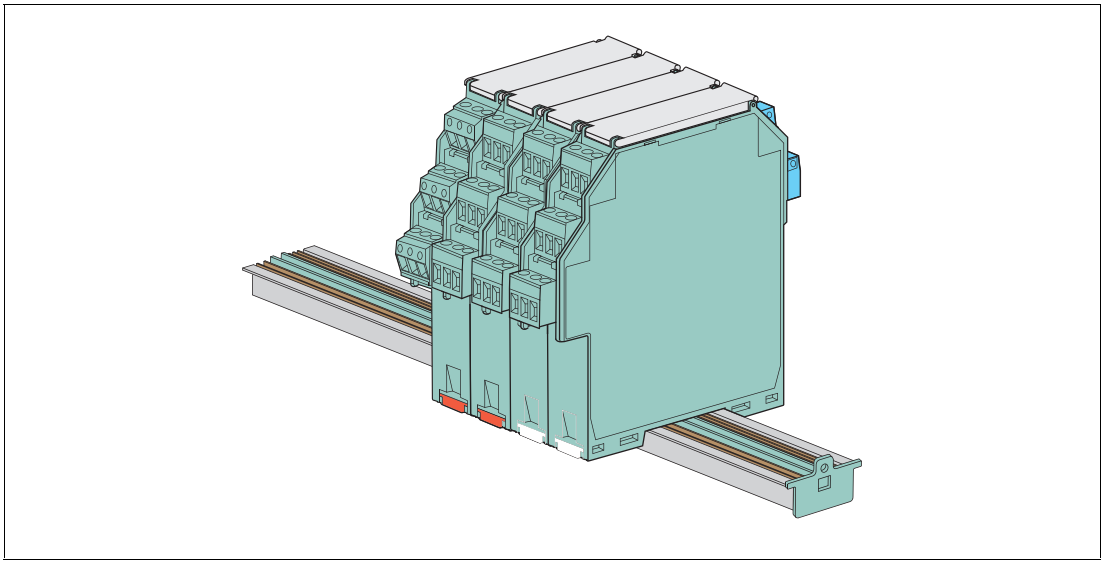


Figure 2.2 K-System on Power Rail

2.2 Housing Styles

Depending on the functionality and application, K-System devices have 3 different housing widths:

- KC devices with 12.5 mm width
- KF devices with 20 mm width
- KF devices or KH devices with 40 mm width

The 3 housing widths versions have the same system characteristics. All devices can be mounted on the 35 mm DIN mounting rail or the Power Rail. See chapter 2.9

KC Device Housing

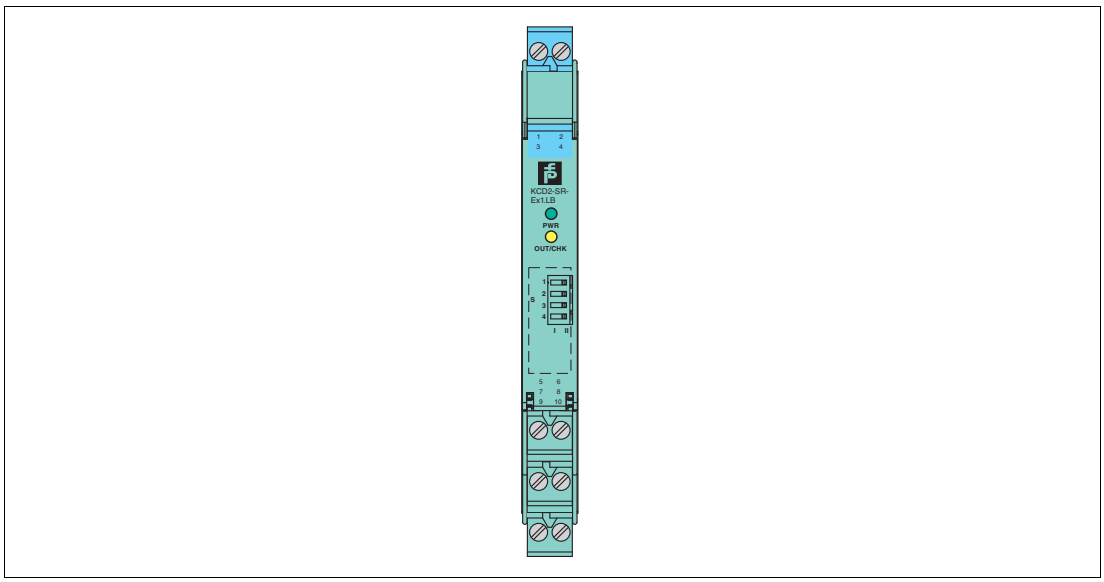


Figure 2.3 KC device housing (12.5 mm)

Used for high signal integrity

- Compact 12.5 mm housing
- High packing density with single loop integrity

KF Device Housing

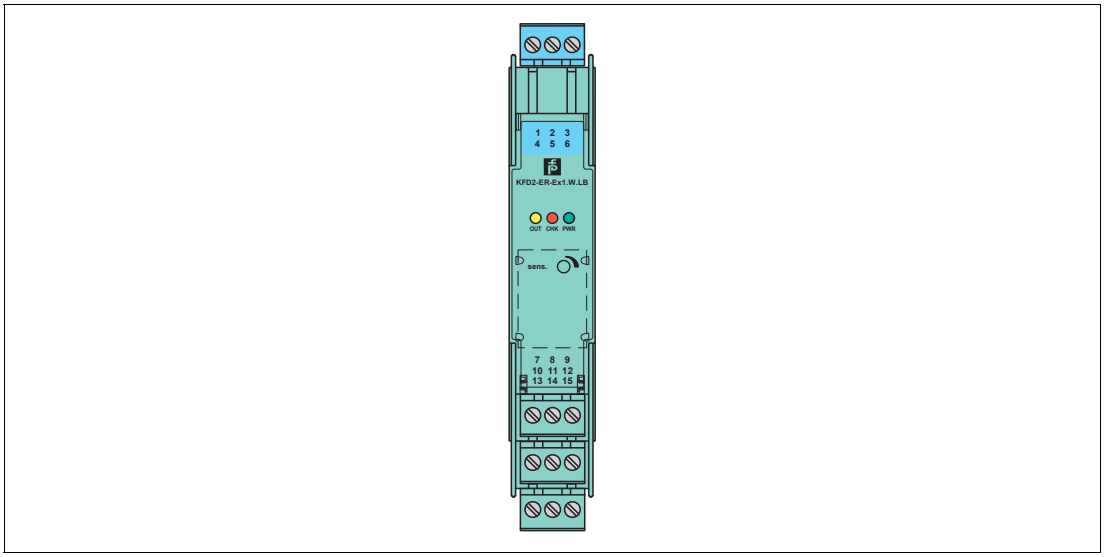


Figure 2.4 KF device housing (20 mm)

Used for high channel density

- Compact 20 mm housing
- Packing density from 5 mm per channel

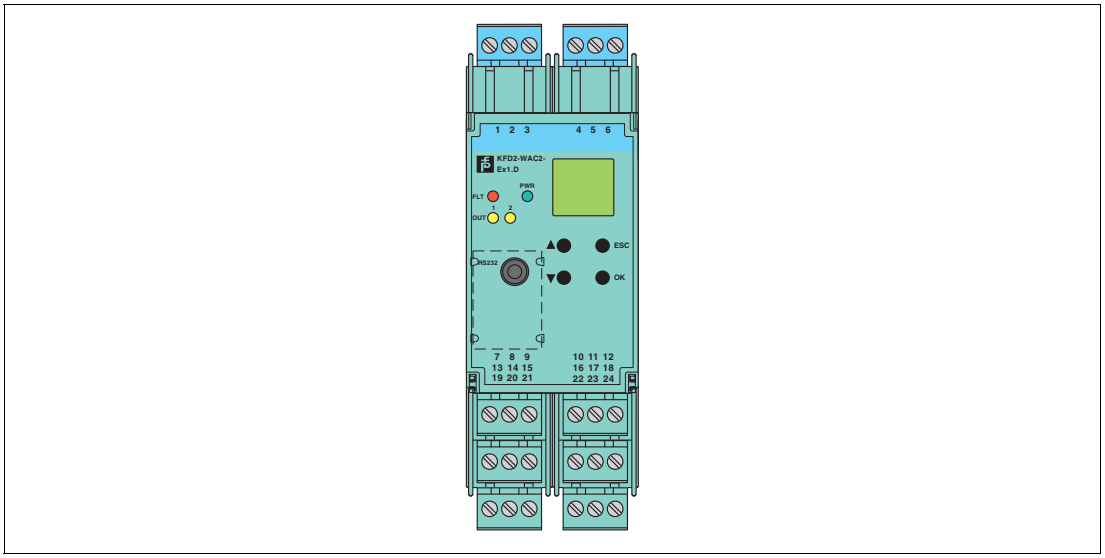


Figure 2.5 KF device housing (40 mm)

Used for applications with high functionality

- Digital devices monitor speed, direction of rotation, slip, flow rates and time.
- Analog devices monitor transmitter signals, temperature signals and load cells.
- Configured using keypad or **PACTware**^{TM} software, see also manual "Installation and Configuration Device Type Manager (DTM)"
- AC/DC wide range supply available

KH Device Housing

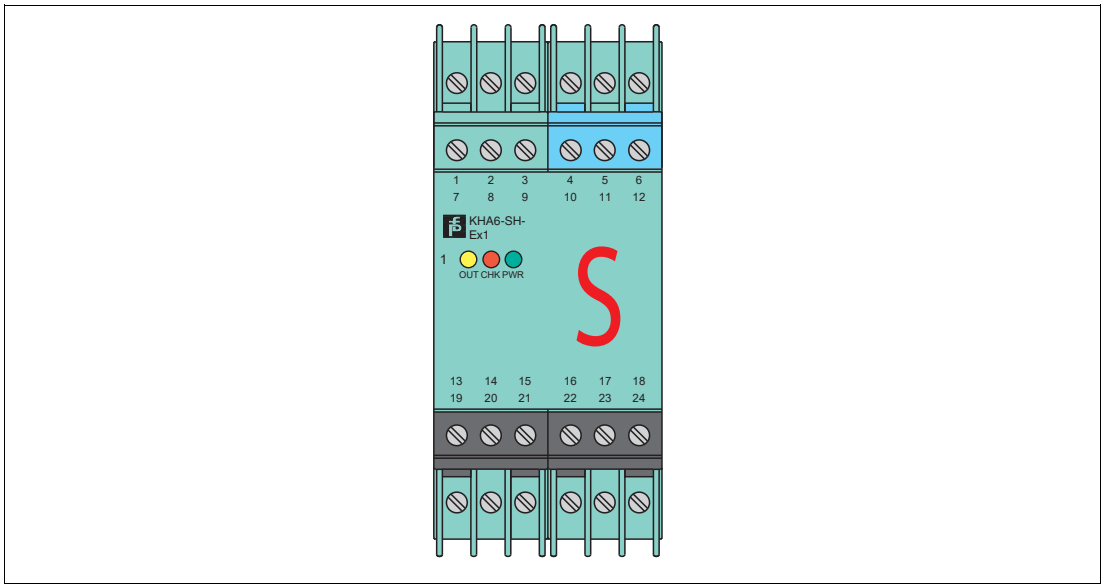


Figure 2.6 KH device housing (40 mm)

2.3 Terminals

2.3.1 Removable Terminal Blocks

The removable terminal blocks simplify connection and control cabinet assembly. The terminal blocks offer space for the connection of leads with core cross-sections of up to 2.5 mm^2 (14 AWG). The terminal blocks are coded with red coding pins so misconnection of terminal blocks are eliminated.

Observe the tightening torque of the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm.

The 20 mm and 40 mm wide KF devices are factory-equipped with screw terminals. The KC devices are available with screw terminals or spring terminals. The order designation of the versions of the KC devices with spring terminals has the extension ".SP".

As an alternative to the factory-equipped terminal blocks the devices can be used with other terminal blocks:

- Terminal blocks with screw terminals
- Terminal blocks with screw terminals and test plug socket
- Terminal blocks with spring terminals and test plug socket

These terminal blocks are available as accessories. The terminal blocks can be easily coded with KF-CP coding pins (available optionally).

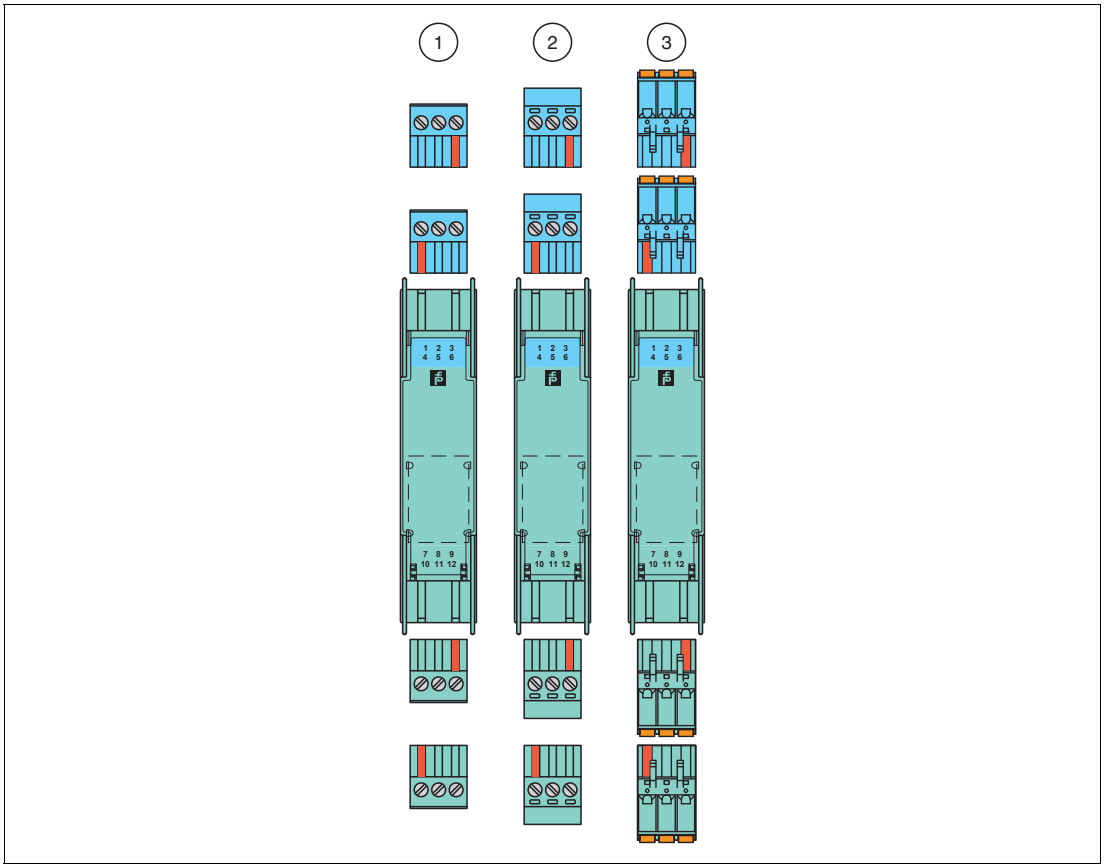


Figure 2.7 K-System removable terminal blocks

1 Terminal blocks with screw terminals
2 Terminal blocks with screw terminals and test sockets
3 Terminal blocks with spring terminals and test sockets

Protection against direct contact

The removable terminal blocks have different heights:

- Height 15 mm (1), (2), (3): These terminal blocks are used in applications that have rated voltages lower than 50 V AC. The insulation of the removable terminal blocks provides protection against direct contact. The insulation corresponds to a reinforced insulation according to EN 61010-1 for a rated insulation voltage of 50 V AC.
- Height 15.5 mm (4), (5): These terminal blocks are used in applications that have rated voltages higher than 50 V AC. The insulation of the removable terminal blocks provides protection against direct contact. The insulation corresponds to a basic insulation according to EN 61010-1 for a rated insulation voltage of 300 V AC. The higher terminals are marked (X).

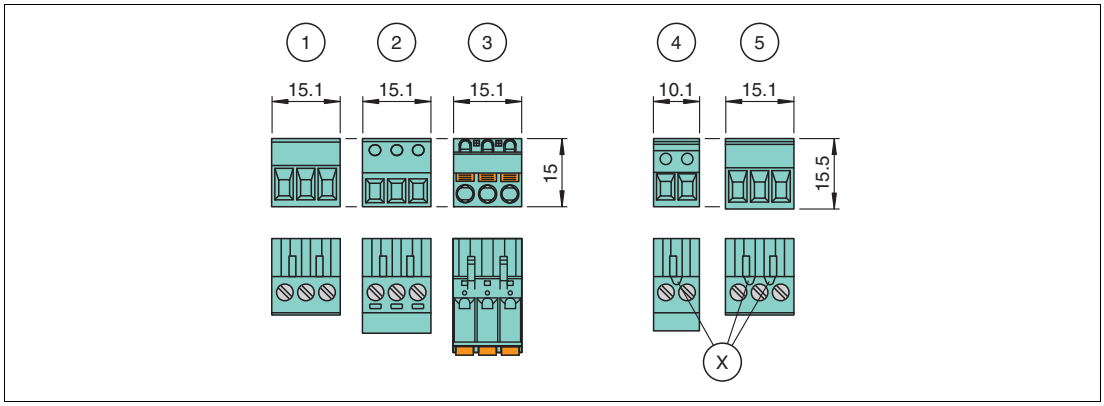


Figure 2.8 Removable terminal blocks with different heights

1 Terminal block with screw terminals, height 15 mm
2 Terminal block with screw terminals and test sockets, height 15 mm
3 Terminal block with spring terminals and test sockets, height 15 mm
4 Terminal block with screw terminals and test sockets, height 15.5 mm
5 Terminal block with screw terminals, height 15.5 mm
X Marking

Note

See corresponding datasheets for further information.

2.3.2 Terminal Designation

Note

See corresponding datasheets for precise terminal designation.

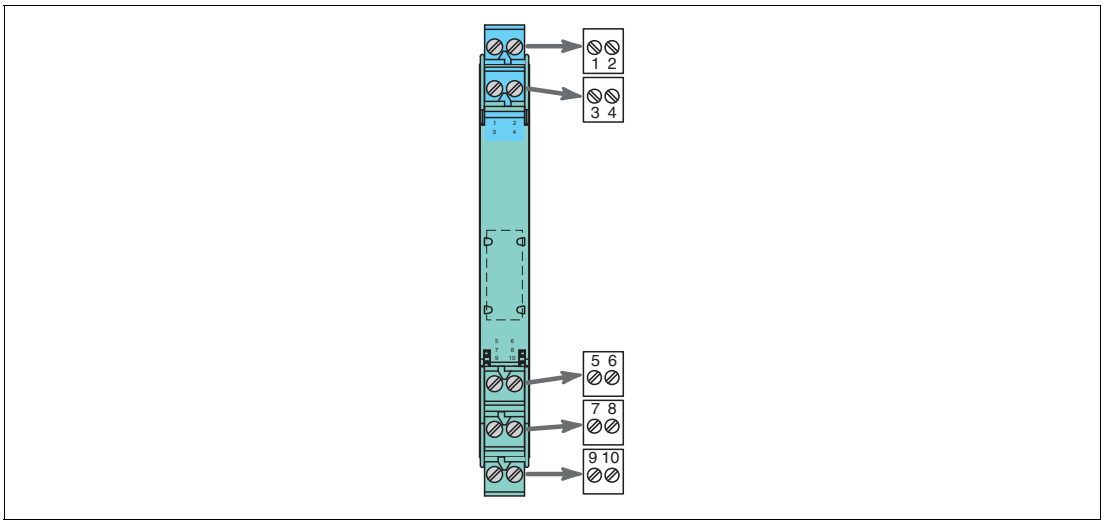


Figure 2.9 KC device housing (12.5 mm)

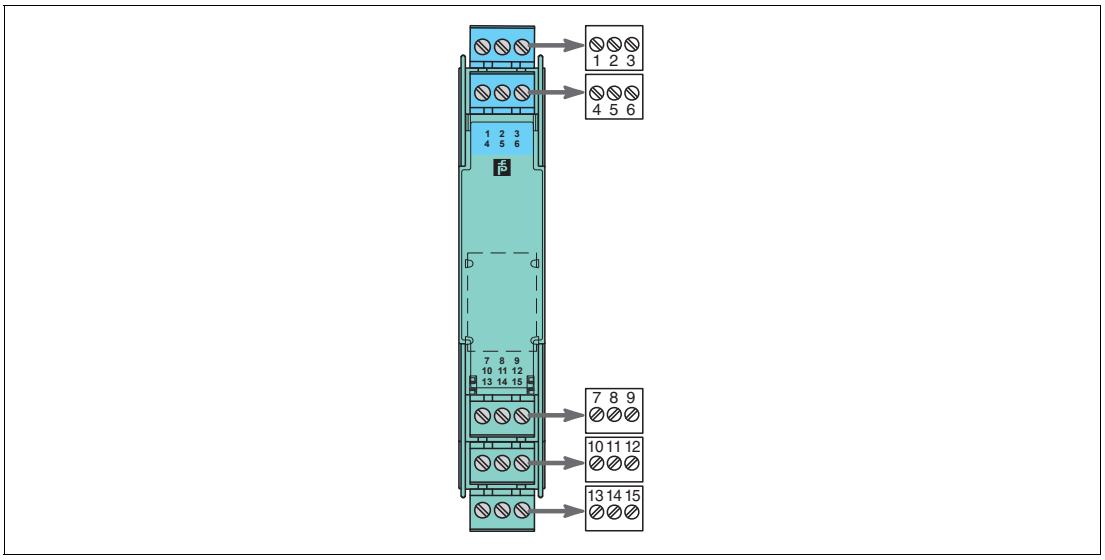


Figure 2.10 KF device housing (20 mm)

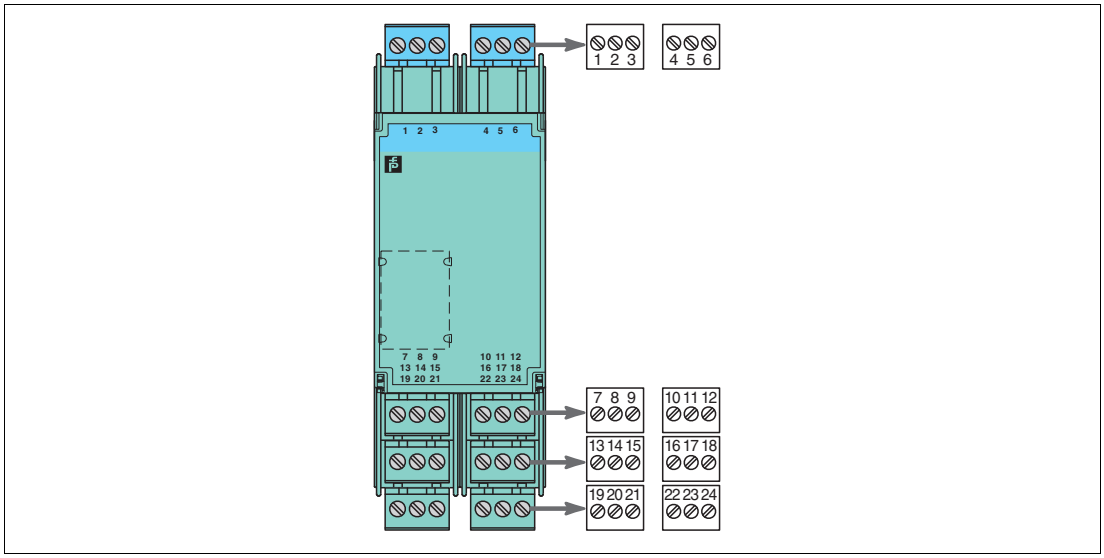


Figure 2.11 KF device housing (40 mm)

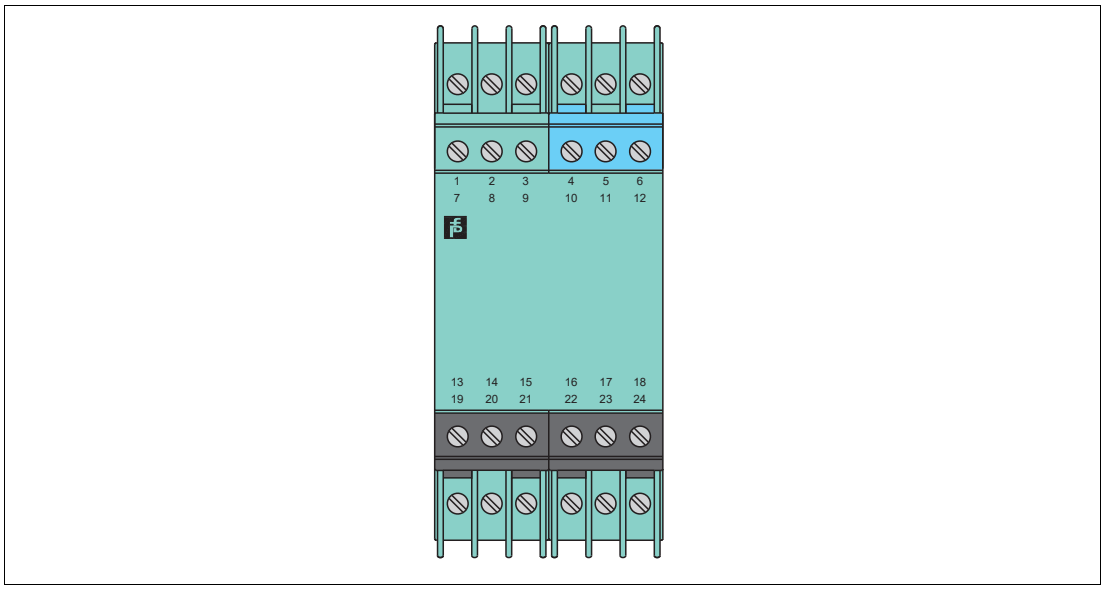


Figure 2.12 KH device housing (40 mm)

2.4 Color Identification

The color identification of the devices has the following meaning:

- Green (1) indicates devices with DC power supply.
- Black (2) indicates devices with AC power supply.
- Gray (3) indicates devices with AC/DC wide range supply.
- Blue (4) indicates devices that process signals from the hazardous area.

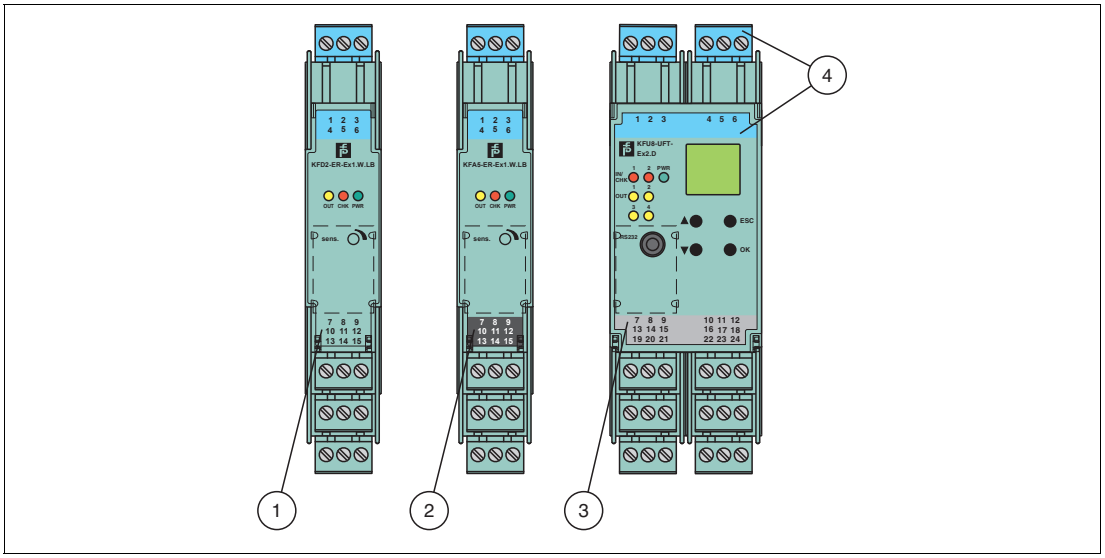


Figure 2.13 Color identification of devices

1 green
2 black
3 gray
4 blue

2.5 Status Indicators of the Isolators

LEDs are often used on isolators to indicate different statuses (e. g. for power supply, device failure, status messages, binary switching states). Standard LED colors are assigned to the status display according to NAMUR NE44.

LED	Display function	Display	Meaning
Green LED	Power supply	On	Power supply OK
		Off	No power supply or insufficient power supply – device faulty
Red LED	Device fault, device failure	On	Internal fault signal, failure signal – fault/failure display of causes detected inside the device, device needs replacing
	Line fault	Flashing	External fault signal, failure signal – fault/failure display of causes detected outside the device, inspection and elimination of fault required
	No fault	Off	No malfunction, device is operating properly
Yellow LED	Switching states of binary inputs and outputs	On	Possible causes of the output: • The relay is energized. • The NO contact (also a change-over contact) is actively closed. • The open collector is switched through. • The switching voltage generated inside the device is applied. Possible causes of the input: • A binary switching signal is present. • An analog limit value is reached.
		Off	Possible causes of the output: • The relay is de-energized. • The NO contact (also a change-over contact) is actively opened. • The open collector is not switched through. • The switching voltage generated inside the device is not applied. Possible causes of the input: • A binary switching signal is present. • An analog limit value is reached.

Table 2.1 Meaning of status indicators

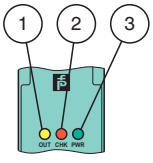


Figure 2.14 Example status indicators

1 Yellow LED "OUT"
Switching state of the output

2 Red LED "CHK"
Lead breakage and short circuit status indicator

3 Green LED "PWR"
Power supply status indicator

2021-03

2.6 Operating Elements

Many devices of the K-System can be adapted to different applications.
Depending on the device different operating elements are available for this configuration.

These operating elements are:

DIP switches

Via DIP switches you can configure the basic functions of the device.

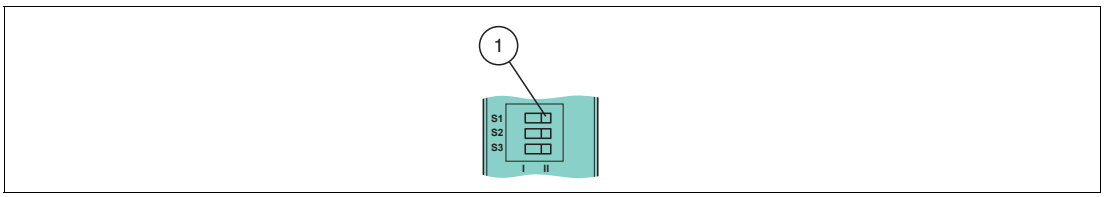


Figure 2.15

1 DIP switch

Rotary switches

Via rotary switches you can configure the basic functions of the device.

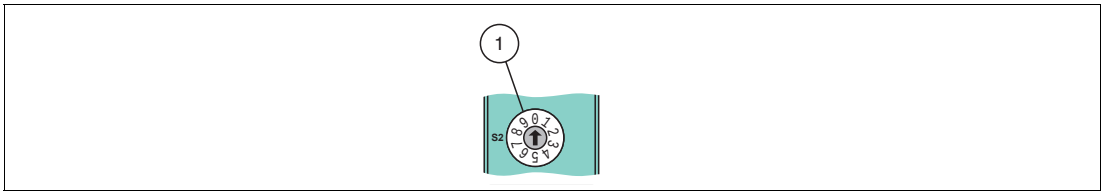


Figure 2.16

1 Rotary switch

Potentiometers

Via potentiometers you can configure the calibration of input and output characteristics.

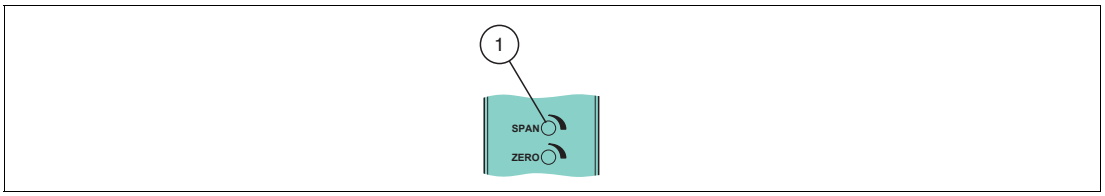


Figure 2.17

1 Potentiometer

Keypad and LC display

Via keypad you can configure the settings of the device parameters. Measured values, fault signals and configuration settings are displayed on the LC display.

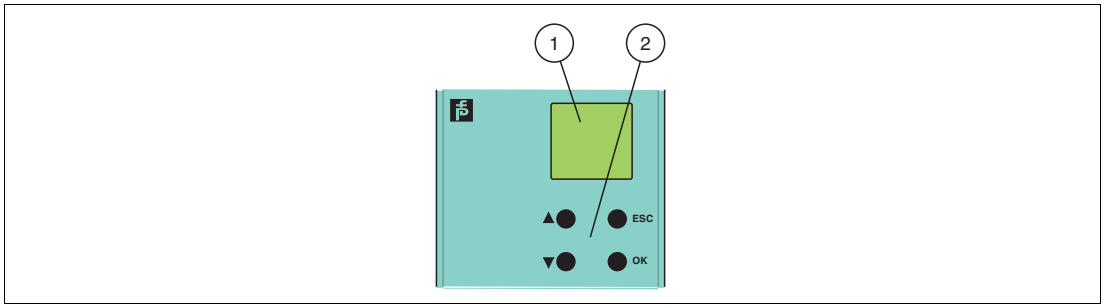


Figure 2.18

1 LC display
2 Keypad

Programming sockets for the connection of a PC with parameterization software PACTware™

Via parameterization software **PACTware™** you can configure the device easily. The configuration data can be edited and saved. The parameterization software helps users for maintenance, diagnostics and troubleshooting.

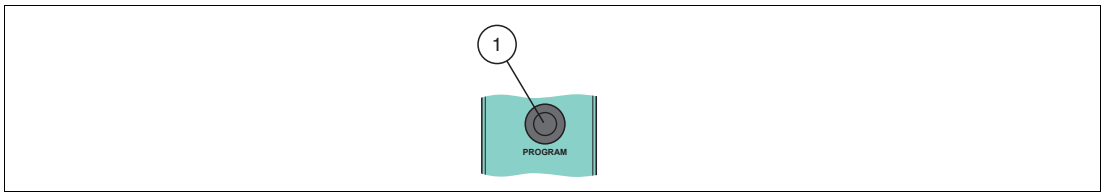


Figure 2.19

1 Programming socket

Note

See manual "HART Multiplexer System KFD*-HM*-16" for further information for communication via software.

Note

See corresponding datasheets for further information.

2.7 Label Carrier

For individual labeling, the isolated barriers are equipped ex works with a label carrier. Labels can be inserted into the label carrier.

It is also possible to attach an adhesive label to the transparent front flap.

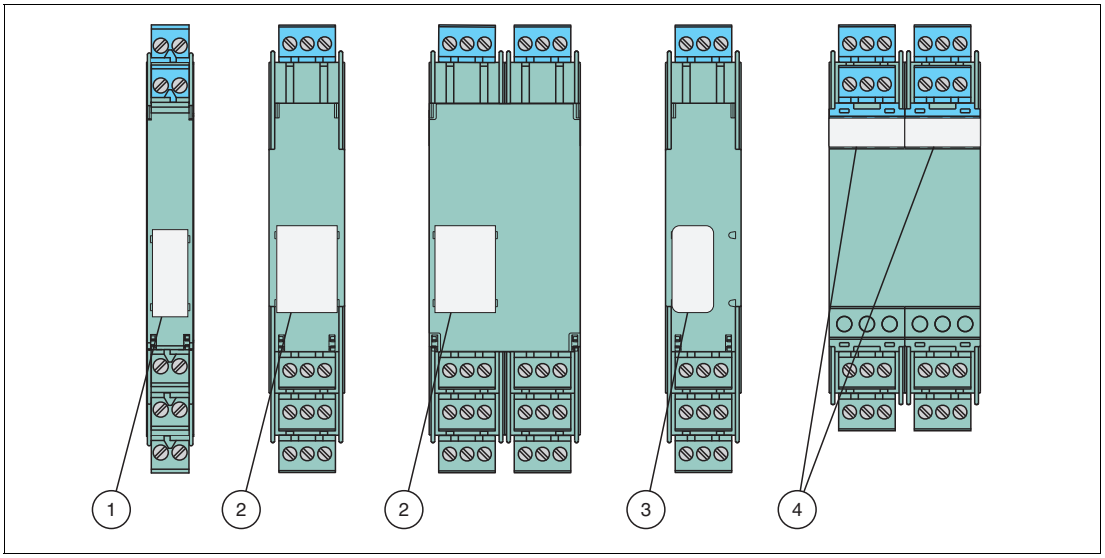


Figure 2.20 Devices with transparent front flap

1 Label carrier on KC devices with label 22 mm x 9 mm
2 Label carrier on KF devices for with 22 mm x 16.5 mm
3 Adhesive label 22 mm x 11 mm for all KC and KF devices, can only be used on devices with a transparent front flap
4 Label carrier on KF devices with label 18 mm x 8 mm, can only be used on devices without a transparent front flap

2.8 DIN Mounting Rail

The devices are mounted on a 35 mm DIN mounting rail according to EN 60715.

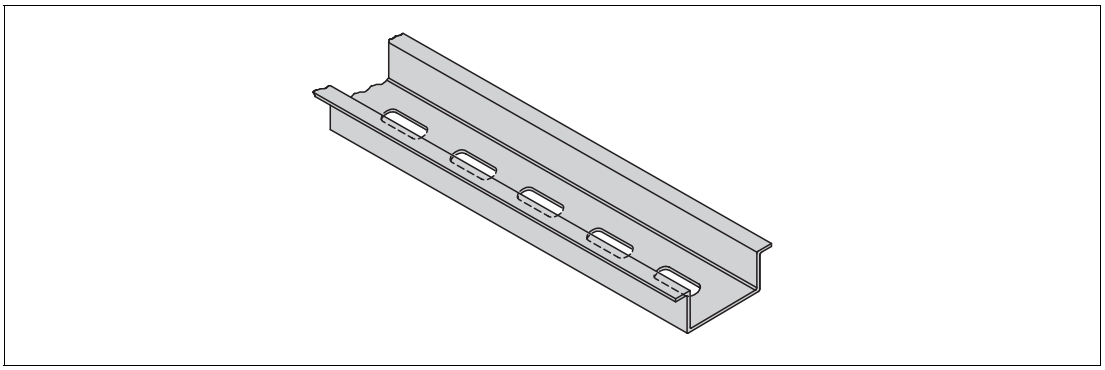


Figure 2.21 Example: DIN mounting rail UPR-MR (35 mm x 15 mm)

2.9 Power Rail

To reduce wiring and installation costs, Power Rail is the optimum solution. The Power Rail is a DIN mounting rail with plastic insert, that delivers power to the devices (24 V DC) and transfers bus signals and a collective error message.

The Power Rail is factory-equipped with cover and end caps. These parts cover empty and open segments of the Power Rail. Thus, the Power Rail is protected from contamination. Additionally the cover and end caps prevent that electrically conductive parts come in contact with the Power Rail.

Power Rail is available in two versions:

Power Rail UPR-03

The Power Rail UPR–03 has 3 conductors.

- 2 conductors for power
- 1 conductor for collective error messaging

Power Rail UPR-05 (only for KFD2-WAC2-(Ex)1.D)

The Power Rail UPR–05 has 5 conductors.

- 2 conductors for power
- 1 conductor for collective error messaging
- 2 conductors for serial data exchange

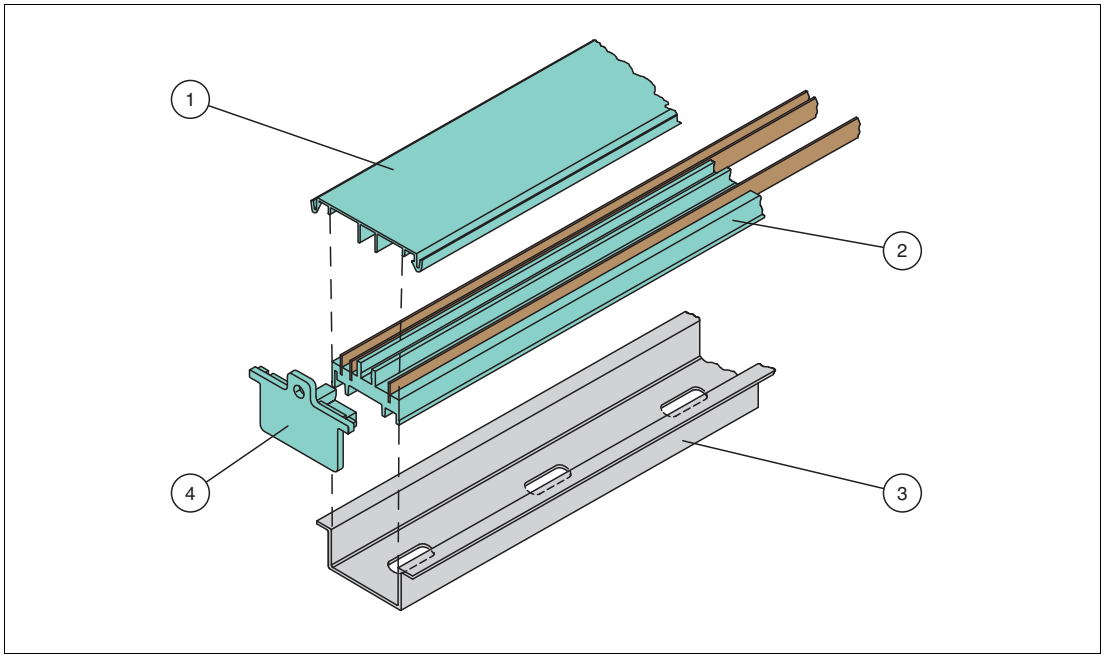


Figure 2.22 Example: Power Rail UPR-03

1 Cover UPR-COVER
2 Insert UPR-INS-03
3 DIN mounting rail UPR-MR (35 mm x 15 mm)
4 End cap UPR-E

3 Mounting and Installation

Danger!

Explosion hazard from damaged electronic components

Premature wear of electronic components in a device that was previously used in a general electrical installation can cause sparks that can ignite the surrounding potentially explosive atmosphere.

Never install devices that have already been operated in general electrical installations in electrical installations used in combination with hazardous areas!

Danger!

Explosion hazard from pollution

An excessively polluted surface of the device can become conductive and consequently ignite a surrounding potentially explosive atmosphere.

Ensure that you install the device only in environments with a pollution degree 2 or better according to IEC/EN 60664–1.

3.1 Mounting

Danger!

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

Only connect supplies that provide protection against electric shock to power feed modules (e. g. SELV or PELV).

Caution!

Property damage from use of isolators for Power Rail supply

Using the isolators for Power Rail supply can damage the isolators and make the Power Rail fail.

Do not supply the Power Rail via isolators.

Mounting in the Non-Hazardous Area

Mounting the Isolated Barrier

Snap the device onto the DIN mounting rail in a **vertical downward** movement.
See following figure.

Mounting in Areas that Require the Equipment Protection Level Gc

Danger!

Explosion hazard from live wiring of non-intrinsically safe circuits

If you connect or disconnect energized non-intrinsically safe circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized non-intrinsically safe circuits in the absence of a potentially explosive atmosphere.

Danger!

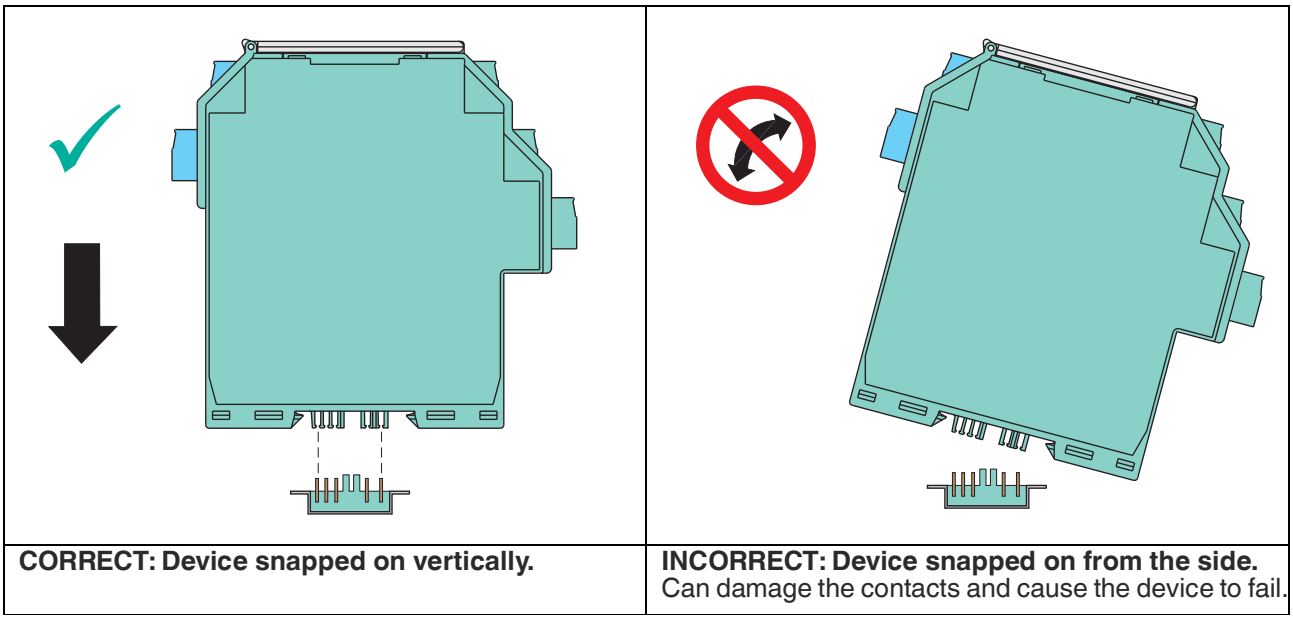
Explosion hazard from wrong mounting

The device safety can be impaired by external environmental influences and by mechanical stress. That can lead to sparking that can ignite a surrounding potentially explosive atmosphere.

Mount the device in a surrounding enclosure that complies with IEC/EN 60079–0 and that is rated with the degree of protection IP54 according to IEC/EN 60529.

Mounting the Isolated Barrier

Snap the device onto the DIN mounting rail in a **vertical downward** movement.
See following figure.



CORRECT: Device snapped on vertically.	INCORRECT: Device snapped on from the side. Can damage the contacts and cause the device to fail.

Figure 3.1

Vertical and horizontal mounting

Low heat dissipation allows vertical or horizontal mounting without separation distance. Operation is guaranteed over the full temperature range of the system in any mounting direction and without restriction.

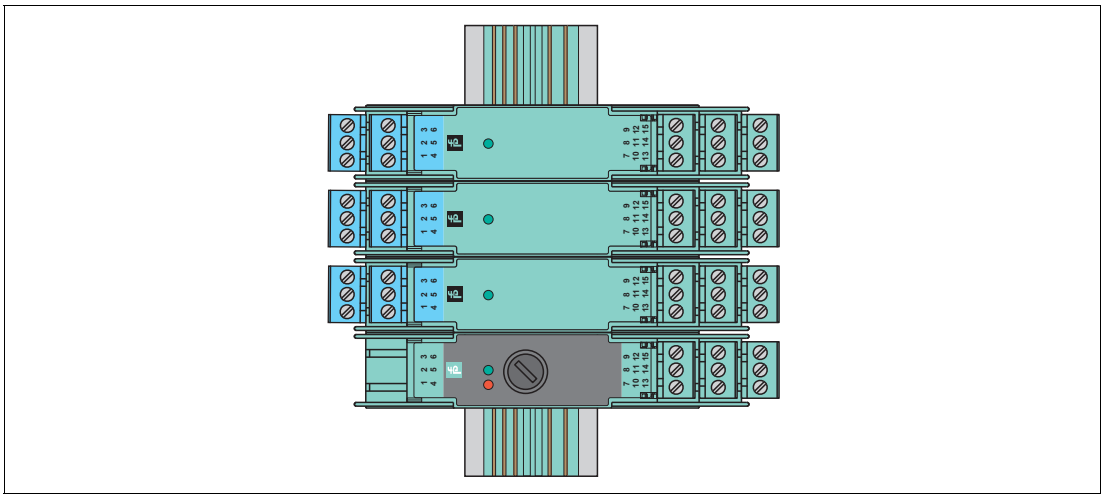


Figure 3.2 Vertical mounting without separation distance (group mounting)

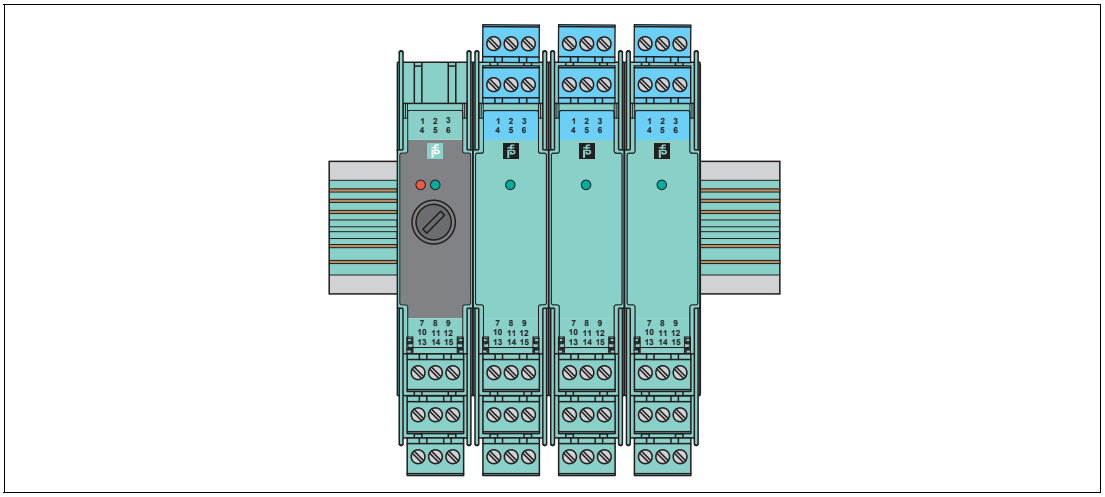


Figure 3.3 Horizontal mounting without separation distance (group mounting)

Mounting Conditions for Operating the Device at Higher Ambient Temperature

Certain devices with a maximum allowable ambient temperature of 60 °C (140 °F) can be operated at ambient temperatures up to 70 °C (158 °F) if mounted horizontally. These devices have a corresponding reference to this manual in the datasheet.

Caution!

Device failure due to overlooking heat dissipation

Overlooking heat dissipation can compromise the function and the electrical safety of the device.

- Mount the device on the DIN mounting rail in a horizontal mounting position.
- Mount the device on the DIN mounting rail according to the specified minimum separation distance.
- Do not operate devices without this reference in the datasheet at an ambient temperature up to 70 °C (158 °F).

Mounting the Isolated Barriers with Separation Distance

Mount the device on the DIN mounting rail. Observe the specified minimum separation distance.
See following figures.

- KC devices with 12.7 mm housing width, housing type A*: min. 6 mm
- KF devices with 20 mm housing width, housing type B*: min. 10 mm
- KF devices with 40 mm housing width, housing type C*: min. 15 mm

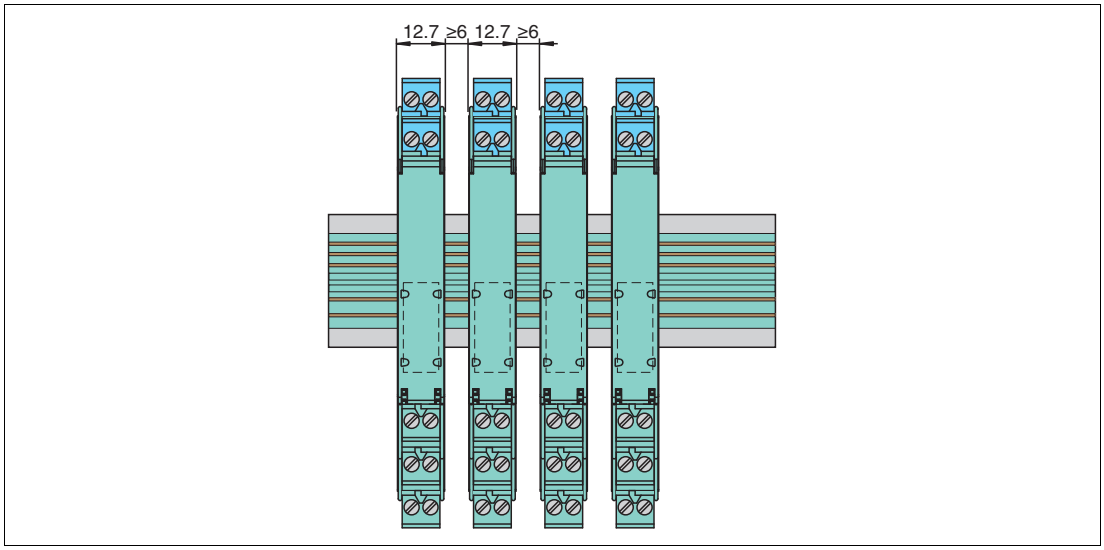


Figure 3.4 Horizontal mounting of KC devices with 12.7 mm housing width (single device mounting)

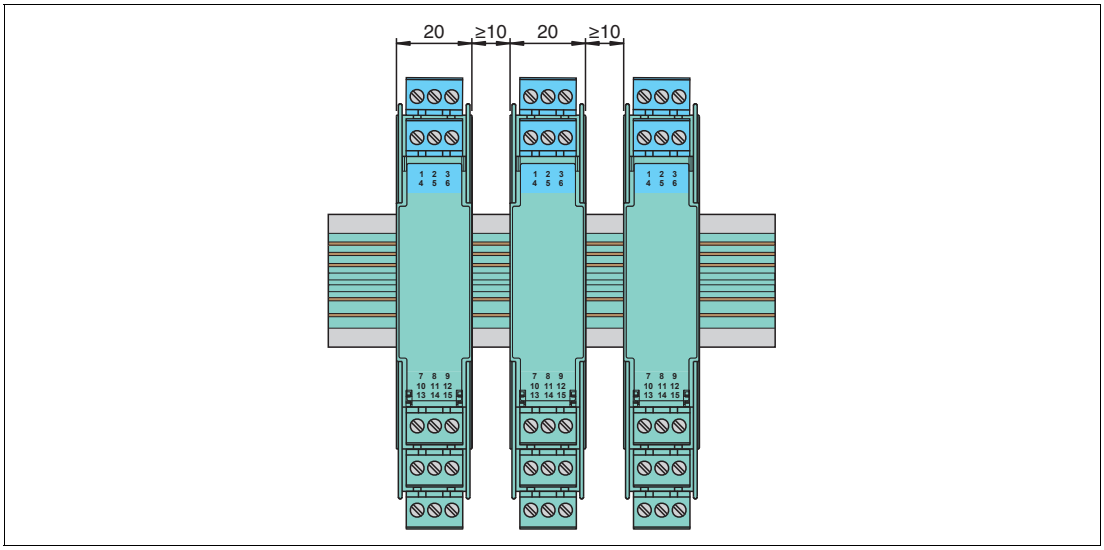


Figure 3.5 Horizontal mounting of KF devices with 20 mm housing width (single device mounting)

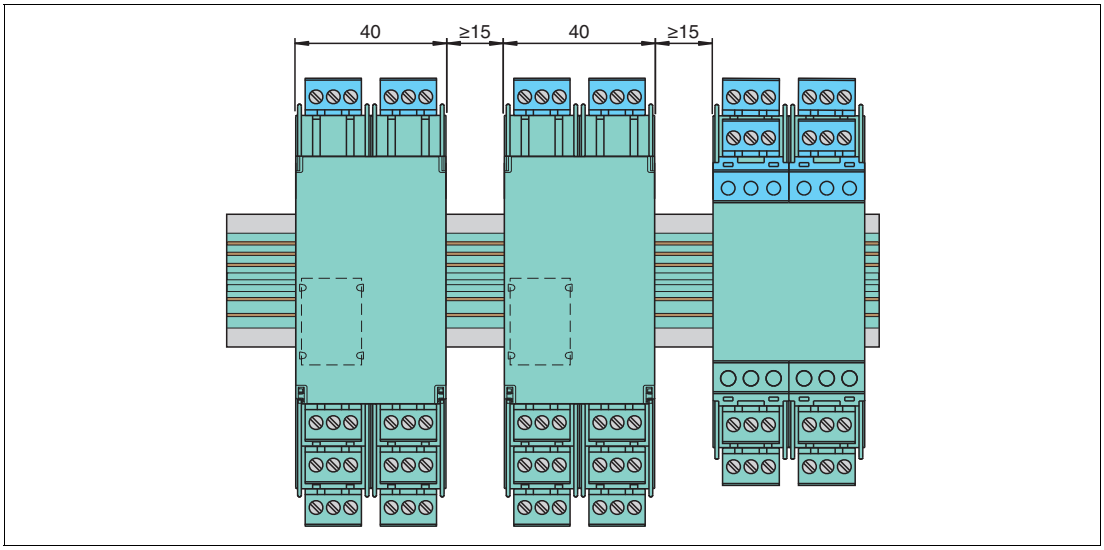


Figure 3.6 Horizontal mounting of KF devices with 40 mm housing width (single device mounting)

Mounting the Terminal Blocks

Danger!

Danger to life from electric shock

Working on live parts at voltages higher than 50 V AC or 120 V DC can result in electric shock.

1. De-energize the device.
2. Secure the circuit against reconnection.
3. Verify that the device is de-energized at all poles.
4. Provide protection from adjacent live parts, if present.

1. Switch off the voltage.
2. Connect the terminal blocks or disconnect the terminal blocks.

3.2 Connection

Danger!

Explosion hazard from live wiring of non-intrinsically safe circuits

If you connect or disconnect energized non-intrinsically safe circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized non-intrinsically safe circuits in the absence of a potentially explosive atmosphere.

Danger!

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

- Maintain sufficient distance between the connection lines, terminals, surrounding enclosure, and the environment.
- Insulate connection lines, terminals, and the surrounding enclosure from the environment.

Danger!

Danger to life from incorrect installation

Incorrect installation of cables and connection lines can compromise the function and the electrical safety of the device.

- Observe the permissible core cross section of the conductor.
- When using stranded conductors, crimp wire end ferrules on the conductor ends.
- Use only one conductor per terminal.
- When installing the conductors the insulation must reach up to the terminal.
- Observe the tightening torque of the terminal screws.

Danger!

Explosion hazard from exposed conductors

Exposed conductors of inadequately attached cables can cause sparks that can ignite the surrounding potentially explosive atmosphere.

When installing the device ensure that the cables are adequately attached.

Caution!

Property damage from use of inappropriate tool

Using an inappropriate tool may damage the screw heads.

- Use a slot-head screwdriver with a size of 3.5 x 0.5.
- Observe the tightening torque of the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm.

Note

See corresponding datasheets for further information.

3.2.1 Field Side Connection

Danger!

Explosion hazard from wrong separation distances

If you do not observe the minimum separation distance between 2 intrinsically safe circuits, this can lead to added currents or voltages. This can result in a current/voltage flashover generating sparks. The sparks can ignite the surrounding potentially explosive atmosphere.

Ensure that you observe all separation distances between 2 adjacent intrinsically safe circuits according to IEC/EN 60079-14.

Danger!

Explosion hazard from wrong separation distances

If you do not observe the minimum separation distances between intrinsically safe circuits of associated apparatus and non-intrinsically safe circuits, this can lead to added currents or voltages. This can result in a current/voltage flashover generating sparks.
The sparks can ignite the surrounding potentially explosive atmosphere.

Ensure that you observe the compliance of the separation distances to all non–intrinsically safe circuits according to IEC/EN 60079–14.

Connecting the Field Side

Connect the field devices via the screw terminals or spring terminals.

3.2.2 Control Side Connection

Connection of Devices with Relay Output

Danger!
Danger to life from electric shock
Working on live parts at voltages higher than 50 V AC or 120 V DC can result in electric shock.

1. De-energize the device.
2. Secure the circuit against reconnection.
3. Verify that the device is de-energized at all poles.
4. Provide protection from adjacent live parts, if present.

Warning!
Risk of short circuit
Live working can cause injuries to the operator and/or damage to the device.
Disconnect the device, before you plug or unplug the plugs.

Connection of other Devices

Danger!
Danger to life from electric shock
Absent or insufficient insulation can result in electric shock.
Only connect circuits that provide protection against electric shock (e. g. SELV or PELV).

Warning!
Risk of short circuit
Live working can cause injuries to the operator and/or damage to the device.
Disconnect the device, before you plug or unplug the plugs.

Connecting the Control Side

Connect the control system via the screw terminals or spring terminals.

3.2.3 Power Supply Connection

The devices are available with different supply voltages.

- 24 V DC power supply
- 115 V AC or 230 V AC power supply for applications where direct current is not available
- AC/DC wide range supply with 24 V DC or 115/230 V AC

Note

The supported supply voltage for each device is identified on the side plate.

The devices are supplied with power in various ways.

- Power supply without Power Rail, see chapter 3.2.3.1
- Power supply with Power Rail, see chapter 3.2.3.2
  - Non-redundant supply with power feed module
  - Redundant supply with power feed module
  - Direct supply with power supply

3.2.3.1 Power Supply without Power Rail

If devices with AC or universal power supplies are used, the advantages of Power Rail are not available.

Conventional power supplies create complicated and expensive wiring systems.
After all isolated barriers are connected, there is a significant amount of wiring and more wiring must be added for extra functions such as line fault detection.

Connection of KCD and KFD Devices

Danger!

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

Only connect supplies that provide protection against electric shock (e. g. SELV or PELV).

Connection of KFA, KFU, and KHA Devices

Danger!

Danger to life from electric shock

Working on live parts at voltages higher than 50 V AC or 120 V DC can result in electric shock.

1. De-energize the device.
2. Secure the circuit against reconnection.
3. Verify that the device is de-energized at all poles.
4. Provide protection from adjacent live parts, if present.

Connecting the Power Supply

Connect the power supply via the screw terminals or spring terminals.

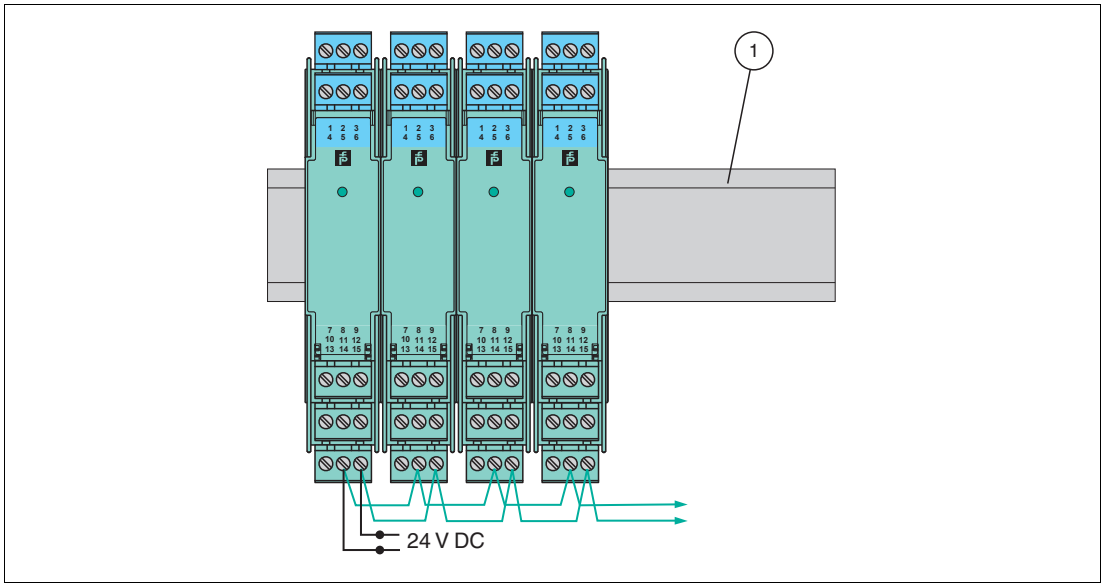


Figure 3.7 Conventional installation

1 DIN mounting rail

3.2.3.2 Power Supply with Power Rail

For devices with a 24 V DC supply voltage, use of the Power Rail reduces wiring and installation costs. The Power Rail almost completely eliminates the risk of wiring faults and facilitates expansion.

Power is supplied to the Power Rail via a power feed module which provides a voltage of 24 V DC (max. 4 A) to a maximum of 80 devices.

The power feed module features a replaceable 5 A fuse at the front. This fuse ensures that the Power Rail and connecting contacts are protected. It prevents damage caused by reverse supply voltage or by installing too many isolators. The isolators on the Power Rail feature integrated device fuses. Any faults in the isolator or in the signal leads do not affect the Power Rail supply system. The 5 A fuse permits a rated current of up to 4 A across the entire temperature range.

The power feed module also has the task of outputting a collective error message or power failure of the isolators via a separate relay output.

Alternatively, supply of the Power Rail can be provided using the power supply KFA6-STR-1.24.*. In this case, no collective error message is possible.

Supply with Power Feed Module

Danger!

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

Only connect supplies that provide protection against electric shock to power feed modules (e. g. SELV or PELV).

Caution!

Property damage from use of isolators for Power Rail supply

Using the isolators for Power Rail supply can damage the isolators and make the Power Rail fail.

Do not supply the Power Rail via isolators.

Connecting the Power Supply

Connect the power supply via the Power Rail.

Non-Redundant Supply

The power feed module mounts on the Power Rail for easy and reliable distribution of power to all connected isolators. This method eliminates the wiring loops (daisy chain) necessary on a conventional installation without Power Rail.

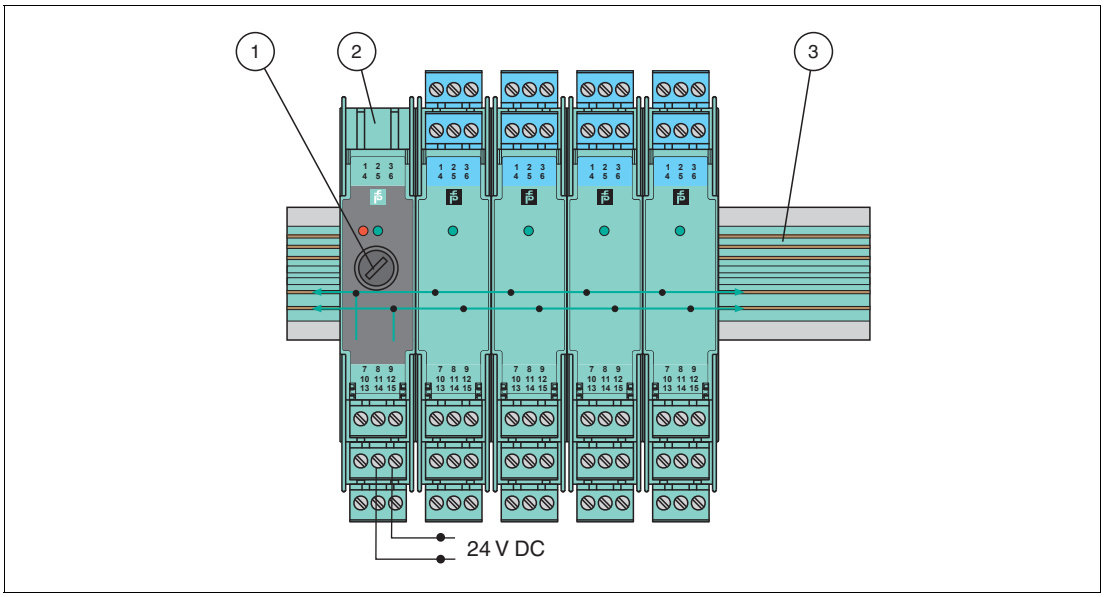


Figure 3.8 Power Rail installation

1 Replaceable fuse
2 Power feed module
3 Power Rail

Redundant Supply

Two power supplies or a redundant power supply with two power feed modules offer a high degree of availability. If a power supply or the fuse in a power feed module fails, the redundant supply continues to energize the isolators through their Power Rail connection.

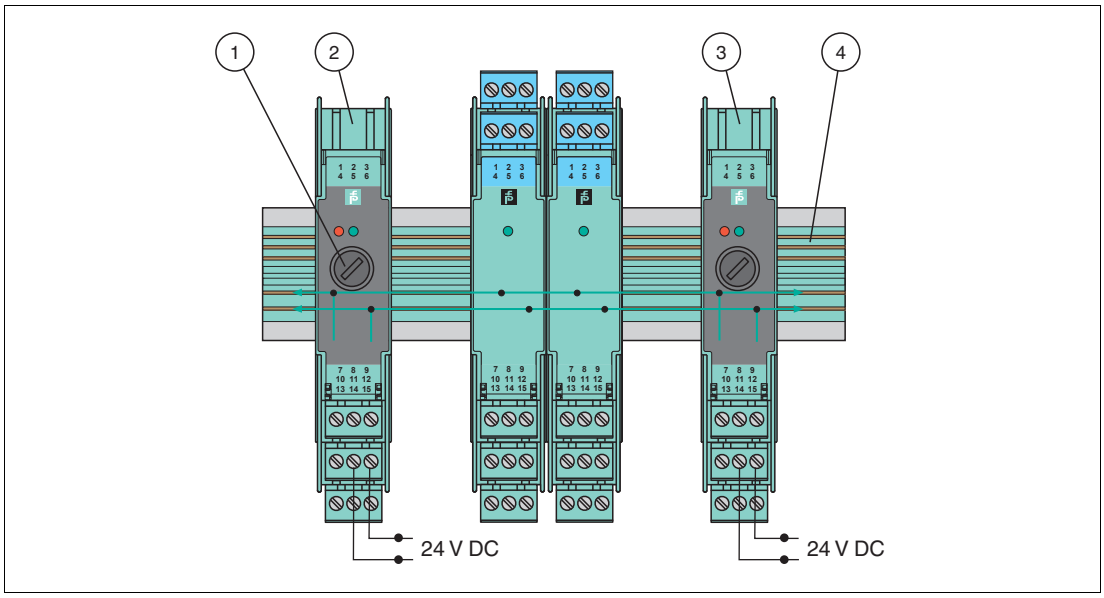


Figure 3.9 Redundant power connections

1 Replaceable fuse
2 Power feed module 1
3 Power feed module 2
4 Power Rail

Direct Supply with Power Supply

A complete power solution for a K-System installation is possible by using the following power supplies:

- KFA6-STR-1.24.4 from 115/230 V AC to 24 V DC/4 A or
- KFA6-STR-1.24.500 from 115/230 V AC to 24 V DC/500 mA

The power supplies snap on the Power Rail to easily and efficiently distribute power to the isolated barriers.

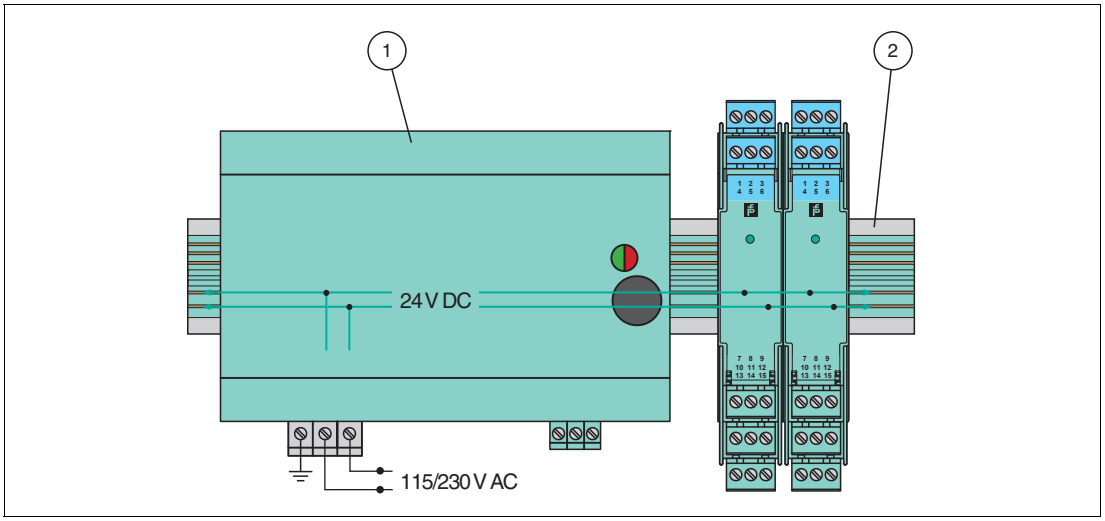


Figure 3.10 Integrated power supply (4 A)

1 Power supply
2 Power Rail

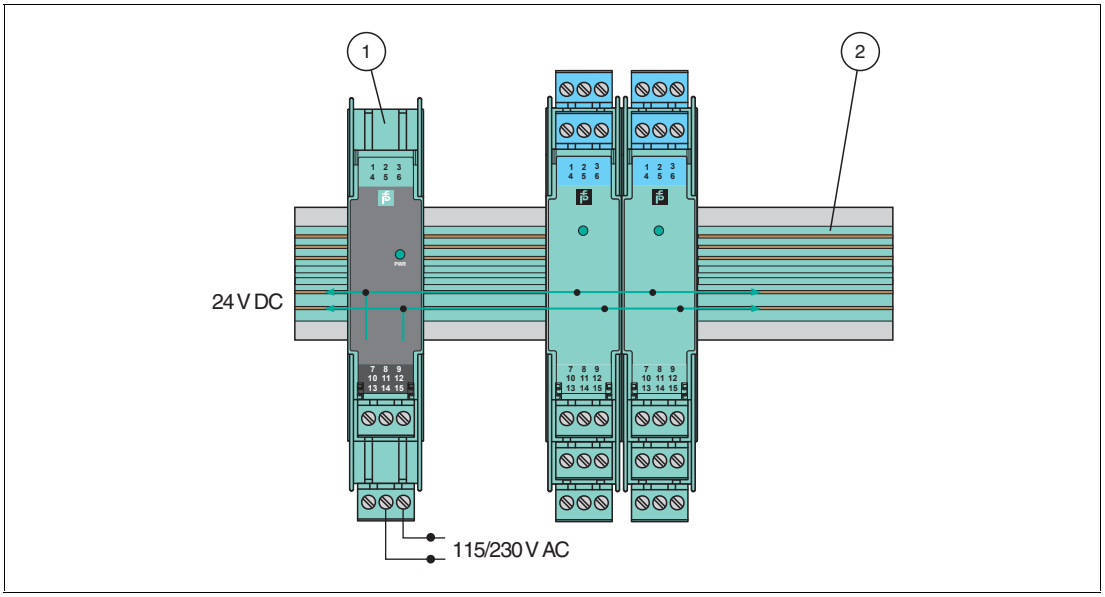


Figure 3.11 Integrated power supply (500 mA)

1 Power supply
2 Power Rail

3.2.4 Establishing the Communication via Software

Danger!

Explosion hazard from sparking when plugging or pulling the adapter

Plugging or pulling the adapter in a potentially explosive atmosphere can cause sparks that can ignite the surrounding atmosphere.

Only plug or pull the adapter in the absence of a potentially explosive atmosphere.

Caution!

Fault in the plant

Changing the device data changes the device function.

Before entering new device data, make sure the plant is not endangered by changing the device data.

Establishing the Communication via Software

Establish the HART communication via K-ADP-USB adapter and HART multiplexer on the control side, if available.

Note

See manual "HART Multiplexer System KFD*-HM*-16" for further information for communication via software.

4 Configuration

Danger!

Explosion hazard from sparking when using operating elements

Using operating elements in a potentially explosive atmosphere can cause sparks that can ignite the surrounding atmosphere.

Only use operating elements (e. g., switch, slider, button, etc.) in the absence of a potentially explosive atmosphere.

Caution!

Potential device malfunction from change of device function

Changes in the device function can lead to device malfunction. The function of the device is no longer guaranteed.

Before transferring the new device function, make sure that the changed device function does not cause a danger to the device and the plant.

Configuring the Device

Set the particular operating elements as described in section "Configuration" of the data sheet.

Note

See corresponding datasheets for further information.

5 Operation

Danger!

Explosion hazard from live wiring of non-intrinsically safe circuits

If you connect or disconnect energized non-intrinsically safe circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized non-intrinsically safe circuits in the absence of a potentially explosive atmosphere.

Danger!

Explosion hazard from sparking when using operating elements

Using operating elements in a potentially explosive atmosphere can cause sparks that can ignite the surrounding atmosphere.

Only use operating elements (e. g., switch, slider, button, etc.) in the absence of a potentially explosive atmosphere.

5.1 Fault Monitoring

Numerous faults can occur between measurement of the process variable and evaluation in the control system. This can lead to undesirable process statuses under certain circumstances. These process statuses may result in plant downtime or quality problems or even present a hazard to persons and the environment. Depending on the device version, the isolators enable monitoring of the following faults:

- Line faults
  Here, the connection cables between the isolator, the field device and the control system are monitored for lead breakages or short circuits.
- Device faults
  The isolators are designed so that internal faults are detected and reported.
  In the case of a power failure, the outputs are switched to the de-energized state.

5.2 Fault Output

Depending on the configuration of the devices, these faults are transmitted to the outputs at the control side and in separate fault indication outputs as additional information.

- Red fault indication LEDs on the isolator
- Fault indication output
- Collective error message on Power Rail

Fault Indication Output

Line and device faults are transmitted if the device has a fault indication output (FAULT). The fault indication output is active in a normal state and inactive in a fault state (closed-circuit principle). Is it impossible to reverse the detection direction of the fault indication output.

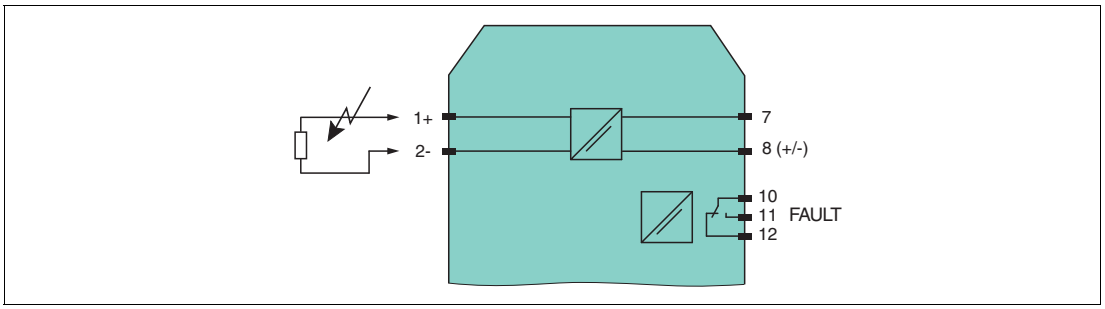


Figure 5.1

Line Fault Transparency (LFT)

Line fault transparency makes electrical conditions on the field side visible on the control side of the isolator. This enables line faults between the isolator and the field device to be detected and transmitted to the control system via the signal line.

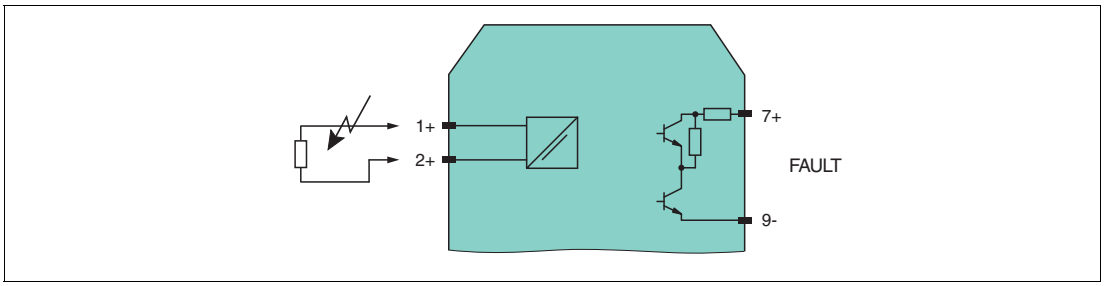


Figure 5.2 Example of line fault transparency with digital input

Collective Error Message on Power Rail

The fault can also be output via the Power Rail as a collective error message (FAULT).

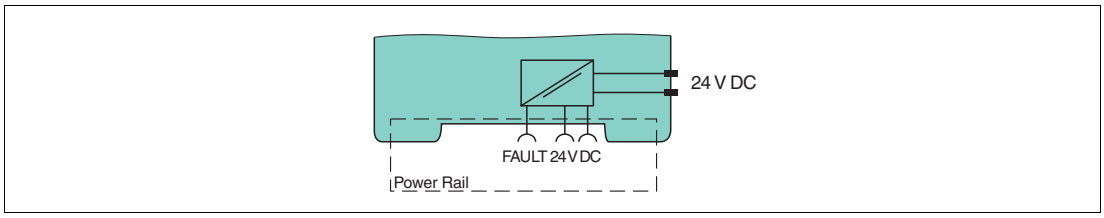


Figure 5.3

The collective error message enables line fault detection of many isolators without requiring additional wiring. In the event of a fault, a fault message signal is transmitted to the Power Rail from an isolator. The power feed module evaluates the signal and transmits the fault message signal to the controller by means of a potential-free contact.

The potential-free contact simultaneously reports the device power failure or the failure of one device minimum.

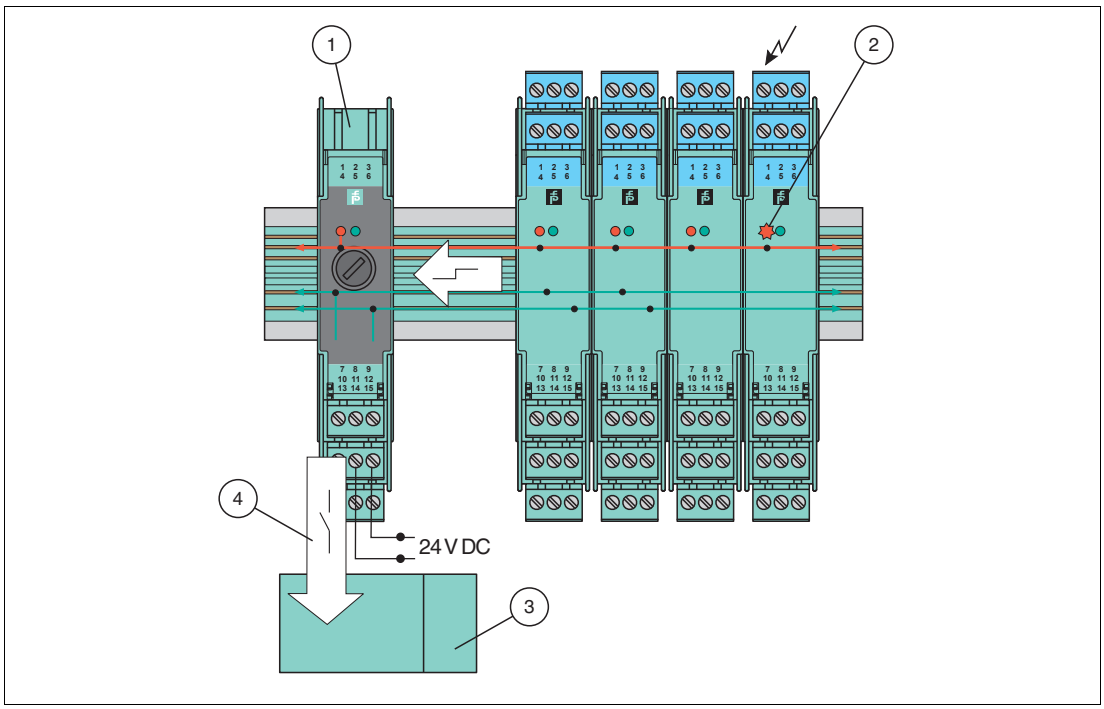


Figure 5.4 Collective error message via power feed module

1 Power feed module
2 Fault indication on one of the devices (red LED flashes)
3 Process control system
4 Fault indication output

5.3 Current and Voltage Standard Signals

The following signals have established themselves as the standard:

- the 0/4 mA to 20 mA current signal
- the 0/2 V to 10 V voltage signal
- the 0/1 V to 5 V voltage signal

Analog sensor signals and digital frequency signals are converted into one of the two standard signals for processing in a wide variety of measurement, regulatory and control tasks. This offers the measurement and control technician an easy-to-measure standard signal common to all manufacturers. Sensor signals are converted into standard signals via signal converters.

For more diagnostic options, the NAMUR organization published NAMUR recommendation NE43, dividing the value range of the signal (e. g. current signal) into several areas. Valid, defined measurement value information is transferred within the range from 3.8 mA to 20.5 mA. Failure information is available when the signal current is < 3.6 mA or > 21 mA i. e. outside of the range for measured value information. The same applies to the voltage signal.

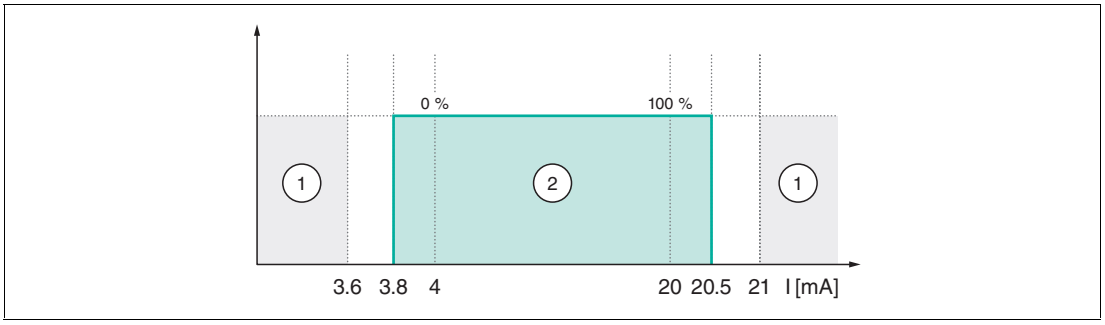


Figure 5.5 Signal ranges according to NAMUR NE43 (e. g. current signal)

1 Failure information
2 Measuring information

6 Dismounting, Maintenance, and Repair

Danger!

Explosion hazard from live wiring of non-intrinsically safe circuits

If you connect or disconnect energized non-intrinsically safe circuits in a potentially explosive atmosphere, sparks can ignite the surrounding atmosphere.

Only connect or disconnect energized non-intrinsically safe circuits in the absence of a potentially explosive atmosphere.

Danger!

Danger to life from using damaged or repaired devices.

Using a defective or repaired device can compromise its function and its electrical safety.

- Do not use a damaged or polluted device.
- The device must not be repaired, changed or manipulated.
- If there is a defect, always replace the device with an original device from Pepperl+Fuchs.

Danger!

Danger to life from electric shock

Working on live parts at voltages higher than 50 V AC or 120 V DC can result in electric shock.

1. De-energize the device.
2. Secure the circuit against reconnection.
3. Verify that the device is de-energized at all poles.
4. Provide protection from adjacent live parts, if present.

Disconnecting Circuits

1. Disconnect the power supply.
2. Disconnect the field circuit.
3. Disconnect the control circuit.
4. Disconnect the HART communication, if available.

6.1 Dismounting the Isolated Barrier

Dismounting the Isolated Barrier

Use for dismounting of the device a slotted screwdriver

1. Insert the screwdriver (4) into the groove of the red mounting slider (3).
2. Turn the screwdriver (4) in the groove until the red mounting slider (3) springs back.
3. Repeat these steps on the other side of the device.
4. Remove the isolator (2) from the DIN mounting rail (1).

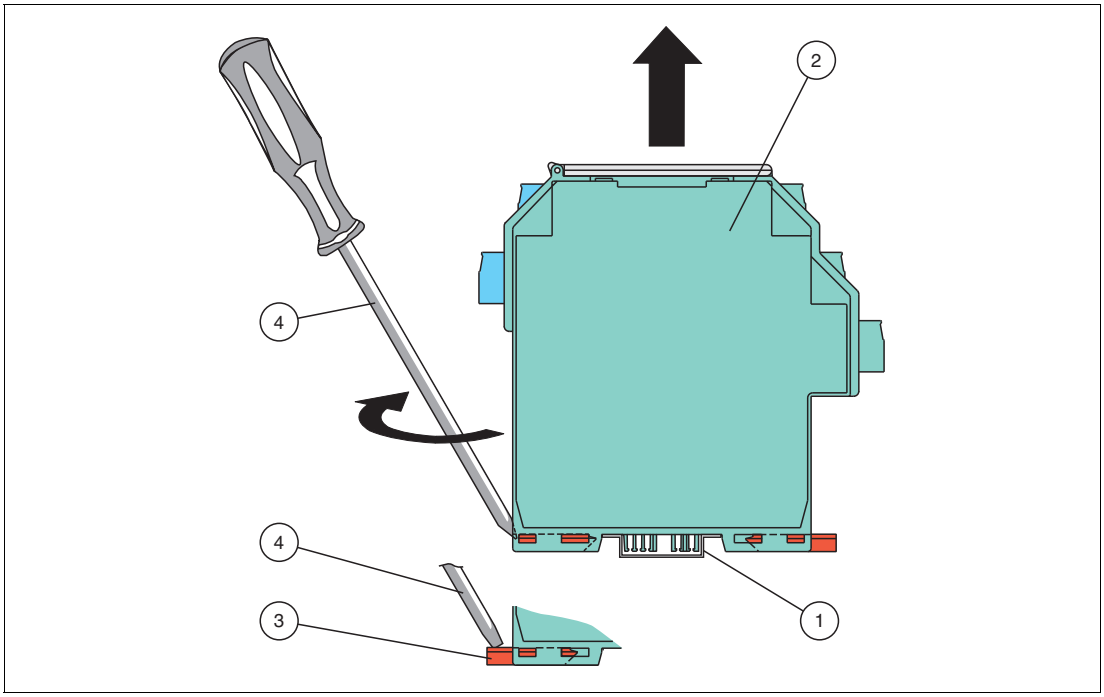


Figure 6.1 Dismounting of the isolated barrier from the DIN mounting rail

1 35 mm DIN mounting rail
2 Isolated barrier
3 Mounting slider
4 Slotted screwdriver

7 Technical Specifications

7.1 Technical Data

Electrical Data

Non-Hazardous Area Signals or Control Circuit Signals

- 0/4 mA to 20 mA signal level according to NE 43
- 0/2 V to 10 V signal level according to NE 43
- 0/1 V to 5 V signal level according to NE 43
- Current output HART compatible
- Current input HART compatible
- Digital output: active or passive electronic output 100 mA/30 V, short-circuit protected
- Relay output 2 A, minimum load 1 mA/24 V
- Logic level 24 V according to IEC 60946
- Functional isolation or safe isolation according to IEC 61140 and NAMUR NE 23

Hazardous Area Signals or Signals in the Field Circuit

- Transmitter power supply up to 17 V DC
- Current output HART compatible
- Pt100, 2-, 3-, (4)-wire technology
- Resistor 0 Ω to 400 Ω with freely definable characteristic
- Potentiometer
- Thermocouples of all types, internal cold junction, external reference
- Current output HART compatible
- Digital input according to NAMUR EN 60947-5-6
- Digital output for standard Ex-i valves, short-circuit protected

Characteristic Safety Values

- MTBF: **M**ean **T**ime **B**etween **F**ailures

Conformity

General

- Isolators with and without explosion protection, mostly with Ex ia IIC/Class I Div. 1, international approvals
- EMV according to
  - EN 61326-1
  - EN 61326-3-2, only for devices with SIL rating, where the data sheet mentions this standard.
    If you operate the device with a DC supply voltage, you must ensure that the bridging of the 20 ms voltage interruption is realized by the power supply.
  - NAMUR NE 21
    If you operate the device with a DC supply voltage, you must ensure that the bridging of the 20 ms voltage interruption is realized by the power supply.

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- LEDs according to NAMUR NE 44
- Software according to NAMUR NE 53
- Switch-on pulse suppression
- K*D2 devices:
  - Supply voltage 20 V DC to 30 V DC via Power Rail or supply terminals
  - Collective error message via Power Rail
- K*A devices:
  - Supply voltage 115 V/230 V AC, details see datasheet
- K*U devices:
  - Supply voltage 24 V DC or 115/230 V AC, details see datasheet
- Safety devices according to VDE 0660, part 209, AK according to DIN 19250

Digital Inputs and Outputs according to NAMUR

- IEC/EN 60947-5-6: Low voltage switch gear and control gear – part 5 and 6: Control devices and switching elements – DC interface for proximity sensors and switch amplifiers (NAMUR), 1999

Ambient Conditions

Ambient Temperature

- -20 °C to 60 °C (-4 °F to 140 °F), exceptions see data sheets
- extended ambient temperature range up to 70 °C (158 °F), necessary mounting conditions see chapter 3.1

Storage Temperature

- -40 °C to 90 °C (-40 °F to 194 °F), exceptions see data sheets

Reference Conditions for Adjustment

- 20 °C (68 °F)

Relative Humidity

- max. 95 % without moisture condensation

Vibration Resistance

- according to EN 60068-2-6, 10 Hz to 150 Hz, 1 g, high crossover frequency

Shock Resistance

- according to EN 60068-2-27, 15 g, 11 ms, half-sine

Mechanical Specifications

Mounting

- Snap-on 35 mm DIN mounting rail according to EN 60715. Can be mounted horizontally or vertically, side by side.
- Panel mount: The lugs on the base of the isolator must be extended and used for mounting purposes with 3 mm screws.
- K-MS mounting base for screw attachment

Housing Material

- Polycarbonate (PC)

Dimensions

- Dimension drawings please refer to chapter Dimensions.

Protection Degree

- IP20 according to EN 60529

Connection

- KH* devices: self-opening terminals for max. core diameter of 1 x 2.5 mm^2 (14 AWG)
- KF* and KC* devices: removable connector with integrated self opening terminals for leads of up to a max. of 1 x 2.5 mm^2 (14 AWG)
- Observe the tightening torque of the terminal screws. The tightening torque is 0.5 Nm to 0.6 Nm.

Fire Protection Class

- Housing: V2 according to UL 94 standard. Unless stated otherwise all details relate to the reference conditions.

Labeling

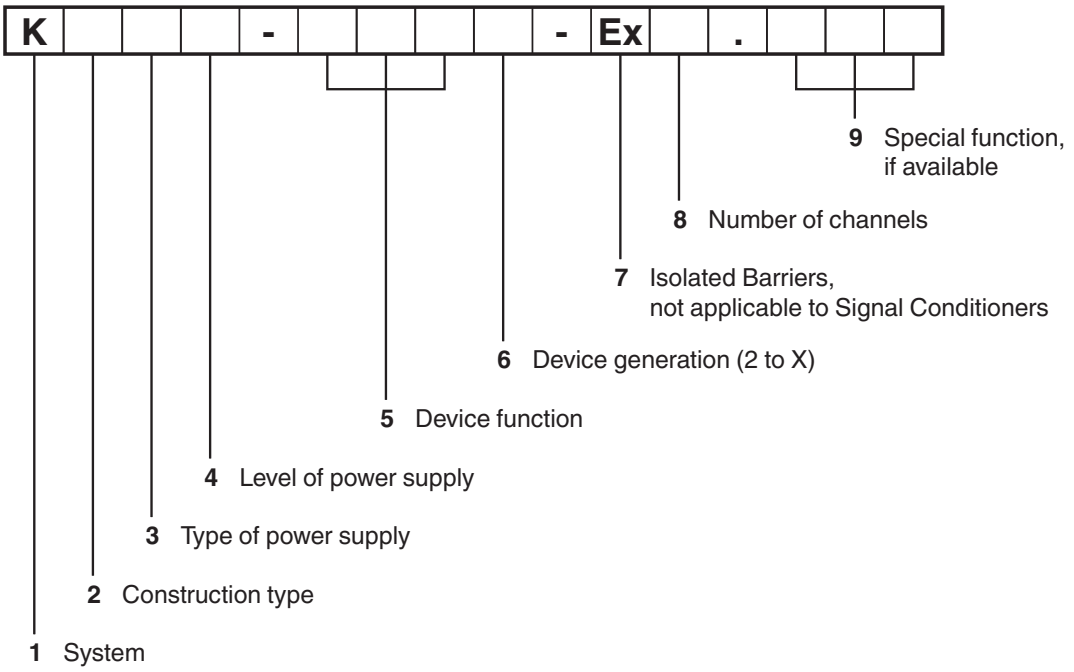
Place for labeling on the front side:

- KC devices (12.5 mm): label 22 mm x 9 mm
- KF devices (20 mm and 40 mm): label 22 mm x 16.5 mm
- All KC and KF devices: adhesive label 22 mm x 11, can only be used on devices with a transparent front flap
- KF devices: label 18 mm x 8 mm, can only be used on devices without a transparent front flap

Note

See corresponding datasheets for further information.

7.2 Model Number Description



Position 1	K	K-System
Position 2	C	Version with removable terminal blocks, 12.5 mm width
	F	Version with removable terminal blocks, 20 mm or 40 mm width
	H	Version without removable terminal blocks, 20 mm or 40 mm width
Position 3	D	DC power supply
	A	AC power supply
	U	AC/DC power supply
Position 4	0	without power supply
	2	24 V
	4	100 V
	5	115 V
	6	230 V
	8	24 V DC or 115/230 V AC
Position 5	CC	Converter for current/voltage
	CD	Active current driver
	CR	Transmitter power supply, current output
	CRG	Transmitter power supply with trip value
	CS	Passive current driver
	DU	Switch amplifier, time relay
	DWB	Overspeed/underspeed monitor, logic control unit
	EB	Power feed module
	ELD	Ground fault detection
	ER	Conductivity switch amplifier
	FF	RS 232 repeater

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Position 5	GS	Trip amplifier for current/voltage
	GU	Universal trip amplifier
	GUT	Temperature converter with trip value
	HLC	HART Loop Converter
	HMM	HART Multiplexer Master
	HMS	HART Multiplexer Slave
	LGH	Place holder isolator
	PT	Potentiometer converter
	RC	Converter for resistors
	RCI	Solenoid driver
	RO	Relay module
	RR	Thermometer resistance repeater
	RSH	Relay module in fail-safe technology
	SCD	SMART current driver
	SCS	SMART current driver/repeater
	SD	Solenoid driver, loop powered
	SH	Switch amplifier in fail-safe technology
	SL	Solenoid driver, bus powered
	SLD	Solenoid driver, bus and loop powered
	SON	Switch amplifier with NAMUR output
	SOT	Switch amplifier with passive, potential free transistor output
	SR	Switch amplifier with relay output
	SRA	Switch amplifier with relay output, 2:1 operation mode
	SRT	Switch amplifier with active transistor and relay output
	ST	Switch amplifier with active transistor output
	STC	SMART transmitter power supply with current output
	STR	Power supply
	STV	SMART transmitter power supply with voltage output
	TR	RTD converter
	TT	Converter for thermocouple/mV signal
	UFC	Universal frequency converter
	UFT	Frequency converter with direction and synchronization monitoring
	USC	Universal signal converter with trip value
	UT	Universal temperature converter
	VC	Converter for current/voltage
	VCR	Transmitter power supply, repeater for current/voltage
	VD	Solenoid driver
	VM	Solenoid driver
	VR	Voltage repeater
	WAC	Strain gauge converter

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7.3 Dimensions

7.3.1 Housing Types Isolated Barriers K-System

Housing Type A2

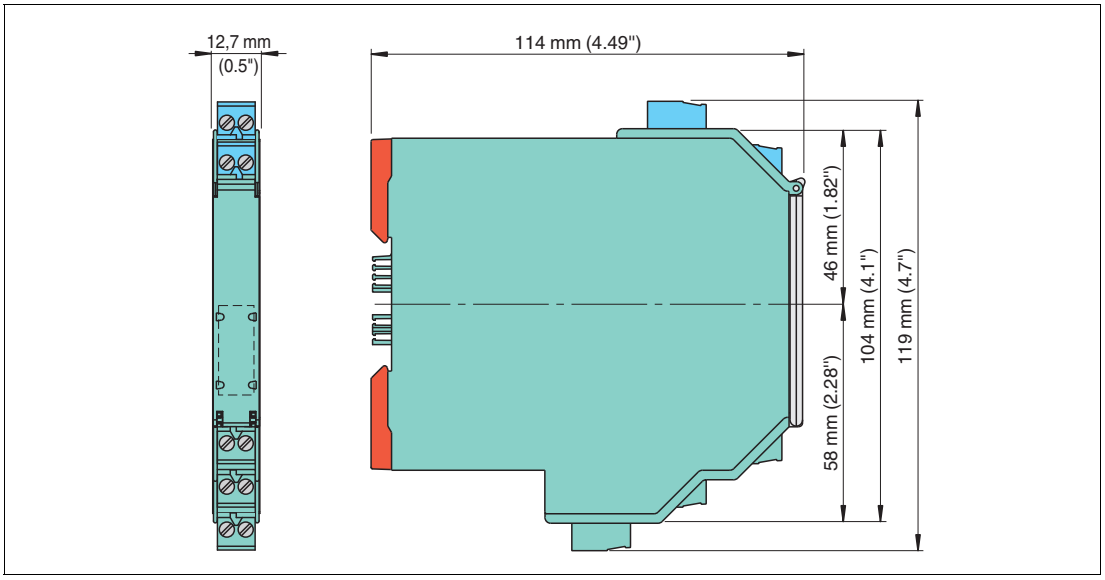

Figure 7.1

Number of terminal blocks max. 5

- Dimension drawing with screw terminals
- When using screw terminals with test sockets the device is 124 mm (4.9 in) in height.
- When using spring terminals the device is 131 mm (5.16 in) in height.

Housing Type B1

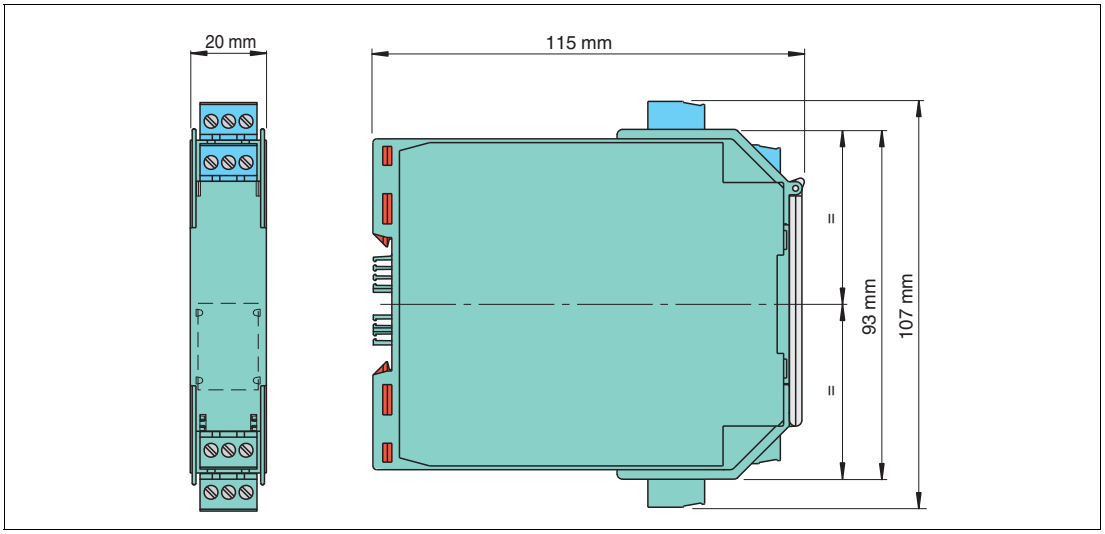

Figure 7.2

Number of terminal blocks maximum 4

- Dimension drawing with screw terminals
- When using screw terminals with test sockets the device is 115 mm (4.6 in) in height.
- When using spring terminals the device is 122 mm (4.8 in) in height.

Housing Type B2

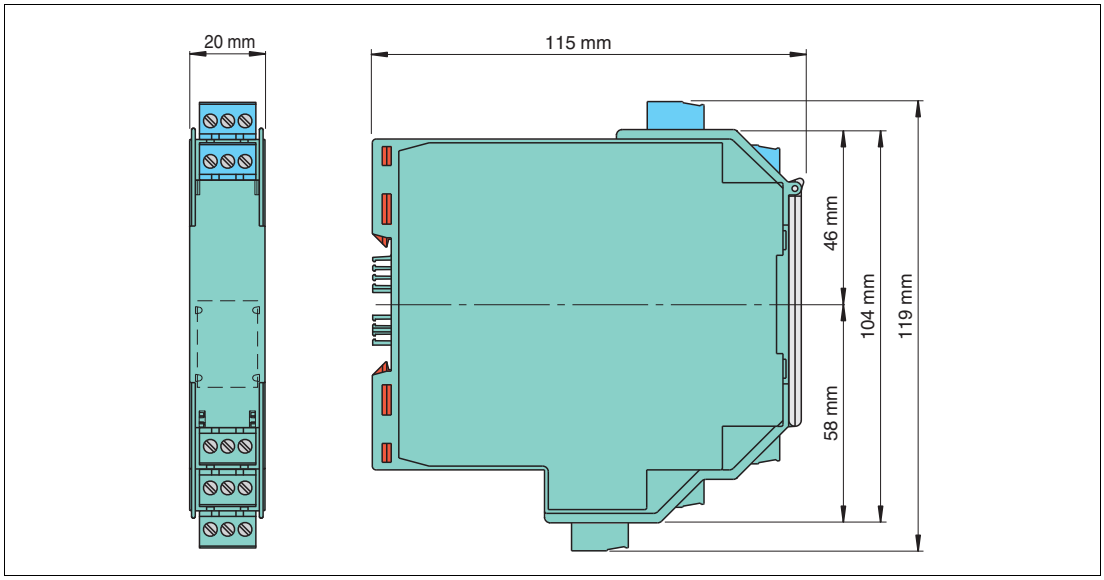

Figure 7.3

Number of terminal blocks maximum 5

- Dimension drawing with screw terminals
- When using screw terminals with test sockets the device is 124 mm (4.9 in) in height.
- When using spring terminals the device is 131 mm (5.16 in) in height.

Housing Type C1

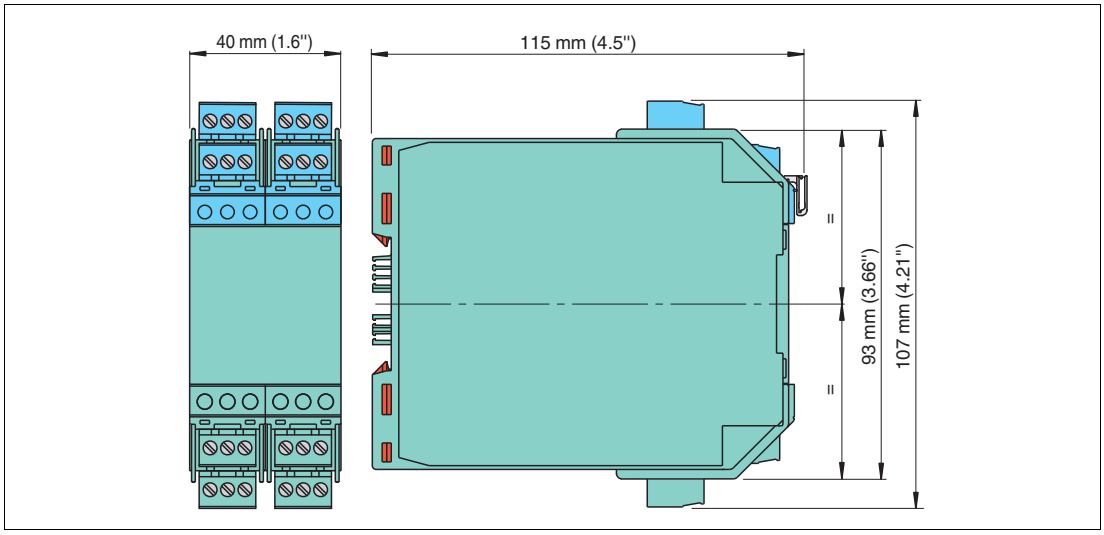

Figure 7.4

Number of terminal blocks max. 8

- Dimension drawing with screw terminals
- When using screw terminals with test sockets the device is 115 mm (4.6 in) in height.
- When using spring terminals the device is 122 mm (4.8 in) in height.

Housing Type C2

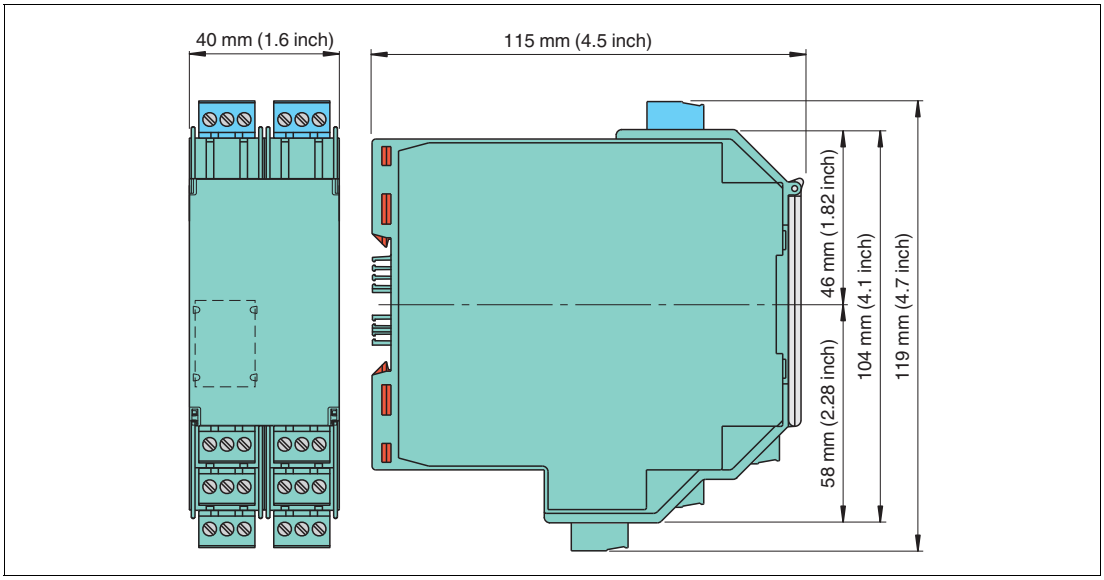

Figure 7.5

Number of terminal blocks max. 10

- Dimension drawing with screw terminals
- When using screw terminals with test sockets the device is 124 mm (4.9 inch) in height.
- When using spring terminals the device is 131 mm (5.16 inch) in height.

Housing Type D2

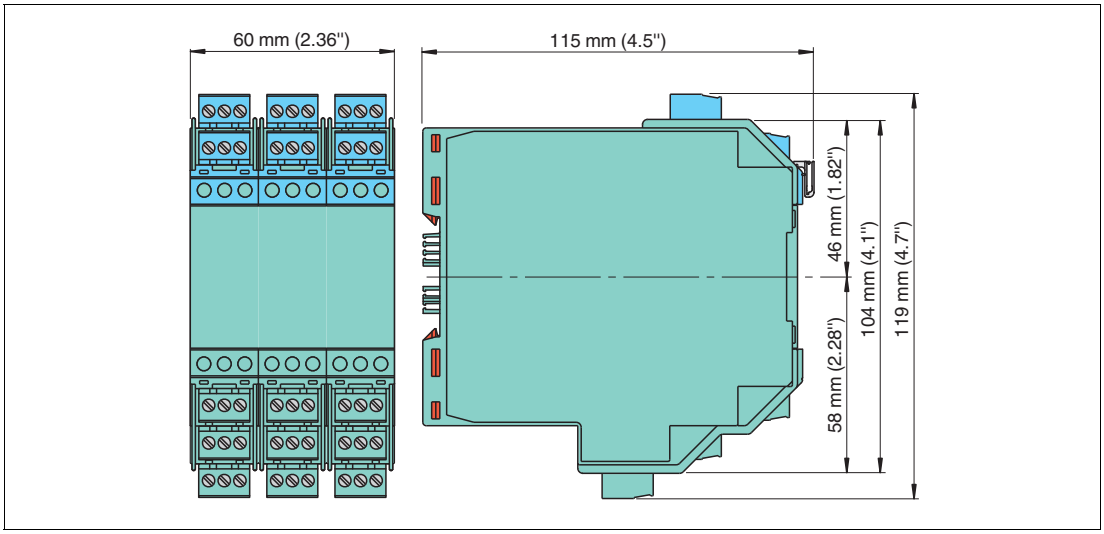

Figure 7.6

Number of terminal blocks max. 15

- Dimension drawing with screw terminals
- When using screw terminals with test sockets the device is 124 mm (4.9 in) in height.
- When using spring terminals the device is 131 mm (5.16 in) in height.

Housing Type E

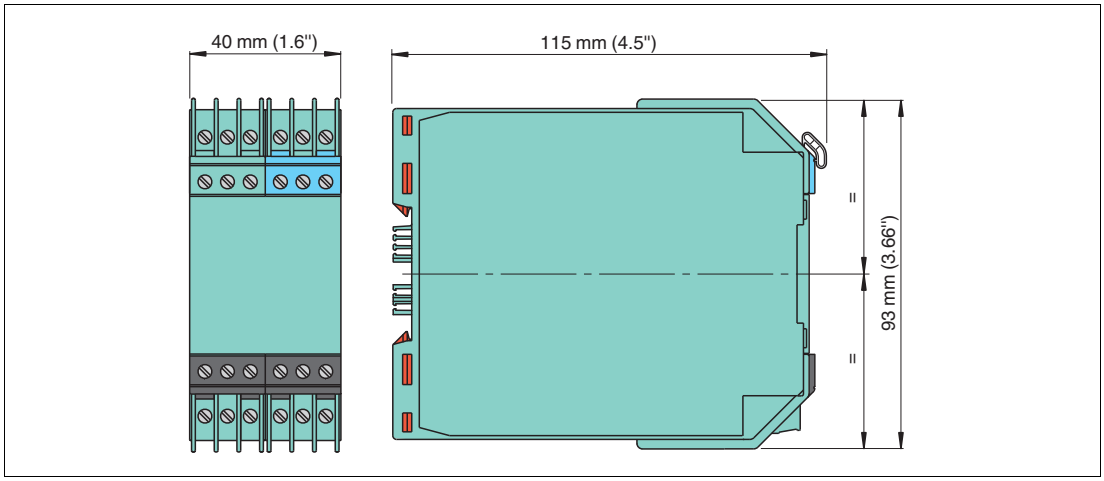

Figure 7.7

Housing Power Supply 4 A

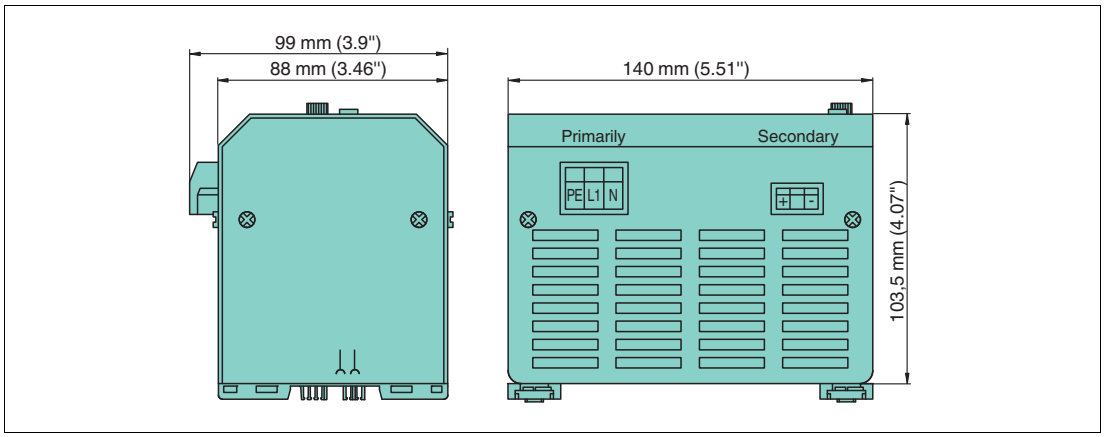

Figure 7.8

2021-03

Your automation, our passion.

Explosion Protection

- Intrinsic Safety Barriers
- Signal Conditioners
- FieldConnex® Fieldbus
- Remote I/O Systems
- Electrical Ex Equipment
- Purge and Pressurization
- Industrial HMI
- Mobile Computing and Communications
- HART Interface Solutions
- Surge Protection
- Wireless Solutions
- Level Measurement

Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
- Displays and Signal Processing
- Connectivity

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Data sheet

Redundancy with boost

Tab - 2.09

SLR5.100

- Input: AC 230V/115V, DC 210-375V
- Output: 24V/5A
- High overload current, no switch-off
- Quasi-Wide-Range Input
- N+1 redundancy, RDY relay contact

The Redundant Variant

IEC60950

UL508 LISTED IND. CONT. EQ. 18 WM, 60°C

UL60950 E137006 CUL/CSA-C22.2 No 950-M90

EMC and Low Volt. Directive

Input

Input voltage	AC100-120/220-240 V (switchable), 47-63 Hz (85-132 VAC / 176-264 VAC, 210-375 VDC, see also „Output: Continuous Loading“)

Quasi-Wide-Range Input: With the switch in the 230V position the power supply unit operates at low and moderate loads (until 3 A) at any input voltage between 95 and 264 V AC.
Note: At DC input, always leave the switch in the 230V position.

Input current	< 2.6 A (switch in 115V position) < 1.4 A (switch in 230V position)
• DCin at open output	typ. 5 mA (preserves battery sources)
Inrush current	typ. < 15 A at 264 V AC and cold start

To be fused with a 10A, B-type 'circuit-breaker' switch based on the usual thermomagn. overload sensing principle (used anyway to fuse the input lines). In addition, the unit contains an internal fuse (not accessible).

Harmonic current emissions	acc. to EN 61000-3-2
Transient handling	Transient resistance acc. to VDE 0160 / W2 (750 V / 1.3 ms), for *all* load conditions.
Hold-up time	> 37 ms at 196 VAC, 24 V / 5 A (see diagram overleaf)

Efficiency, Reliability etc.*

Efficiency	typ. 89 % (230 VAC, 24 V / 5 A)
Losses	typ. 14.8 W (230 VAC, 24 V / 5 A)
MTBF	480.000 h acc. to Siemensnorm SN 29500 (24 V/5 A, 230 VAC, T_{amb} = +40 °C)
Life cycle (electrolytics)	The unit exclusively uses longlife electrolytics, specified for +105°C (cf. 'The SilverLine', p.2).

Construction / Mechanics*

Housing dimensions and Weight

• W x H x D	64 mm x 124 mm x 102 mm (+ DIN rail)
• Free space for ventilation	above/below 25 mm recommended left/right 15 mm recommended
• Weight	620 g

Design advantages:
- Input and output pluggable by means of Combicon® plug connector.
- Ensure strain relief of the plug connectors when installing the unit. ⚠
- Input and output are strictly apart from each other and so cannot be mixed up (input below, output above).

Output

Rated output voltage	24 V DC

For balanced current sharing during parallel operation:
Soft characteristic (25.2 V DC ±2% at no-load, 24 V DC ±0.5% at nominal load, almost linear characteristic curve)

Output noise suppression	Radiated EMI values below EN50081-1, even when using long, unscreened output cables.
Ambient temperature range T_{amb}	Operation: -10°C...+70°C (>60°C: Derating) Storage: -25°C...+85°C

Continuous loading (at T_{amb}= -10°C...+60°C, convection cooling), see also diagram overleaf. For start at T_{amb}< 0°C and low input voltage, please contact PULS.
Output is protected against short circuit, open circuit and overload

Switch	AC/DCin		Iout
230V	176-264 V	ACin	5 A / 6 A *
	95-176 V	ACin	3 A
	210-375 V	DCin	5 A / 6 A *
	150-210 V	DCin	3 A
	100-150 V	DCin	2 A
115V	85-132 V	ACin	5 A / 6 A *

* short-term 6 A (< 1 min), at 45°C or forced cooling even continuous

Derating	typ. 3 W/K (at T_{amb}=+60°C...+70°C)
Voltage regulation	better than 2% Vout overall
Ripple / Noise	< 30 mV_{PP}, (20 MHz bandw., 50 Ω measurem.)
Overvolt. protection	typ. 29 V
Parallel operation	yes, current sharing via soft characteristic (see diagram)
Front panel indicator	Green LED

RDY relay contact

• Type	normally open contact
• closes	when output voltage > 22.1V ±4%
• opens	when output voltage < 19.8V ±4%
• Electrical isolation	500V DC to output voltage
• Contact rating	1A at 28V DC

* For further information see data sheets „The SilverLine“, „SilverLine Family Branches“ and mechanics data sheet

Order information

Order number	Description
SLR5.100	N+1 redundancy*
SL5.100	Basic version without redundancy*
SLS5.100	Safety Cover*
SLZ01	Screw mounting set, two needed per unit

Start / Overload Behaviour

Start-up delay	typ. 0.1 s
Rise time	ca. 5-20 ms, depending on load

Overload Behaviour

- Special PULS Overload Design (see right diagram) – no disconnection, no hiccup if overloaded – high overload current (up to 1.9 I_{Nom}), Vout is gradually reduced with increasing current.
- 20% power boost – 6A short-term, at 45°C or forced cooling even continuous

Advantages:

- High short-circuit current, giving large 'start-up window': unit starts reliably even with awkward loads (DC-DC converters, motors).
- No 'sticking' such as can occur with fold-back characteristics
- Secondary fuses operate reliably

Further information

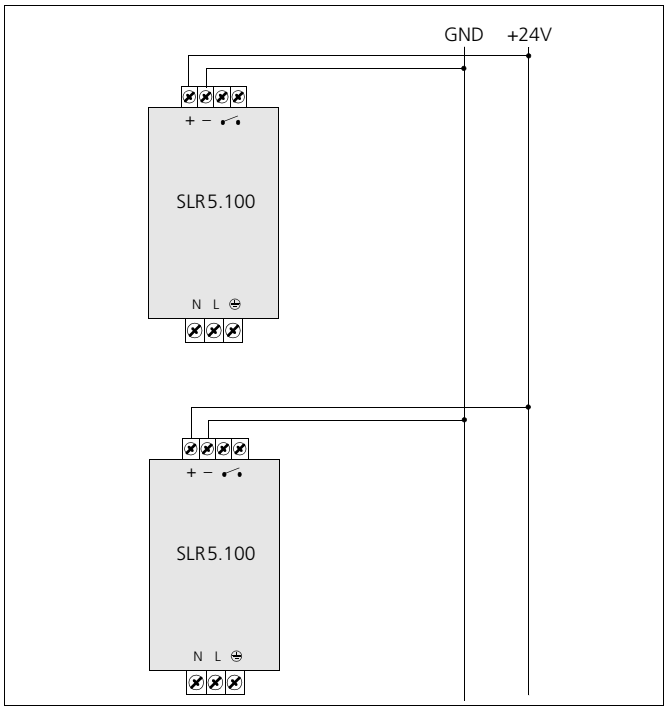
Further information, especially about

- EMC
- Connections
- Safety, Approvals
- Mechanics and Mounting

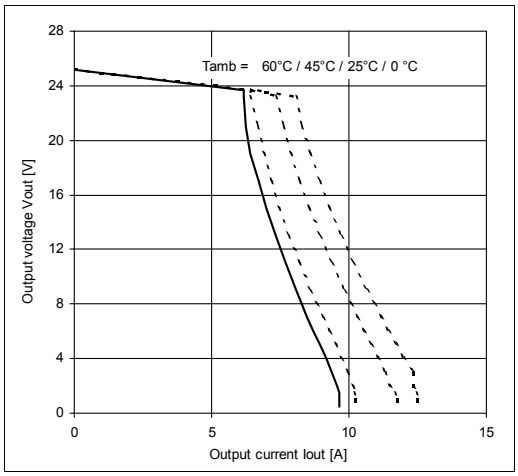
see page 2 of „The SilverLine" data sheet.

For detailed dimensions
see SilverLine mechanics data sheet SLR2.5/ 5/ 10

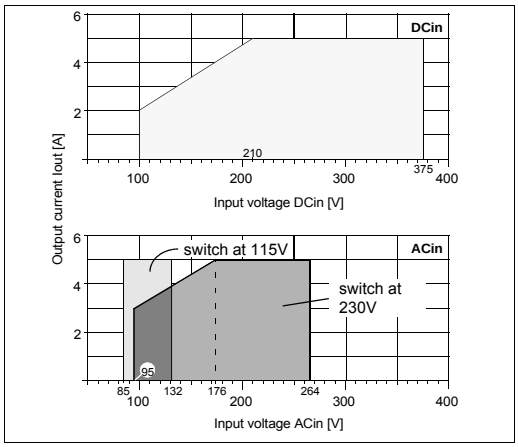
Power wiring



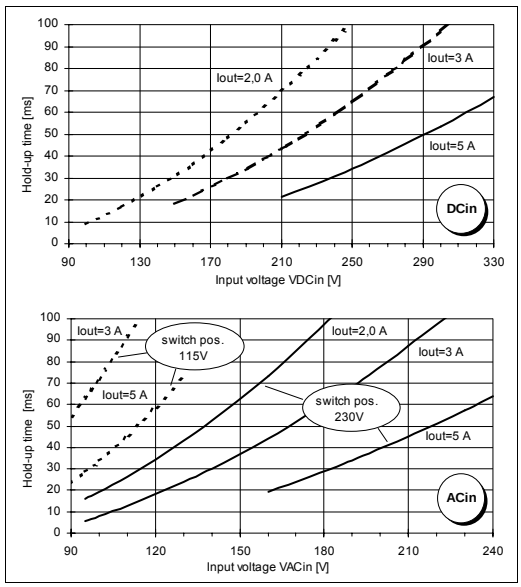
Output characteristic (min.)



Output Current over Input Voltage (min.)



Hold-up time (min.)



Unless otherwise stated, specifications are valid for AC 230V input voltage, +25°C ambient temperature, and 5 min. run-in time. They are subject to change without prior notice.

Your partner in power supply:

EPSMA European Power Supply Manufacturers Association

AWARDED Bayerns Best 50 Czech 100 Best EuropeÕs 500

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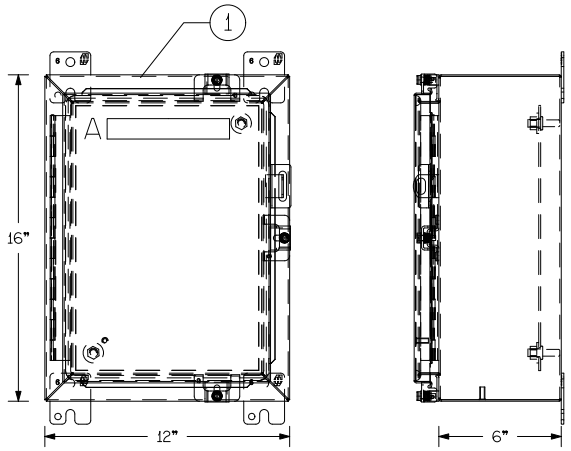
Arabellastraße 15
D-81925 München
Tel.: +49 89 9278-0
Fax: +49 89 9278-199
www.puls-power.com

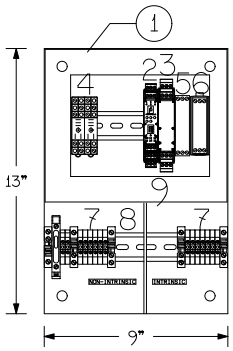
Tab - 3.01



NOTE: ENCLOSURE MUST BE LOCATED IN A NON-EX AREA

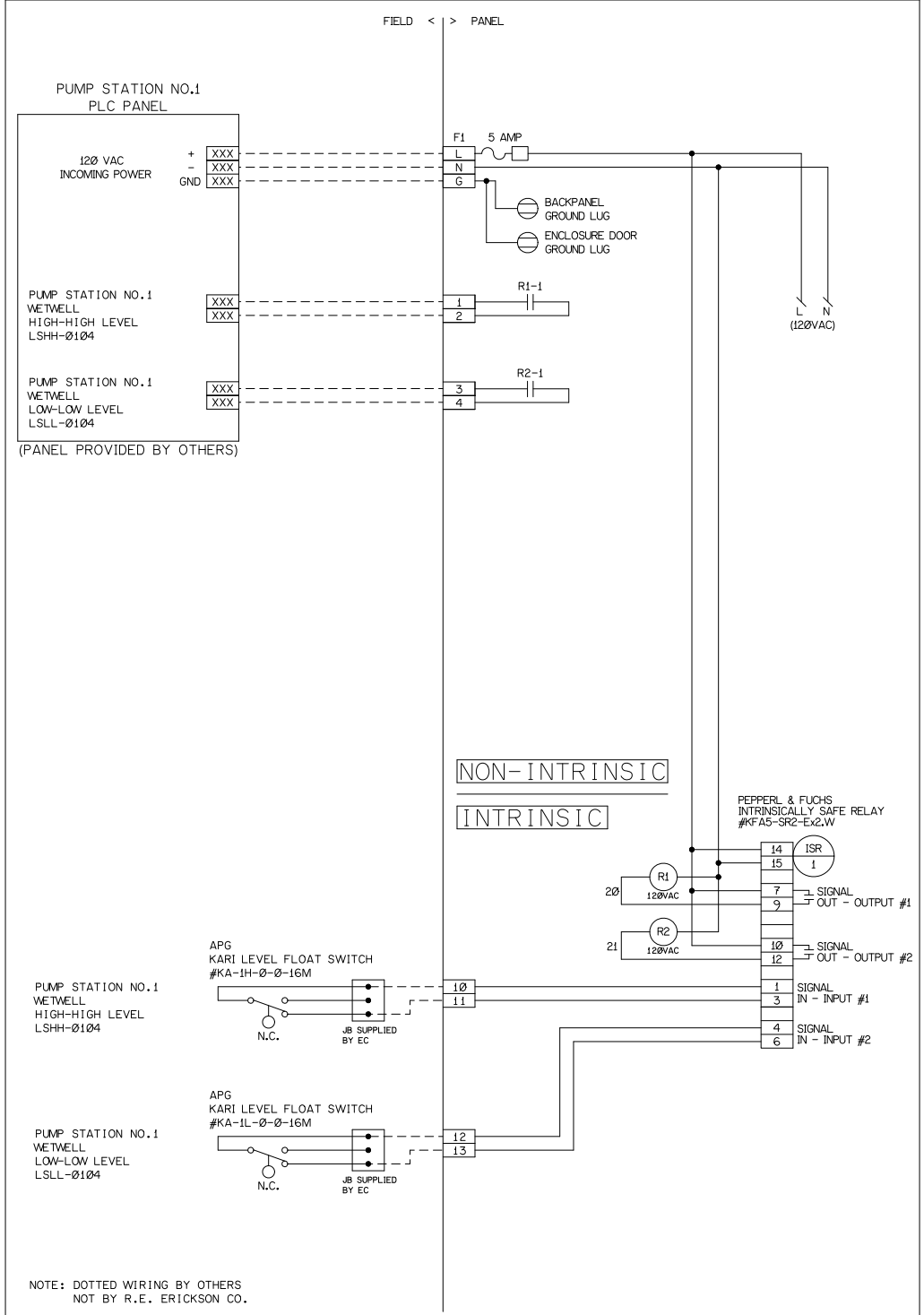
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
1	1	ENCLOSURE NEMA 4X 316 STAINLESS STEEL WALL MOUNT	HAMMOND	1418N4S16B6

NO.	REVISION	DATE		
			DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 1 ISR PANEL	SCALE: 1" = 8"
1	AS-BUILT	11/29/21	ENCLOSURE DETAILS	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 1 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-001B



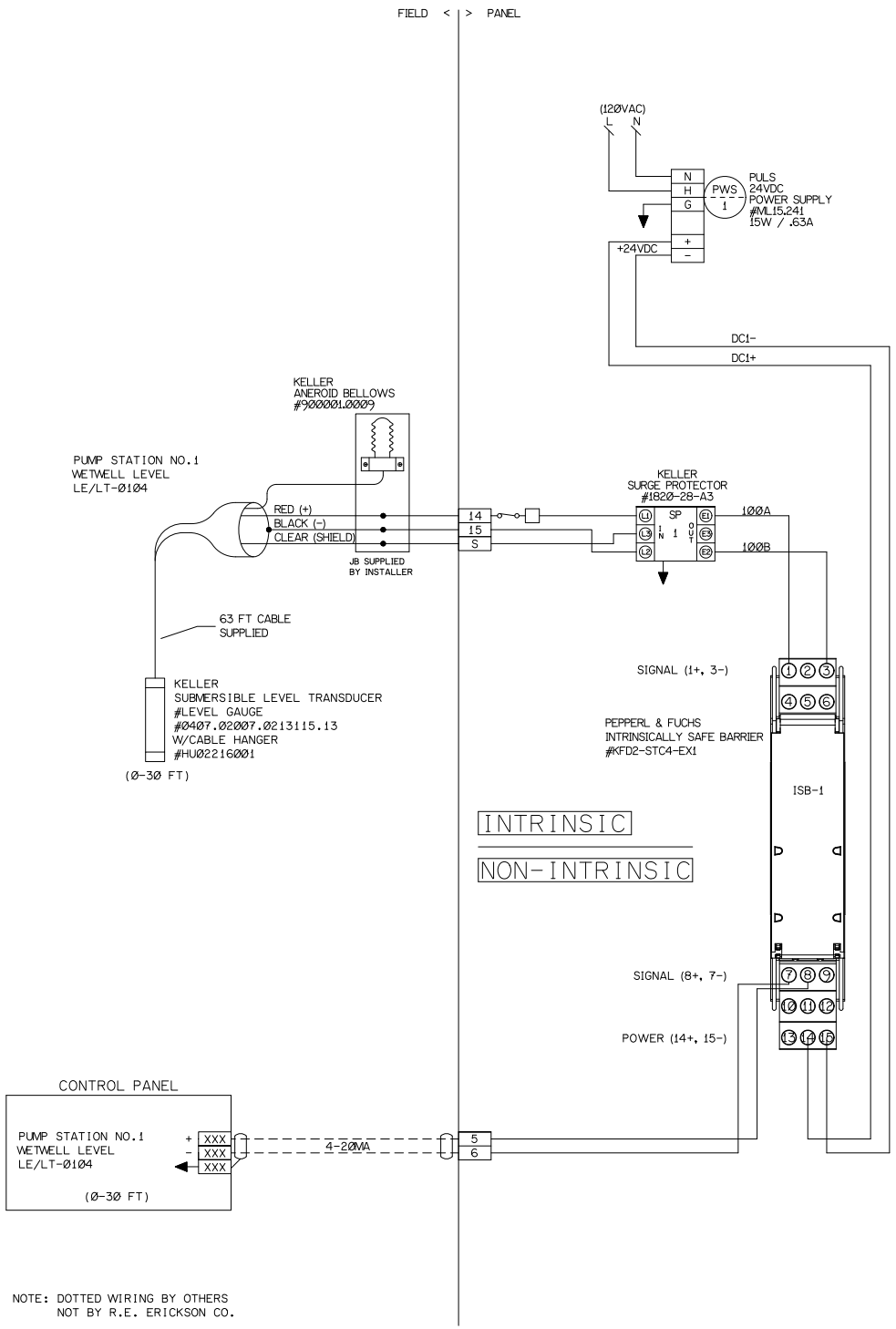
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
1	1	BACKPANEL STEEL PAINTED WHITE ENAMEL	HAMMOND	INCLUDED
2	1	INTRINSICALLY SAFE RELAY	PEPPERL & FUCHS	KFA5-SR2-Ex2.W
3	1	INTRINSICALLY SAFE BARRIER	PEPPERL & FUCHS	KFD2-STC4-EX1
4	2	120 VAC RELAY DPDT w/ LED	ALLEN BRADLEY	700-HK36A1-4
	2	RELAY BASE DP	ALLEN BRADLEY	700-HN121
5	1	SURGE PROTECTOR	KELLER	1820-28-A3
6	1	24VDC POWER SUPPLY	PULS	ML15.241
7	A/R	FUSEHOLDER TERMINAL BLOCK LARGE (AC BLOWN FUSE IND.)	ALLEN BRADLEY	1492-H4
	A/R	FUSEHOLDER TERMINAL BLOCK END COVER	ALLEN BRADLEY	1492-N37
	A/R	TERMINAL BLOCK END CLAMPS	ALLEN BRADLEY	1492-EAJ35
	A/R	TERMINAL BLOCK - ISOLATION	ALLEN BRADLEY	1492-JKD4
	A/R	TERMINAL BLOCK	ALLEN BRADLEY	1492-J4
	A/R	TERMINAL BLOCK END COVER	ALLEN BRADLEY	1492-EBJ3
	A/R	TERMINAL BLOCK GROUND TYPE	ALLEN BRADLEY	1492-JG4
8	A/R	DIN RAIL EQUIPMENT MOUNTING TRACK	PHOENIX	0801733
9	A/R	WIREWAY	PANDUIT	1"

NO.	REVISION	DATE		
1	AS-BUILT	11/29/21	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 1 ISR PANEL	SCALE: 1" = 8"
2	UPDATED	9/22/22	BACK PANEL LAYOUT	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 2 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-002B



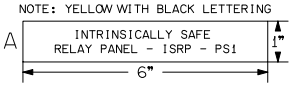
NO.	REVISION	DATE	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 1 ISR PANEL	SCALE: NONE
1	AS-BUILT	11/29/21	ELECTRICAL WIRING SCHEMATIC	DR. BY: GER
2	UPDATED	9/22/22	TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
				SHEET 3 OF 5
				DRAWING NO. 16361-003B

R.E. ERICKSON, CO. INC.
595 PROVIDENCE HWY.
WALPOLE, MASS. 02081 TEL. 508-668-9330



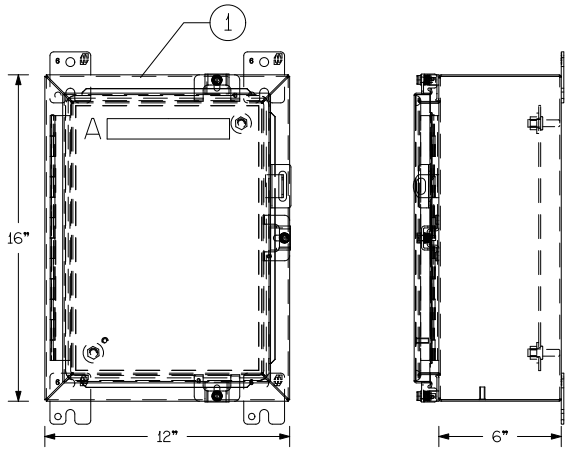
NO.	REVISION	DATE		
1	AS-BUILT	11/29/21	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 1 ISR PANEL	SCALE: NONE
2	UPDATED	9/22/22	ELECTRICAL WIRING SCHEMATIC	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 4 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-004B

NOTE: YELLOW WITH BLACK LETTERING



NO.	REVISION	DATE	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 1 ISR PANEL	SCALE: 1" = 16"
1	AS-BUILT	11/29/21	NAMEPLATES	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 5 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-005B

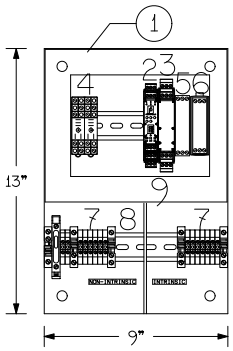
Tab - 3.02



NOTE: ENCLOSURE MUST BE LOCATED IN A NON-EX AREA

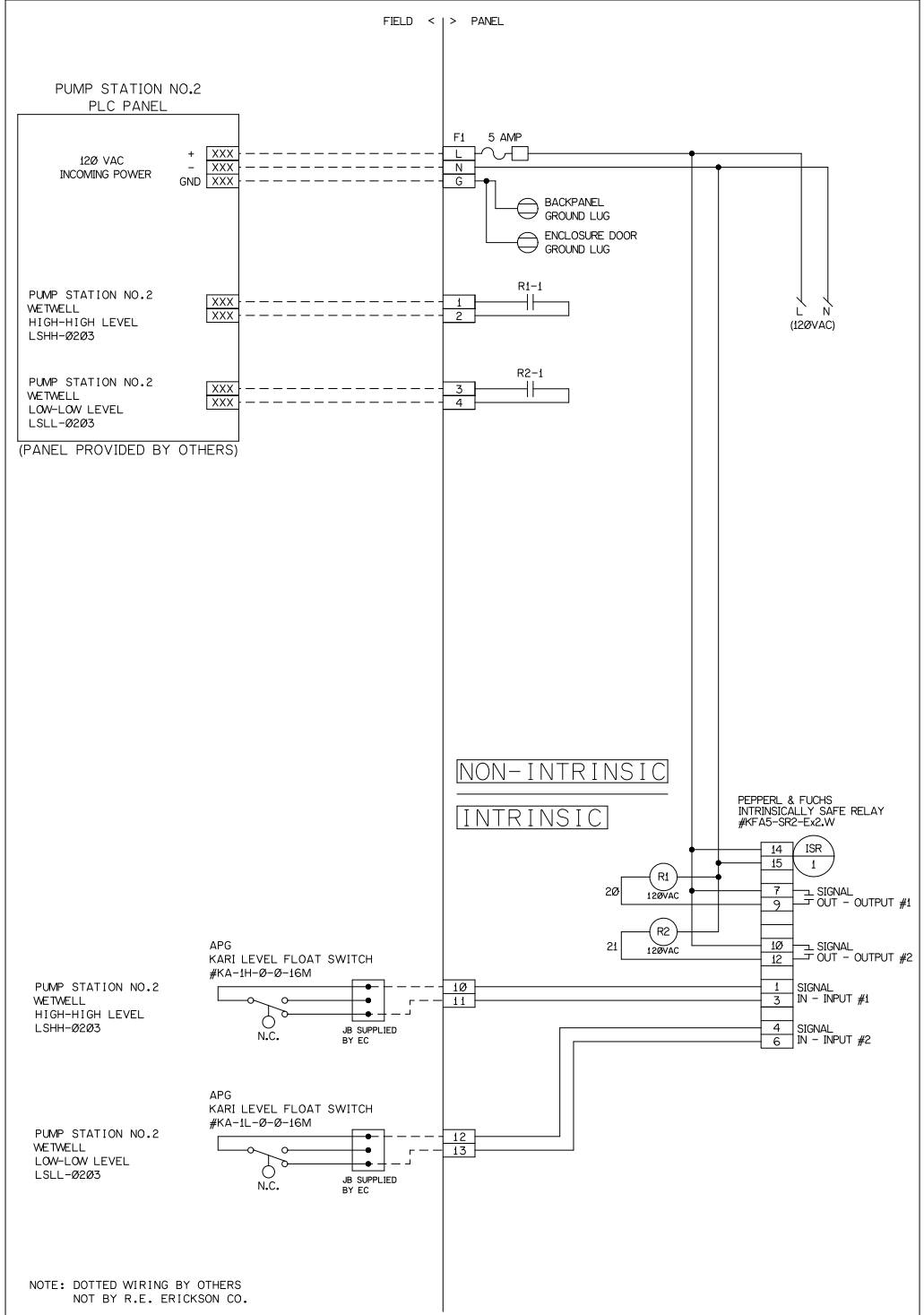
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
1	1	ENCLOSURE NEMA 4X 316 STAINLESS STEEL WALL MOUNT	HAMMOND	1418N4S16B6

NO.	REVISION	DATE	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 2 ISR PANEL	SCALE: 1" = 8"
1	AS-BUILT	11/29/21	ENCLOSURE DETAILS	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 1 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-001C



ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
1	1	BACKPANEL STEEL PAINTED WHITE ENAMEL	HAMMOND	INCLUDED
2	1	INTRINSICALLY SAFE RELAY	PEPPERL & FUCHS	KFA5-SR2-Ex2.W
3	1	INTRINSICALLY SAFE BARRIER	PEPPERL & FUCHS	KFD2-STC4-EX1
4	2	120 VAC RELAY DPDT w/ LED	ALLEN BRADLEY	700-HK36A1-4
	2	RELAY BASE DP	ALLEN BRADLEY	700-HN121
5	1	SURGE PROTECTOR	KELLER	1820-28-A3
6	1	24VDC POWER SUPPLY	PULS	ML15.241
7	A/R	FUSEHOLDER TERMINAL BLOCK LARGE (AC BLOWN FUSE IND.)	ALLEN BRADLEY	1492-H4
	A/R	FUSEHOLDER TERMINAL BLOCK END COVER	ALLEN BRADLEY	1492-N37
	A/R	TERMINAL BLOCK END CLAMPS	ALLEN BRADLEY	1492-EAJ35
	A/R	TERMINAL BLOCK - ISOLATION	ALLEN BRADLEY	1492-JKD4
	A/R	TERMINAL BLOCK	ALLEN BRADLEY	1492-J4
	A/R	TERMINAL BLOCK END COVER	ALLEN BRADLEY	1492-EBJ3
	A/R	TERMINAL BLOCK GROUND TYPE	ALLEN BRADLEY	1492-JG4
8	A/R	DIN RAIL EQUIPMENT MOUNTING TRACK	PHOENIX	0801733
9	A/R	WIREWAY	PANDUIT	1"

NO.	REVISION	DATE		
1	AS-BUILT	11/29/21	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 2 ISR PANEL	SCALE: 1" = 8"
2	UPDATED	9/22/22	BACK PANEL LAYOUT	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 2 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-002C



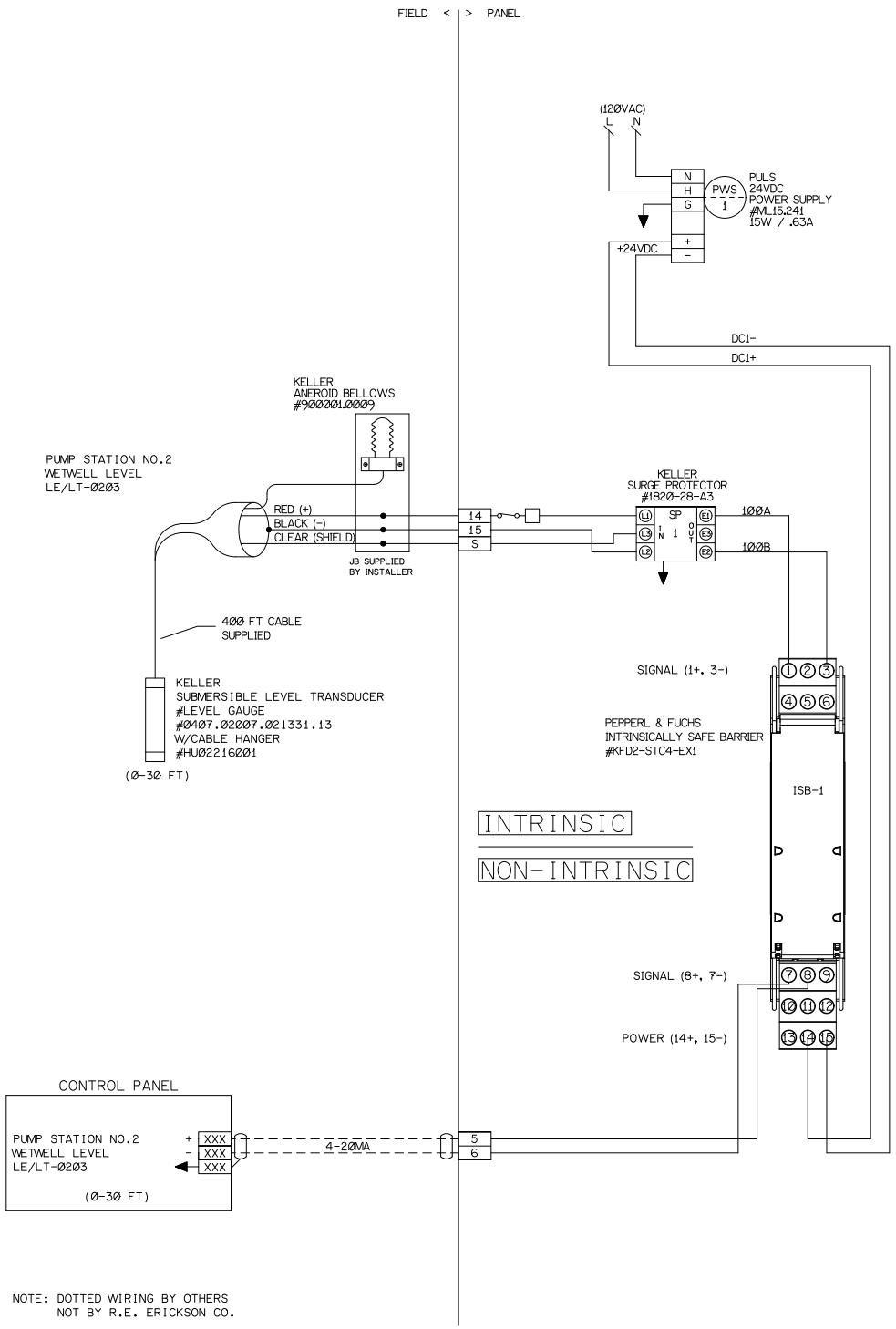
NOTE: DOTTED WIRING BY OTHERS
NOT BY R.E. ERICKSON CO.

NO.	REVISION	DATE
1	AS-BUILT	11/29/21
2	UPDATED	9/22/22

DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 2 ISR PANEL
ELECTRICAL WIRING SCHEMATIC
TOWN OF ORLEANS, MASSACHUSETTS

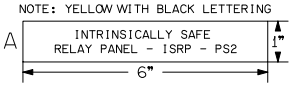
R.E. ERICKSON, CO. INC.
595 PROVIDENCE HWY.
WALPOLE, MASS. 02081 TEL. 508-668-9330

SCALE: NONE
DR. BY: GER
DATE: 09-10-20
SHEET 3 OF 5
DRAWING NO. 16361-003C



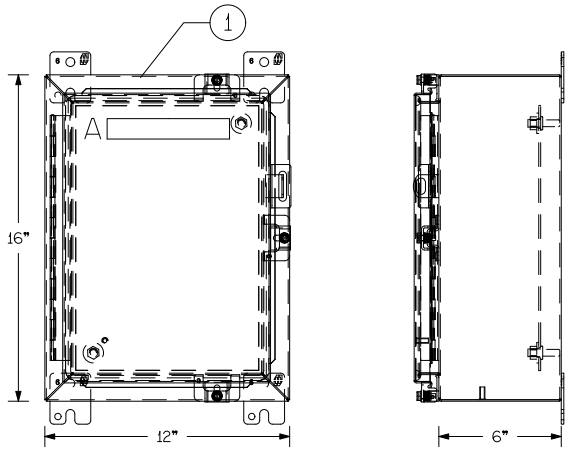
NO.	REVISION	DATE		
1	AS-BUILT	11/29/21	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 2 ISR PANEL	SCALE: NONE
2	UPDATED	9/22/22	ELECTRICAL WIRING SCHEMATIC	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 4 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-004C

NOTE: YELLOW WITH BLACK LETTERING



NO.	REVISION	DATE	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 2 ISR PANEL	SCALE: 1" = 16"
1	AS-BUILT	11/29/21	NAMEPLATES	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 5 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-005C

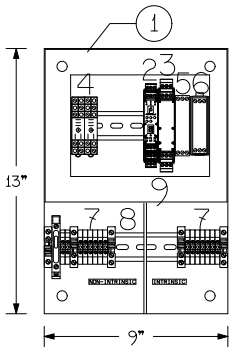
Tab - 3.03



NOTE: ENCLOSURE MUST BE LOCATED IN A NON-EX AREA

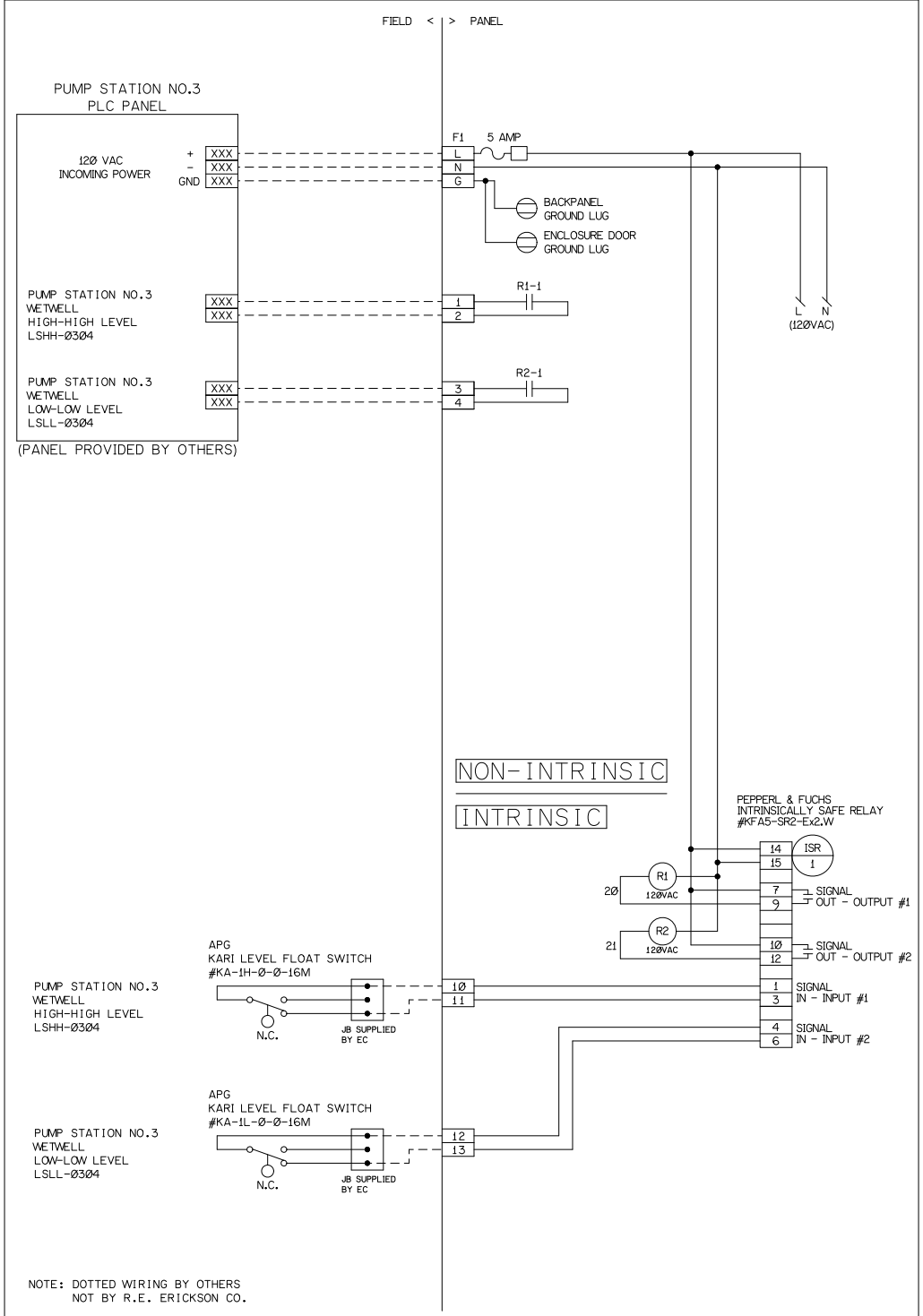
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
1	1	ENCLOSURE NEMA 4X 316 STAINLESS STEEL WALL MOUNT	HAMMOND	1418N4S16B6

NO.	REVISION	DATE		
			DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 3 ISR PANEL	SCALE: 1" = 8"
1	AS-BUILT	11/29/21	ENCLOSURE DETAILS	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 1 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-001D



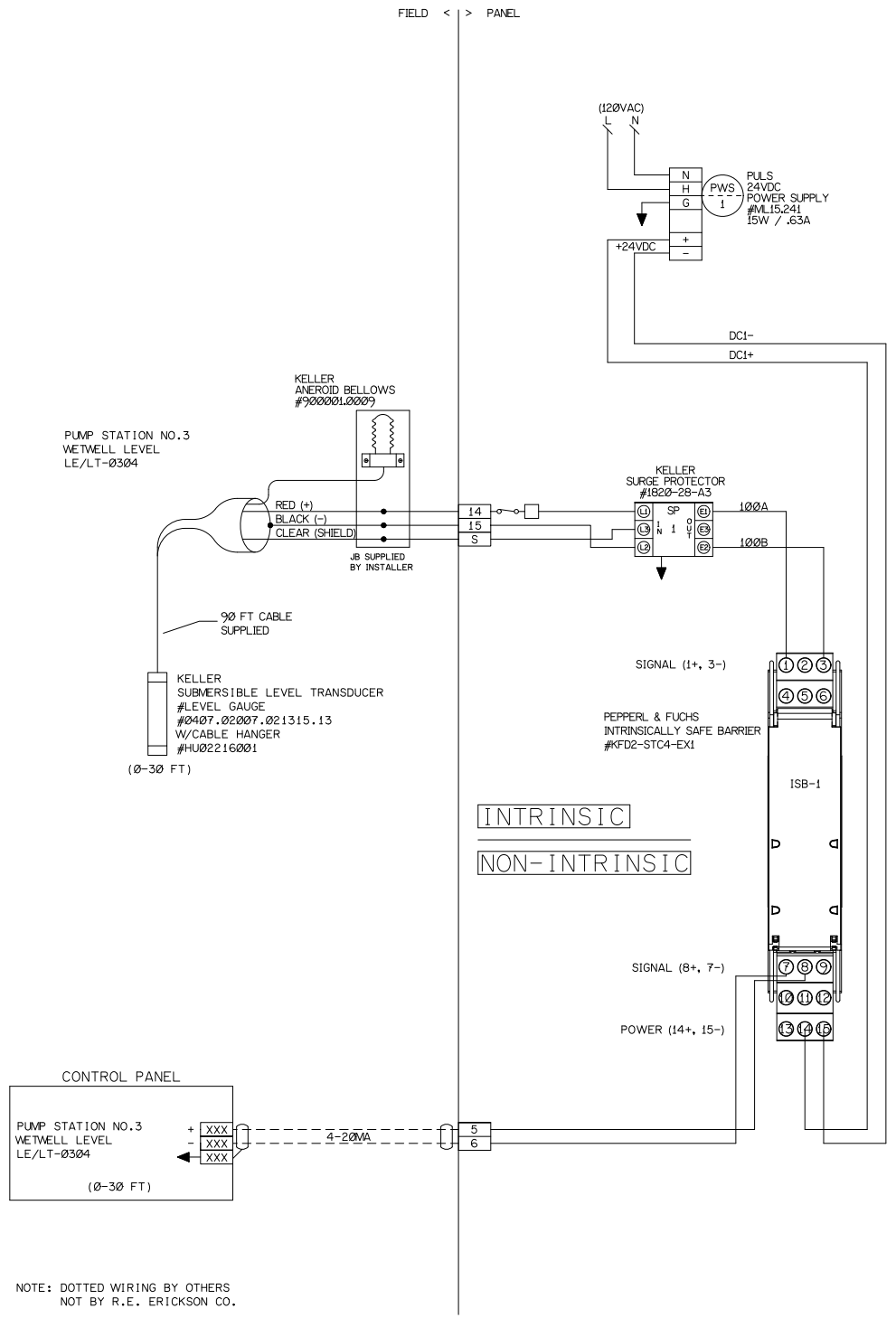
ITEM	QTY	DESCRIPTION	MANUFACTURER	PART NUMBER
1	1	BACKPANEL STEEL PAINTED WHITE ENAMEL	HAMMOND	INCLUDED
2	1	INTRINSICALLY SAFE RELAY	PEPPERL & FUCHS	KFA5-SR2-Ex2.W
3	1	INTRINSICALLY SAFE BARRIER	PEPPERL & FUCHS	KFD2-STC4-EX1
4	2	120 VAC RELAY DPDT w/ LED	ALLEN BRADLEY	700-HK36A1-4
	2	RELAY BASE DP	ALLEN BRADLEY	700-HN121
5	1	SURGE PROTECTOR	KELLER	1820-28-A3
6	1	24VDC POWER SUPPLY	PULS	ML15.241
7	A/R	FUSEHOLDER TERMINAL BLOCK LARGE (AC BLOWN FUSE IND.)	ALLEN BRADLEY	1492-H4
	A/R	FUSEHOLDER TERMINAL BLOCK END COVER	ALLEN BRADLEY	1492-N37
	A/R	TERMINAL BLOCK END CLAMPS	ALLEN BRADLEY	1492-EAJ35
	A/R	TERMINAL BLOCK - ISOLATION	ALLEN BRADLEY	1492-JKD4
	A/R	TERMINAL BLOCK	ALLEN BRADLEY	1492-J4
	A/R	TERMINAL BLOCK END COVER	ALLEN BRADLEY	1492-EBJ3
	A/R	TERMINAL BLOCK GROUND TYPE	ALLEN BRADLEY	1492-JG4
8	A/R	DIN RAIL EQUIPMENT MOUNTING TRACK	PHOENIX	0801733
9	A/R	WIREWAY	PANDUIT	1"

NO.	REVISION	DATE		
1	AS-BUILT	11/29/21	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 3 ISR PANEL	SCALE: 1" = 8"
2	UPDATED	9/22/22	BACK PANEL LAYOUT	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 2 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-002D



NO.	REVISION	DATE	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 3 ISR PANEL	SCALE: NONE
1	AS-BUILT	11/29/21	ELECTRICAL WIRING SCHEMATIC	DR. BY: GER
2	UPDATED	9/22/22	TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
				SHEET 3 OF 5
				DWG NO. 16361-003D

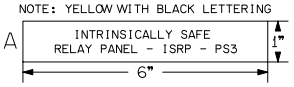
R.E. ERICKSON, CO. INC.
595 PROVIDENCE HWY.
WALPOLE, MASS. 02081 TEL. 508-668-9330



NO.	REVISION	DATE	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 3 ISR PANEL	SCALE: NONE
1	AS-BUILT	11/29/21	ELECTRICAL WIRING SCHEMATIC	DR. BY: GER
2	UPDATED	9/22/22	TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
				SHEET 4 OF 5
				DRAWING NO. 16361-004D

R.E. ERICKSON, CO. INC.
595 PROVIDENCE HWY.
WALPOLE, MASS. 02081 TEL. 508-668-9330

NOTE: YELLOW WITH BLACK LETTERING



NO.	REVISION	DATE	DOWNTOWN AREA COLLECTION SYSTEM AND PUMP STATION NO. 3 ISR PANEL	SCALE: 1" = 16"
1	AS-BUILT	11/29/21	NAMEPLATES	DR. BY: GER
			TOWN OF ORLEANS, MASSACHUSETTS	DATE: 09-10-20
			R.E. ERICKSON, CO. INC.	SHEET 5 OF 5
			595 PROVIDENCE HWY.	
			WALPOLE, MASS. 02081 TEL. 508-668-9330	DRAWING NO. 16361-005D

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

9.3 - Instrument Calibration Report

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

R.E. ERICKSON, CO., INC.

INSTRUMENT CALIBRATION SHEET

INSTRUMENT		MANUFACTURER	CUSTOMER
Description:	Pump Station 1	Name: Siemens Mag Meter	Name: Orleans WW
	Flow Meter	Model #: 7ME6910-1AA10-1AA0	Number: 16361
		Serial #: N1N6080085	

FUNCTIONS

	RANGE	VALUE	UNITS
Indicate? **YES**	Chart:		
Record? **NO**	Scale:	0-1100	GPM
Transmit? **YES**	Input:		
Convert? **NO**	Output:	4-20	mA

COMPUTING FUNCTIONS? **NO**

Describe:

CONTROL? **NO** Modes? P / I / D

Action? Direct / reverse

SWITCH? **NO**

Setting? fixed / adjustable

Reset? auto / manual

ANALOG CALIBRATIONS

REQUIRED			AS CALIBRATED			
			Before		After	
Input	Indicated	Output	Indicated	Output	Indicated	Output
0%	0	4	0	4	0	4
100%	1100	20	1100	20	1100	20

CONTROL MODE SETTINGS: P: I: D: Deadband:

RELAY OUTPUTS

	Setpoints				
Number					Notes
1					
2					
3					
4					
5					
6					
7					

NOTES: 6 inch mag meter # 7ME6580-4HJ14-2AA2

Instrument Calibrated

Date: 11/8/2022

Service Technician: Bob Briscoe

Tag No.: FIT-105

Loop No.:

R.E. ERICKSON, CO., INC.

INSTRUMENT CALIBRATION SHEET

INSTRUMENT		MANUFACTURER	CUSTOMER
Description:	Pump Station 1	Name: Keller	Name: Orleans WW
	Wetwell Level Transmitter	Model #: 0407.02007.021358.13	Number: 16361
		Serial #:	

FUNCTIONS

	RANGE	VALUE	UNITS
Indicate? **YES**	Chart:		
Record? **NO**	Scale:	0-30	Feet
Transmit? **YES**	Input:		
Convert? **NO**	Output:	4-20	mA

COMPUTING FUNCTIONS? **NO**

Describe:

CONTROL? **NO** Modes? P / I / D

Action? Direct / reverse

SWITCH? **NO**

Setting? fixed / adjustable

Reset? auto / manual

ANALOG CALIBRATIONS

REQUIRED			AS CALIBRATED			
			Before		After	
Input	Indicated	Output	Indicated	Output	Indicated	Output
0%	0	4	0	4	0	4
100%	30	20	30	20	30	20

CONTROL MODE SETTINGS: P: I: D: Deadband:

RELAY OUTPUTS

	Setpoints				
Number					Notes
1					
2					
3					
4					
5					
6					
7					

NOTES:

Instrument Calibrated

Date: 11/8/2022

Service Technician: Bob Briscoe

Tag No.: LT-104

Loop No.:

R.E. ERICKSON, CO., INC.

INSTRUMENT CALIBRATION SHEET

INSTRUMENT		MANUFACTURER	CUSTOMER
Description:	Pump Station 1	Name: Precision Digital	Name: Orleans WW
	Wetwell Level Indicator	Model #: PD8-765-6X0-10	Number: 16361
		Serial #:	

FUNCTIONS

	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? **NO**	CONTROL? **NO** Modes? P / I / D
Indicate? **YES**	Chart:			Describe:	Action? Direct / reverse
Record? **NO**	Scale:	0-30	Feet		SWITCH? **NO**
Transmit? **YES**	Input:				Setting? fixed / adjustable
Convert? **NO**	Output:	4-20	mA		Reset? auto / manual

ANALOG CALIBRATIONS

REQUIRED			AS CALIBRATED			
			Before		After	
Input	Indicated	Output	Indicated	Output	Indicated	Output
0%	0	4	0	4	0	4
100%	30	20	30	20	30	20

CONTROL MODE SETTINGS:	P:	I:	D:	Deadband:

RELAY OUTPUTS

	Setpoints				
Number					Notes
1					
2					
3					
4					
5					
6					
7					

NOTES:	**Instrument Calibrated**
	Date: 11/8/2022
	Service Technician: Bob Briscoe
	Tag No.: LI-104
	Loop No.:

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

9.4 - Pump Start up report

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

Start-up & Field Test Procedure

11306 – KSB Submersible Solids Handling Pumps
Orleans, MA

Pump Station # 1

Description	PS1.P-1	PS1.P-2	PS1.P-3
1. Complete visual inspection of pump & guide system for defects	✓	✓	✓
2. Complete installation inspection of pump and guide system,	✓	✓	✓
3. Verify proper oil levels in mechanical seal housing	✓	✓	✓
4. Inspect power cable jacket, support, and lift chain *	✓	✓	✓
5. Verify power cable properly supported and routed	✓	✓	✓
6. Complete review of pump control panel & local monitoring panel for proper installation and field wiring	✓	✓	✓
7. Review hoist installation (if applicable) and lifting method *	✓	✓	✓
8. Complete review of power circuitry for proper design, short circuit protection, and voltage.	✓	✓	✓
9. Check all field connections and terminal strip connections	✓	✓	✓
10. Bump each motor for proper rotation.	✓	✓	✓
11. Fill wetwell	✓	✓	✓
12. Operate pump under load and verify and log all appropriate electrical data including running amps, thermistor resistance, moisture sensor resistance, gauge readings, flowrate			
Pump Motor Thermistors (cool (<500 ohms))	OK	OK	OK
Pump Moisture Sensor (>25 K ohms)	OK	OK	OK
Pump Motor Voltage (460 V)	497	496	496
Pump Motor Amps (37.5 FLA)	35.6/35.6/36.1	35.8/34.7/36.2	36.1/36.6/34.9
Pump gauge pressure (86 ft TDH) (GAUGE PSI) [TDH FT]	(21) [66]	(21) [66]	(22) [68]
Pump Flow (552 GPM) (SINGLE PUMP)	761	767	773
13. Inspect pump installations for any excessive vibration or noise	✓	✓	✓

TWO(2) PUMPS ON PARALLEL (30psi) 1113 GPM TOTAL
GAUGE CORRECTION = 13 FT. FRICTION = ≈5 FT (STATION LOSSES)

NOTES:- ALL IMPELLER BOLTS WERE CHECKED FOR PROPER TORQUE
*OWNER MAY SWITCH TO LIFTING CABLES
-TEMP RVSS STARTERS WERE INSTALLED FOR S/U - VFD'S LATER
-ONLY TEMP. PROTECTION CONNECTED. PUMPSAFE RELAYS TO BE HOOKED UP WHEN VFD'S ARE INSTALLED

Pump Station # 2

Description	PS2.P-1	PS2.P-2
1. Complete visual inspection of pump & guide system for defects		
2. Complete installation inspection of pump and guide system,		
3. Verify proper oil levels in mechanical seal housing		
4. Inspect power cable jacket, support, and lift chain		
5. Verify power cable properly supported and routed		
6. Complete review of pump control panel & local monitoring panel for proper installation and field wiring		
7. Review hoist installation (if applicable) and lifting method		

UNITED CONCRETE PRODUCTS

Start-Up Report Three Phase:

Project Information

Project Name: Orleans Station #1 Job # 27087 Report Date: 11-2-2022

Flow Test

Static Water Pressure Gauge Reading: N/A psi

Gallons per Inch at Wet Well: 48.9 gpi Forced Main Full: Y ☒ N ☐

Measurements from Water Surface to Stationary Surface at Top of Wet Well:

P-1	Test #1		Test #2		Test #3	
Starting Water Level:	234.5	inches		inches		inches
Stop Water Level:	267.0	inches		inches		inches
Draw Down Total:	32.5	inches		inches		inches
Draw Down Duration:	2	min		min		min
GPM:	794		Dead Head			
Pressure Gauge Reading:	21	psi	44	psi		psi

P-2	Test #1		Test #2		Test #3	
Starting Water Level:	246.5	inches		inches		inches
Stop Water Level:	279.75	inches		inches		inches
Draw Down Total:	33.25	inches		inches		inches
Draw Down Duration:	2	min		min		min
GPM:	812		Dead Head			
Pressure Gauge Reading:	21	psi	43.5	psi		psi

P-3	Test #1		Test #2		Test #3	
Starting Water Level:	235.75	inches		inches		inches
Stop Water Level:	268.75	inches		inches		inches
Draw Down Total:	33	inches		inches		inches
Draw Down Duration:	2	min		min		min
GPM:	806		Dead Head			
Pressure Gauge Reading:	21	psi	43	psi		psi

Start-Up Completed By: Mark Auclair Title: Mechanical Foreman

Name

Start-Up Accepted By: _____ Title: _____

Name

Notes/Remarks:

Start-up & Field Test Procedure

11306 – KSB Submersible Solids Handling Pumps
Orleans, MA

Pump Station # 2 S/U = 11/16/22 (LIBRARY)

Description		PS2.P-1	PS2.P-2
1.	Complete visual inspection of pump & guide system for defects	✓	✓
2.	Complete installation inspection of pump and guide system,	✓	✓
3.	Verify proper oil levels in mechanical seal housing	✓	✓
4.	Inspect power cable jacket, support, and lift chain	✓	✓
5.	Verify power cable properly supported and routed	✓	✓
6.	Complete review of pump control panel & local monitoring panel for proper installation and field wiring	✓	✓
7.	Review hoist installation (if applicable) and lifting method	✓	✓

8.	Complete review of power circuitry for proper design, short circuit protection, and voltage.	✓	✓
9.	Check all field connections and terminal strip connections	✓	✓
10.	Bump each motor for proper rotation.	✓	✓
11.	Fill wetwell	✓	✓

12. Operate pump under load and verify and log all appropriate electrical data including running amps, thermistor resistance, moisture sensor resistance, gauge readings, flowrate

Pump Motor Thermistors (cool (<500 ohms))	✓	✓
Pump Moisture Sensor (>25 K ohms)	✓	✓
Pump Motor Voltage (460 V)	493 V	491 V 494 VAC
Pump Motor Amps (37.5 FLA)	35.1 / 34 / 34.3	34.6 / 36.1 / 34.7
Pump gauge pressure (86 ft TDH) (PSI GAUGE) [FT. TDH]	(31) [89]	(31) [89]
Pump Flow (536 GPM) (FROM FLOWMETER)	520	525

GAUGE CORRECTION = 15' + 3' FRICTION = 18 FT (31 × 2.3 + 18 = 89 FT.)

13.	Inspect pump installations for any excessive vibration or noise	✓	✓

NOTES: TEMP. CONTROLS, SO ONLY THERMAL PROTECTION IS CONNECTED AT THIS TIME. WHEN VFD'S ARE INSTALLED, THEY MUST HAVE LOAD REACTORS OR FILTERS DUE TO DISTANCE TO PUMPS (> 250 FT.)

Pump Station # 3

S/U = 11/16/22 (STOP + SHOT)

Description	PS3.P-1	PS3.P-2
14. Complete visual inspection of pump & guide system for defects	✓	✓
15. Complete installation inspection of pump and guide system,	✓	✓
16. Verify proper oil levels in mechanical seal housing	✓	✓
17. Inspect power cable jacket, support, and lift chain	✓	✓
18. Verify power cable properly supported and routed	✓	✓
19. Complete review of pump control panel & local monitoring panel for proper installation and field wiring	✓	✓
20. Review hoist installation (if applicable) and lifting method	✓	✓
21. Complete review of power circuitry for proper design, short circuit protection, and voltage.	✓	✓
22. Check all field connections and terminal strip connections	✓	✓
23. Bump each motor for proper rotation.	✓	✓
24. Fill wetwell	✓	✓

25. Operate pump under load and verify and log all appropriate electrical data including running amps, thermistor resistance, moisture sensor resistance, gauge readings, flowrate

Pump Motor Thermistors (cool (<500 ohms))	✓	✓
Pump Moisture Sensor (>25 K ohms)	✓	✓
Pump Motor Voltage (460 V)	494	491 492 VAC
Pump Motor Amps (27 FLA)	20.5 / 20.7 / 22.1	19.5 / 20.1 / 19.9
Pump gauge pressure (71 ft TDH) (PSI GAUGE) [FT. TDH]	(31) [83]	(31) [83]
Pump Flow (305 GPM) (FLOWMETER)	353	335

GAUGE CORRECTION = 10' + 2' FRICTION = 12 FT (31 × 2.3 + 12 = 83 FT.)

26.	Inspect pump installations for any excessive vibration or noise	✓	✓

NOTES: TEMP CONTROLS, SO ONLY THERMAL PROTECTION CONNECTED AT PRESENT.
P-1 WAS REPLACED WITH NEW UNIT - S.N - 997459634?

UNITED CONCRETE PRODUCTS

Start-Up Report Three Phase:

Project Information

Project Name: Orleans Station #2 Job # 27087 Report Date: 11-17-2022

Flow Test

Static Water Pressure Gauge Reading: N/A psi

Gallons per Inch at Wet Well: 31.3 gpi Forced Main Full: Y ☒ N ☐

Measurements from Water Surface to Stationary Surface at Top of Wet Well:

P-1	Test #1		Test #2		Test #3	
Starting Water Level:	252.25	inches		inches		inches
Stop Water Level:	210.25	inches		inches		inches
Draw Down Total:	38	inches		inches		inches
Draw Down Duration:	2	min		min		min
GPM:	594.7					
Pressure Gauge Reading:	31	psi		psi		psi

Flow Meter 520

Dead Head PSI 43

P-2	Test #1		Test #2		Test #3	
Starting Water Level:	240.5	inches		inches		inches
Stop Water Level:	279	inches		inches		inches
Draw Down Total:	38.5	inches		inches		inches
Draw Down Duration:	2	min		min		min
GPM:	602					
Pressure Gauge Reading:	31	psi		psi		psi

Flow Meter 525

Dead Head PSI 43

P-3	Test #1		Test #2		Test #3	
Starting Water Level:		inches		inches		inches
Stop Water Level:		inches		inches		inches
Draw Down Total:		inches		inches		inches
Draw Down Duration:		min		min		min
GPM:						
Pressure Gauge Reading:		psi		psi		psi

Start-Up Completed By: Mark Auclair Title: _____
Name

Start-Up Accepted By: _____ Title: _____
Name

Notes/Remarks: The 2 min. draw down has a 20sec. +- ramp up & ramp down on start & stop.

UNITED CONCRETE PRODUCTS

Start-Up Report Three Phase:

Project Information

Project Name: Orleans Station #3 Job # 27087 Report Date: 11-17-2022

Flow Test

Static Water Pressure Gauge Reading: N/A psi

Gallons per Inch at Wet Well: 31.3 gpi Forced Main Full: Y ☒ N ☐

Measurements from Water Surface to Stationary Surface at Top of Wet Well:

P-1	Test #1		Test #2		Test #3	
Starting Water Level:	249	inches		inches		inches
Stop Water Level:	274	inches		inches		inches
Draw Down Total:	25	inches		inches		inches
Draw Down Duration:	2	min		min		min
GPM:	391					
Pressure Gauge Reading:	31	psi		psi		psi

Flow Meter 353

Dead Head PSI 39

P-2	Test #1		Test #2		Test #3	
Starting Water Level:	254.5	inches		inches		inches
Stop Water Level:	277.5	inches		inches		inches
Draw Down Total:	23	inches		inches		inches
Draw Down Duration:	2	min		min		min
GPM:	359					
Pressure Gauge Reading:	31	psi		psi		psi

Flow Meter 335

Dead Head PSI 38

P-3	Test #1		Test #2		Test #3	
Starting Water Level:		inches		inches		inches
Stop Water Level:		inches		inches		inches
Draw Down Total:		inches		inches		inches
Draw Down Duration:		min		min		min
GPM:						
Pressure Gauge Reading:		psi		psi		psi

Start-Up Completed By: _____ Title: _____
Name

Start-Up Accepted By: _____ Title: _____
Name

Notes/Remarks: The 2 min. draw down has a 20 sec+- ramp up & ramp down on start & stop.

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

10.1 - Odor Control System

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

SERVICE GUIDE

FOR WW DRUM SCRUBBER

INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS

Purafil, Inc. • 2654 Weaver Way, Doraville, Georgia, 30340, U.S.A. • www.purafil.com • tel: (770) 662-8545 • (800) 222-6367

© Purafil 2012 SrvcGde - WW DS - 01

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO 9001:2008

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1	BASIC DESIGN

1.0 PRE-INSTALLATION INSTRUCTIONS

1.1 SAFETY CONSIDERATIONS

- Read this Service Manual carefully. Be thoroughly familiar with the controls and the proper use of the equipment.

- This manual should be retained with the unit because it contains the information necessary for proper maintenance.

- Keep all nuts, bolts, and screws tight to be sure the equipment is in safe working condition.

CAUTION:

- Installer should be a trained, experienced service person.

- Check the assembly and component weights to be sure that the rigging equipment can handle them safely.

- Be sure that the unit is balanced well in the transporting device.

- Always conduct a thorough check when the installation is complete.

- Never enter an enclosed blower cabinet or reach into a housing while fan is running.

- The motors in PURAFIL® equipment get very hot. This is normal and should not be regarded as a problem with the motor. However, take special care to avoid touching the hot areas.

1.2 RECEIVING INSTRUCTIONS

Systems are normally shipped assembled and with motors mounted. All units are attached securely to skids. It is recommended that units be left on their skids for protection and ease of handling while transporting. Straps, rigging, slings, or hooks attached to the skids may be used, with proper care. The units are well protected with triple wall board and are secured with metal bands. Forklifts may be used under the skids, but exercise caution to prevent damage.

Upon receiving systems from Purafil, Inc., note any shipping damage, obvious or hidden, to your carrier and on your Bill of Lading. All problems should be handled between the customer and carrier except for U.P.S. shipments, which require the customer to contact Purafil, Inc. for action.

- If the unit is to be stored before use, see Section 1.4 in this manual.
- If the unit is to be installed immediately, be sure to check Section 3.0 in this manual.
- To uncrate unit, cut metal bands and remove packaging.
- For positioning and special handling, see Section 3.1 in this manual.

1.3 INSPECTION

The condition of the unit upon its arrival is critical to its proper operation. Prior to start-up, inspect the unit carefully, according to the checklist below. Correct any inadequacies before start-up to prevent possible damage or inefficiency. Note, should there be any questions concerning the unit, refer to the numbers found on the unit identification plate, when contacting the PURAFIL® representative.

PRE-OPERATION CHECK LIST

YES	NO	CONDITION
____	____	1. Configuration and material are as specified on the sales order form
____	____	2. Measurements fit submittal requirements
____	____	3. Parts are all present
____	____	4. Latches hold securely and gaskets seal properly
____	____	5. Labels and serial numbers are present
____	____	6. Airflow direction is consistent with installation requirements (check labels attached to unit)

Note: Checking specific points is also imperative after the unit is started up. See section 3.4 in this manual for checklist.

1.4 STORAGE

The unit should be protected from the elements during storage, especially when storage time is extensive. While indoor storage is considered best, outdoor storage can be adequate when precautions are taken.

OUTDOOR STORAGE PRECAUTIONS

- Cover the equipment with a tarp. Intake and discharge openings must be well covered. (Use of black plastic as a cover may cause excessive condensation and rusting.)

- If there is the possibility of moisture collection, allow for proper drainage.

- Do not place heavy equipment on top of the unit.

- Store Purafil® media in a dry place with less than 95% relative humidity.

1.5 FOUNDATION AND CLEARANCES

FOUNDATIONS

Some units may require new or reinforced foundations, due to their weight. Always be sure to check that the existing foundation is adequate for the unit to be installed. Units to be used indoors require particular attention to strength of foundation. In some instances, a concrete base is best suited to the system. Concrete lessens the chance for vibration than if metal structures are used.

CLEARANCE

All units should be easily accessible for the required periodic maintenance. Do not block return and discharge grilles. Sufficient minimum clearances can be recommended by the local PURAFIL® representative.

2.0 BASIC DESIGN OF THE DRUM FILTER

Designed to clean odorous air, the drum filter, coupled with the final particulate filter, contains an inlet pipe, blower, a media bed housed in a LDPE drum, and diffuser. Pre-engineered in a single unit, the drum filter is designed to exhaust recycled air. The drum filter is supplied with Purafil® media. The drum filter has a quiet, low horsepower motor and low pressure drop.

The drum filter includes the following components:

1. INLET PIPING/DIFFUSER – Air enters through a 4" (100 CFM model), 8" (300, 500 CFM models), or 10" (1,000 CFM models) Fernco fitting prior to entering the drum then proceeds through the poly media pre-filter.
   - MEDIA BED – (100 CFM model) consists of 3 ft^3 (cubic feet) of Odorcarb Ultra™ and 2^3 ft (cubic feet) of Odormix™ SP. Each cubic foot of media is contained in a MediaSAK for easy handling and disposal.
   - (300 CFM model) comes complete with 7 ft^3 (cubic feet) of Odorcarb™ Ultra media (280 lbs.) and 3 ft^3 of Odormix™ SP media (120 lbs.).
   - (500 CFM model) comes complete with 13 ft^3 (cubic feet) of Odorcarb™ Ultra media (520 lbs.) and 4 ft^3 (cubic feet) of Odormix™ SP media (160 lbs.)
   - (1,000 CFM model) comes complete with 31 ft^3 (cubic feet) of Odorcarb™ Ultra media (1240 lbs.) and 8 ft^3 (cubic feet) of Odormix™ SP media (320 lbs.).
2. BLOWER – the air is then propelled further by the blower assembly which includes a mill and chemical duty motor and direct drive blower, assuring even, quiet airflow.
3. FINAL FILTER (DS-300, DS-500, and DS-1000) – any remaining contaminants, such as media dust and airborne contaminants are removed in this final stage by a polymedia filter.

FIGURE 1: BASIC DESIGN

3.0 INSTALLATION

After the entire pre-operative inspection is finished (Section 1.3), complete the following sequence for installation:

(1) Remove the unit from the skid and position it in the designated operation location.

(2) Plug in the electrical connections.

(3) Start the unit.

(4) Perform post-start inspection check. (See Section 3.4)

3.1 POSITIONING THE UNIT

The standard unit can simply be transported by lift to its pre-designed operation location (if in close proximity to the skid), according to facility safety requirements.

3.2 MEDIA BANK FILLING INSTRUCTIONS (FOR INITIAL START-UP)

Proper filling, installation, and maintenance of the chemical filtration media is critical to the unit's efficient operation. The drums are designed specifically for media manufactured by Purafil, Inc., allowing the system to perform at maximum efficiency, through proper shape and bed depth. Drum filters are pre-filled with media at the factory.

3.3 MEDIA BANK FILLING INSTRUCTIONS (FOR MEDIA REPLACEMENT)

Once media analysis (300, 500, 1,000 CFM models only) has determined that it is time for a replacement supply of media, replace the media according to the instructions below.

For 100 CFM Model:

- Media replacement is accomplished by removing the motor/blower lid assembly. Disconnect power supply.
- Remove MediaSAKs (5).
- Remove Polymedia (blue) filter.
- Install Polymedia (blue) filter.
- Install new MediaSAKs (5).
- Install motor/blower lid assembly.
- See Section 5.0 for disposal precaution.

For 300, 500, 1,000 CFM Model:

- Remove motor/blower lid assembly. Disconnect power supply.
- Remove Polymedia (blue) filter.
- Remove layer of Odormix™ SP media.
- Remove layer of Odorcarb™ Ultra media
- Remove Polymedia (blue) filter.
- Clean unit as much as possible by washing packing material with water and let dry.
- Install new Polymedia (blue) filter.
- Install new Odorcarb™ Ultra media.
- Install new Odormix™ SP media.
- Install new Polymedia (blue) filter.
- Install motor/blower lid assembly.
- Connect power supply.
- See Section 4.3 for disposal precaution.

3.4 POST-START INSPECTION/CHECK

Before initial start-up of system, contact your local PURAFIL® representative. Their name and phone number is attached to your system. Operate all DS models at the lowest airflow required to maintain a negative pressure and maximize media life.

YES	NO	CONDITION
____	____	1. Joints, seals, and gaskets do not leak.
____	____	2. Particulate filters have been installed.

4.0 MAINTENANCE

4.1 REPLACEMENT PARTS AND MATERIALS

While Purafil, Inc. products are built for durability, some parts of the PURAFIL® unit will require replacement during the normal lifetime of the equipment. Replacement items may be ordered from your local PURAFIL® representative or from Purafil, Inc.

Consumables: In order to maintain proper performance levels, particulate filters and PURAFIL® media must be replaced periodically, as they have a finite life (See Media Sampling Procedure Service Guide).

Moving Parts: Bearings, motors, etc. are all subject to gradual deterioration and/or sudden breakdown.

4.2 MEDIA REPLACEMENT

Need for Sampling

PURAFIL® engineered dry-chemical media has a finite life. Our media contains special active ingredients that react with odors and gaseous pollutants to remove them from the airstream. Once the active ingredients are spent, it is time to replace the media in your system. After start-up, your local PURAFIL® representative will work with the owner to periodically secure media samples. Purafil, Inc. will provide regular laboratory analysis of such samples to establish life cycles. Note, color change of media does not indicate level of remaining life.

Since every installation varies due to the type and quantity level of the contaminant, each operator must develop a sample schedule best suited to their system. However, until a schedule can be established, we recommend that a sample is taken from each vertical media bank and sent for analysis, so that a replacement date can be projected with a recommended sampling schedule.

Media Life Analysis (MLA) is a complimentary Purafil, Inc. service. MLA Sample Kits are available through Purafil, Inc. If analysis reveals that it is time to replace the media, order the appropriate pounds of media required per module used in the unit. See Media Sampling Service Guide for instructions on how to take a media sample from your unit.

5.0 SPECIAL PRECAUTIONS

Disposal

PURAFIL® media is a non-toxic, non-flammable substance. Filtration of contaminants through PURAFIL® media causes molecular changes to occur, and the resulting product is usually not harmful to the environment. Although special precautions are generally not required when disposing of spent media, government regulations may require specific disposal procedures if the resulting product could be harmful to the environment. Large quantities of PURAFIL® media should not be disposed of in dumpster-like equipment because the weight of the media could cause difficulties in handling the dumpster.

Independent laboratory analysis for Environmental Protection Agency toxicity characteristics may be required if the contaminants eliminated from your environment include heavy metals and pesticides.

Inhalation

A well-ventilated work area is suggested for changing the PURAFIL® media, as dusting occurs in fresh media due to handling abrasion. Workers should avoid direct inhalation of considerable PURAFIL® dust, as it induces sneezing. In closed, unventilated spaces, dust masks such as the 3-M No. 8500 are suggested.

Water

Avoid exposing the PURAFIL® media to water or precipitation, as this dissolves permanganate content. Storage of media should be in a dry place with less than 95% relative humidity. Exposure of permanganate solution to the skin causes brown staining which is temporary and not harmful. This staining can be removed by washing in a diluted solution of water and sodium bisulfite.

Eye Contact

If dust is exposed to the eyes or delicate membrane, flush thoroughly with water and seek treatment by a physician. Follow normal procedures for exposure to abrasive dust.

6.0 PURAFIL® STAIN REMOVAL PROCEDURE

The following stain removal procedure is stated here as information only, and neither Purafil, Inc., any of its subsidiaries, nor any agent or employee of Purafil, Inc. make any warranty or other representation regarding the efficacy or safety of this procedure. The stain removal could cause further damage to the garment or to the item from which one may attempt to remove the stain.

If the dust from PURAFIL® media comes in contact with organic material, there are two possible stain problems:

1. Manganese dioxide (MnO_2) which is insoluble, characterized by a medium brown color, and is found in expended PURAFIL® media, can usually be removed by normal washing.

2. New (unused) Odormix™ SP media contains sodium permanganate ($NaMnO_4$) which is a strong oxidant and will react with and discolor any organic material with which it comes in contact. These stains, which will be brownish black in color, may be removed using a solution of sodium bisulfite in water, after the garment has been removed from the person.

   CAUTION: This procedure should start with a very weak solution, gradually increasing the strength until the stain is removed. Use of too strong a solution could conceivably cause additional fabric damage.

   NOTE: Sodium bisulfite gives off sulfur dioxide (SO_2) gas; therefore, it must be used in a well-ventilated area.

   **PURAFIL® Odormix™ SP media is a 50/50 water-wastewater blend of Odorkol ™ media and Odoroxidant™ SP media.*

7.0 WARRANTY

PURAFIL® warrants hardware equipment manufactured by PURAFIL® to be free from defects in material and workmanship under normal use and service for twelve (12) months from startup date or eighteen (18) months from shipment date. PURAFIL'S obligation under this warranty shall be limited to replacing any parts thereof which shall be demonstrated to have been defective. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS.

PURAFIL MAKES NO WARRANTIES AS TO MERCHANTABILITY OR AS TO THE FITNESS OF THE MERCHANDISE FOR ANY PARTICULAR USE AND SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE, DIRECTLY OR INDIRECTLY, ARISING FROM THE USE OF SUCH MERCHANDISE OR FOR CONSEQUENTIAL DAMAGES. No person, firm or corporation is authorized to assume for PURAFIL® any other liability in connection with the sale of these goods. Equipment, parts and material manufactured by others and incorporated in PURAFIL® equipment are warranted by PURAFIL® ONLY TO THE EXTENT OF THE ORIGINAL MANUFACTURERS LIABILITY TO PURAFIL.

8.0 TROUBLESHOOTING

	SYMPTOM	PROBLEM	CHECKS/REMEDY
Media Bank	Airflow too low	Filters loaded	Replace filters

9.0 SAMPLE RECORD

Sampling Record/Schedule					

Represented By:

Important Notice

The information contained in this bulletin reflects the results of various testing and analytical procedures believed by PURAFIL, INC. (a USA corporation) to be useful indicators of the relative performance of air filtration systems and media. It is intended for use by persons having appropriate scientific and technical knowledge and experience, at their own risk. This bulletin does not in any way constitute a representation, warranty, promise, or guarantee by PURAFIL, INC. of the installed performance of PURAFIL® media.

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

10.2 - Portable Hoist

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

THERN

WINCHES AND CRANES

Read this Owner's Manual thoroughly before operating the equipment. Keep it with the equipment at all times. Replacements are available from Thern, Inc., PO Box 347, Winona, MN 55987, 507-454-2996. www.thern.com

IMPORTANT: Please record product information on page 2. This information is required when calling the factory for service.

ORIGINAL TEXT

COMMANDER

Owner's Manual

For

5PT10 and 5PT20 Series Portable Davit Cranes

A12376F-1216

Two-Year Limited Warranty

Please record the following:

Date Purchased:

Crane Model No.:

Crane Serial No.:

If sold with a winch:

Winch Model No.:

Winch Serial No.:

This information is required when calling the factory for service.

Thern, Inc. warrants its products against defects in material or workmanship for two years from the date of purchase by the original using buyer, or if this date cannot be established, the date the product was sold by Thern, Inc. to the dealer. To make a claim under this warranty, contact the factory for an RGA number. The product must be returned, prepaid, directly to Thern, Inc., 5712 Industrial Park Road, Winona, Minnesota 55987. The following information must accompany the product: the RGA number, the date of purchase, the description of the claimed defect, and a complete explanation of the circumstances involved. If the product is found to be defective, it will be repaired or replaced free of charge, and Thern, Inc. will reimburse the shipping cost within the contiguous USA.

This warranty does not cover any damage due to accident, misuse, abuse, or negligence. Any alteration, repair or modification of the product outside the Thern, Inc. factory shall void this warranty. This warranty does not cover any costs for removal of our product, downtime, or any other incidental or consequential costs or damages resulting from the claimed defects. This warranty does not cover brake discs, wire rope or other wear components, as their life is subject to use conditions which vary between applications.

FACTORY AUTHORIZED REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY IS THE EXCLUSIVE REMEDY TO THE CONSUMER. THERN, INC. SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY ON THIS PRODUCT. EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ON THIS PRODUCT IS LIMITED IN DURATION TO THE DURATION OF THIS WARRANTY.

Some states do not allow the exclusion or limitation of incidental or consequential damages, or allow limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Note: Thern, Inc. reserves the right to change the design or discontinue the production of any product without prior notice.

About This Manual

The Occupational Safety and Health Act of 1970 states that it is the employer's responsibility to provide a workplace free of hazard. To this end, all equipment should be installed, operated, and maintained in compliance with applicable trade, industrial, federal, state, and local regulations. It is the equipment owner's responsibility to obtain copies of these regulations and to determine the suitability of the equipment to its intended use.

This Owner's Manual, and warning labels attached to the equipment, are to serve as guidelines for hazard-free installation, operation, and maintenance. They should not be understood to prepare you for every possible situation.

The information contained in this manual is applicable only to the Thern Commander Series Model 5PT10 and 5PT20 Portable Davit Cranes. Do not use this manual as a source of information for any other equipment.

The following symbols are used for emphasis throughout this manual:

⚠WARNING

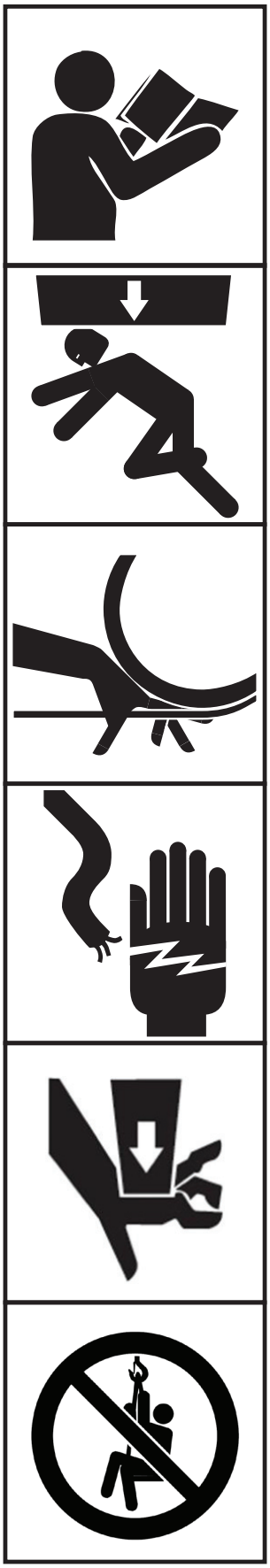
Failure to follow 'WARNING!' instructions may result in equipment damage, property damage, and/or serious personal injury.

⚠CAUTION

Failure to follow 'CAUTION!' instructions may result in equipment damage, property damage, and/or minor personal injury.

Important!

Failure to follow 'important!' instructions may result in poor performance of the equipment.



Suggestions for Safe Operation

⚠WARNING

DO the following:

Read and comply with the guidelines set forth in this Owner's Manual. Keep this manual, and all labels attached to the crane, readable and with the equipment at all times. Contact Thern, Inc. for replacements.

Check lubrication before use.

Install the wire rope securely to the winch drum.

Keep at least 4 wraps of wire rope wound on the drum at all times, to serve as anchor wraps. With less than 4 wraps on the drum the wire rope could come loose, causing the load to escape.

Keep hands away from sheaves, gears, wire rope, and other moving parts.

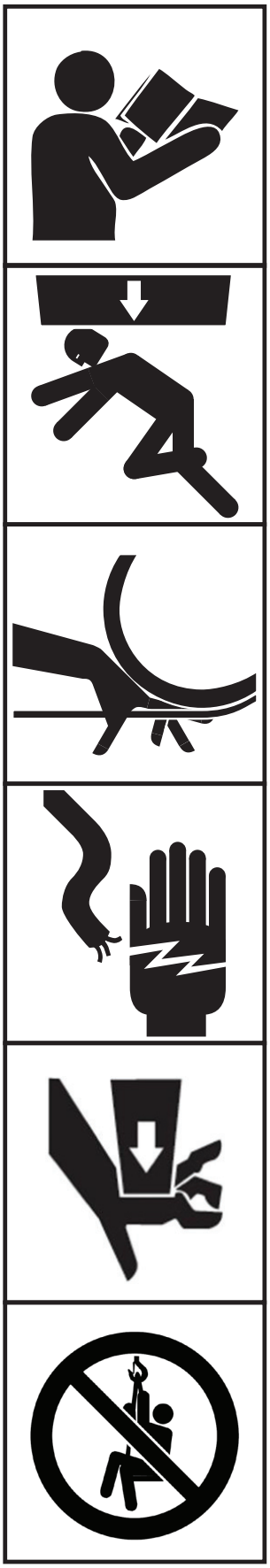
Disconnect electric power before servicing the equipment.

Keep all unnecessary personnel away from crane while in operation.

Keep out of the path of the load, and out of the path of a broken wire rope that might snap back and cause injury.

When operating the ratchet jack, avoid fully un-threading. Test the travel limits of the ratchet jack before assembly to the crane and before loading, to verify it does not fully un-thread. Contact Thern if it does fully un-thread.

Ensure that both threaded ends of the ratchet jack are threaded an equal distance out of the jack when assembled to the crane. If threaded ends are not equal, the crane boom will not be able to operate in its full range of motion, and equipment damage could occur.



Suggestions for Safe Operation (cont.)

DO NOT do the following:

Do not lift people, or things over people. Do not walk or work under a load or in the line of force of any load.

Do not exceed the load rating of the crane or any other component in the system. To do so could result in failure of the equipment.

Do not use more than one crane to move a load that exceeds the load rating of a single crane. A shift in load weight could overload the equipment.

Do not use damaged or malfunctioning equipment. To do so could result in failure of the equipment.

Do not modify the equipment in any way. To do so could cause equipment failure.

Do not wrap the wire rope around the load. This damages the wire rope and could cause the load to escape. Use a sling or other approved lifting device.

Do not operate the crane with guards removed or improperly installed.

Do not divert your attention from the operation. Stay alert to the possibility of accidents, and try to prevent them from happening.

Do not jerk or swing the load. Avoid shock loads by starting and stopping the load smoothly. Shock loads overload the equipment and may cause damage.

Do not use the crane and winch components for any use other than for their original intended function.

Do not use the crane to drag or pull loads. This will create side pulls, which could damage the equipment or cause the load to tip.

Do not leave a suspended load unattended. Place the load on the ground if it must be left unattended.

Do not adjust the winch brake with the load suspended.

Do not operate or apply loads without all pins securely in place.

Do not adjust the boom extension while the crane is loaded.

Do not force the ratchet handle past travel limits. This could sheer the travel limit pin and cause damage or injury.

1.1 Installing the Crane

Important!

- A qualified professional should inspect or design the foundation to insure that it will provide adequate support.
- Locate the crane so it will be visible during the entire operation.

⚠WARNING

Do not install the crane in an area defined as hazardous by the National Electric Code, unless installation in such an area has been thoroughly approved.

Do not install the crane near corrosive chemicals, flammable materials, explosives, or other elements that may damage the crane or injure the operator. Adequately protect the crane and the operator from such elements.

Position the crane so the operator can stand clear of the load, and out of the path of a broken wire rope that could snap back and cause injury.

Attach the crane to a rigid and level foundation that will support the crane and its load under all load conditions, including shock loading.

1.1.1 CONSULT APPLICABLE CODES AND REGULATIONS for specific rules on installing the equipment.

1.1.2 LOCATE THE CRANE in an area clear of traffic and obstacles that could interfere with operation. Make sure the crane is accessible for maintenance and operation.

1.1.3 INSTALL THE CRANE on a level surface. **An uneven surface may cause the boom to rotate in the direction the mast is leaning.**

1.1.4 FASTEN THE BASE securely to the foundation to withstand applicable overturning moments and mounting bolt reaction. See Table 1.

a FOR STANDARD PRODUCTS referred to in this manual, use 5/8-inch coarse thread fasteners, grade 5 or better. Recommended torque for Grade 5 bolts without lubrication is 150 ft-lb.

Refer to manufacturer's instructions for other fastener types with specific torque or installation instructions.

b NON-STANDARD PRODUCTS that vary from the original design may have different fastening requirements. Contact a structural engineer or Thern, Inc. for this information.

TO COMPLY WITH LOCAL CODES, CONTACT A QUALIFIED PROFESSIONAL TO OBTAIN PROPER STRUCTURE OR FOUNDATION SPECIFICATIONS FOR THE MOUNTING OF THERN PRODUCTS.

Table 1 - Crane Reactions[2]

				Pedestal Base		Wall Mount Base			
Crane Model	Mast Moment		Suggested Bolt Size	Axial Force per Bolt[1]		Axial Force per Bolt[1]		Shear Force per Bolt	
5PT10	37,790 in-lbs	4,270 N-m	5/8 inch (M16)	1,680 lbs	7,474 N-m	1,420 lbs	6,374 N	1,150 lbs	5,116 N
5PT20	95,110 in-lbs	10,747 N-m	5/8 inch (M16)	4,240 lbs	18,862 N-m	3,560 lbs	15,837 N	2,740 lbs	5,116 N

1 Force in tension.

2 This information may change without prior notice. It is the responsibility of the installer and/or end user to ensure the most current information is used.

1.2 Assembling the Crane

Important!

- Inspect the crane during assembly according to the Instructions for Periodic Inspection. This will give you a record of the condition of the crane with which to compare future inspections.
- Save all boxes and crates that the crane was shipped in, use them again if you need to repackage the crane.
- Contact the factory immediately if any parts are missing or damaged.
- Do not overtighten fasteners, this may strip threads or cause damage to other parts.

⚠CAUTION

When installing the ratchet jack, support the end of the boom so the boom does not fall and the ratchet jack does not swing up causing damage or injury.

When installing the boom extension, hold the boom extension securely so it does not slide abruptly in or out of the boom causing damage or injury.

1.2.1 STUDY PARTS DRAWINGS to understand how the crane is assembled. See pages 20-23.

1.2.2 LUBRICATE PINS and other components prior to assembly. See Section 3.2 - Lubricating the Crane.

1.2.3 INSTALL THE BASE. See Section 1.1 for additional information and crane overturning moments and mounting bolt reaction forces.

1.2.4 INSTALL THE FLANGE BEARING in the base. Bearing must be set level on the base.

1.2.5 ASSEMBLE THE CRANE in the following order.

a FASTEN THE WINCH to the mounting plate using the fasteners provided. On some models you will need to use an additional winch adapter plate and fasteners provided to fasten the winch to the crane. **Make sure the winch is positioned correctly with the winch drum facing toward the load. See Figure 3.**

b INSTALL THE MAST in the base. Move the mast side-to-side to make sure the bottom of the mast properly seats on the pin in the bottom of the base. **The crane will not be stable unless properly seated. See Figure 2.**

c FASTEN THE BOOM to the mast using the clevis pin and lynch pin provided. **Make sure the boom is positioned correctly, with the carrying handles located on the same side as the handles on the mast.**

d INSTALL THE HANDLE using the mast clevis pin and lynch pin provided.

Figure 1 – Crane Packaging

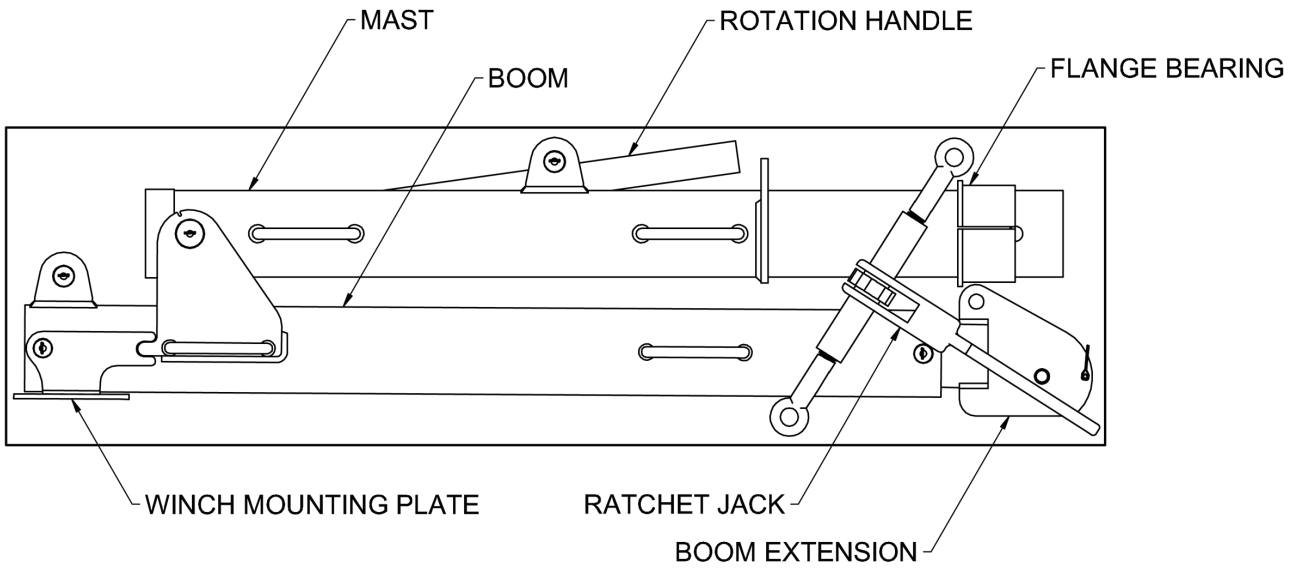


Figure 2 – Assembly Steps

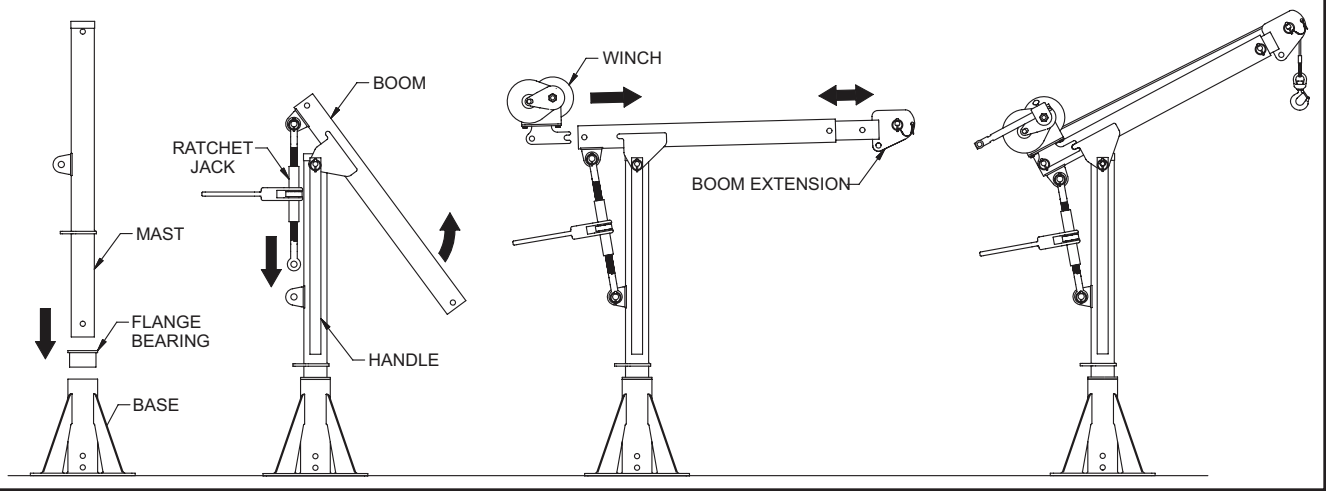


Figure 3 – Winch Mounting

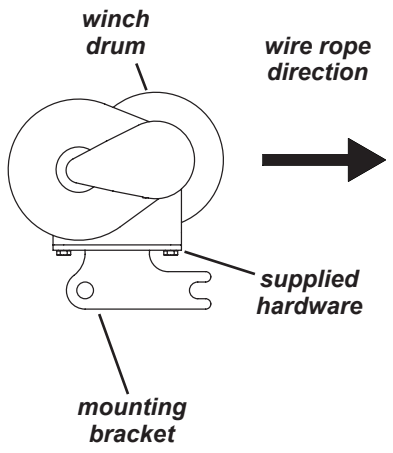
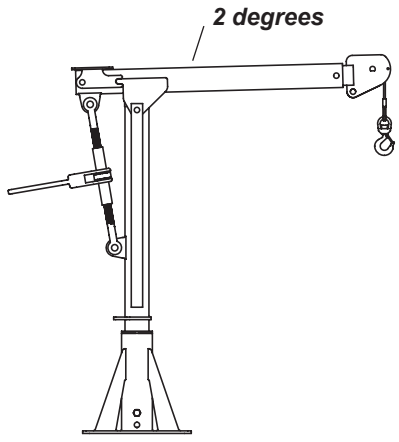


Figure 4 – Lowest Boom Angle



e BEFORE INSTALLING THE RATCHET JACK Ensure that both threaded ends of the ratchet jack are threaded an equal distance out of the jack when assembled to the crane. If threaded ends are not equal, the crane boom will not be able to operate in its full range of motion, and equipment damage could occur.

f INSTALL THE RATCHET JACK by fastening one end of the ratchet jack to the mounting ear on the boom with the clevis and lynch pin provided. Carefully pivot the boom up until the other end of the ratchet jack aligns with the mounting ear on the mast, and secure the ratchet jack to the mast using the clevis pin and lynch pin provided.

g ADJUST THE BOOM with the ratchet jack so the boom is slightly above the lowest boom angle. See Figure 4. **Do not lower boom below the lowest point, or the boom could fall and may result in the load escaping.**

h SLIDE THE BOOM EXTENSION into the boom, and secure in place with the clevis pin and lynch pin provided. **Make sure the boom extension is positioned correctly. See Figure 2.**

i INSTALL THE WINCH onto the boom. Slide into position and secure with provided clevis pin and lynch pin.

1.2.6 INSTALL THE WINCH HANDLE on hand winches, or connect electric current on power winches. Refer to instructions in the Winch Owner's Manual.

1.2.7 INSTALL THE WIRE ROPE. **Use wire rope assemblies in the length specified on page 24-25.**

a REMOVE ROPE KEEPER PIN at the sheave to allow rope to be installed.

b PASS THE WIRE ROPE over the sheave at the end of the boom.

c REINSTALL ROPE KEEP PIN to prevent the rope from escaping the sheave rope groove.

d ANCHOR THE WIRE ROPE to the winch drum and wind 4 wraps of wire rope onto the drum to act as anchor wraps. Refer to the instructions in the Winch Owner's Manual.

1.2.8 MAKE SURE ALL CLEVIS PINS ARE PROPERLY INSTALLED with all lynch pins in place to prevent components from shifting during use.

1.2.9 ADJUST BOOM ANGLE for the desired position using the ratchet-jack (if equipped). See Figure 2.

2.1 General Theory of Operation

Important!

- Limit nonuniform winding by keeping tension on the wire rope.
- It is your responsibility to detect and account for different factors affecting the condition and performance of the equipment.

2.1.1 THE INTENDED USE of this machinery is to lift and lower loads of its rated capacity or less. It is not for lifting people or things over people.

2.1.2 THE FORCE REQUIRED to lift the load must not exceed the load rating of the crane. Consider the total force required to lift the load, not the weight of the load.

2.1.3 THIS EQUIPMENT CAN develop forces that will exceed the load rating. It is the responsibility of the equipment user to limit the size of the load. Inspect the equipment regularly for damage according to the instructions contained in this manual.

2.1.4 PERFORMANCE RATINGS of the equipment are affected by the position of the boom, the amount of wire rope you use and whether you use a single or two part line. **Crane load ratings decrease as you extend the reach.** See the Performance Characteristics Tables on page 24-25.

a LOAD RATING represents the maximum force that can be placed on new equipment.

b LIFT varies with the position of the boom, the length of the wire rope, and the rigging configuration (single or two part line).

c REACH varies with the position of the boom.

2.1.5 DUTY RATINGS refer to the type of use the equipment is subject to. Consider the following when determining duty rating.

a ENVIRONMENT: harsh environments include hot, cold, dirty, wet, corrosive, or explosive surroundings. **Protect the equipment from harsh environments when possible.**

b MAINTENANCE: poor maintenance, meaning poor cleaning, lubrication, or inspection, leads to poor operation and possible damage of the equipment. **Minimize poor maintenance by carefully following the instructions contained in this manual.**

c LOADING: severe loading includes shock loading and lifting loads that exceed the load rating of the equipment. **Avoid shock loads, and do not exceed the load rating of the equipment.**

d FREQUENCY OF OPERATION: frequent or lengthy operations increase wear and shorten the life span of gears, bearings, sheaves, and other components. **Increase maintenance of the equipment if used in frequent operations.**

2.1.6 AIRBORNE NOISE EMISSIONS vary depending on load and the type of winch being used. Standard configurations do not typically exceed a sound pressure level of 80dB(A) at workstations.

2.1.7 VIBRATION LEVELS vary depending on load and type of winch being used. Standard configurations do not typically exceed vibration levels of 2.5 m/s^2.

CONTACT THE FACTORY FOR MORE INFORMATION.

2.2 Preparing for Operation

Important!

- When determining whether the load will exceed the load rating, consider the total force required to move the load.

⚠WARNING

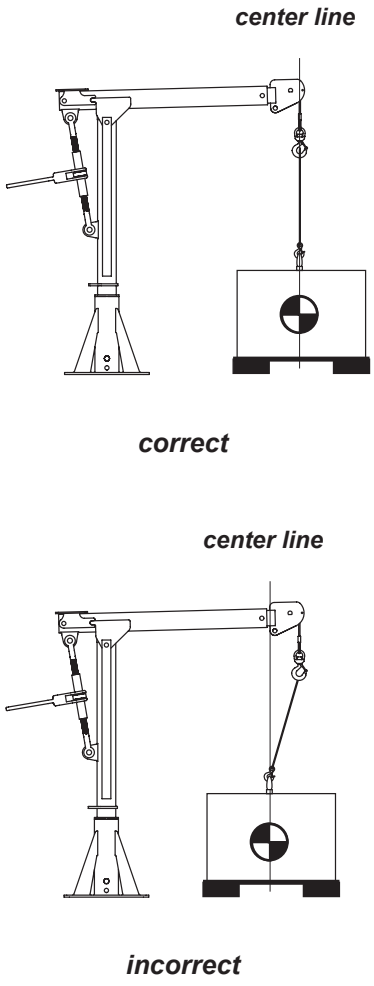
When operating the ratchet jack, avoid fully un-threading. Test the travel limits of the ratchet jack before assembly to the crane and before loading, to verify it does not fully un-thread. Contact Thern if it does fully un-thread.

Do not force the ratchet handle past travel limits. This could shear the travel limit pin and cause damage or injury.

⚠CAUTION

When adjusting boom length, set the boom angle just above the lowest angle and hold the boom extension securely so it does not slide abruptly in or out of the boom causing damage or injury.

Figure 5 – Positioning the Boom



2.2.1 CONSIDER THE OPERATION. Do not begin until you are sure you can perform the entire operation without hazard.

2.2.2 INSPECT ALL COMPONENTS of the system.

a INSPECT THE CRANE and other equipment according to the Instructions for Frequent Inspection.

b INSPECT THE WINCH according to the instructions in the Winch Owner's Manual.

c OPERATORS must be in good health, alert, thoroughly trained in operating the equipment, and properly clothed (hard hat, safety shoes and safety glasses, no loose clothing).

d THE LOAD must be clear of other objects and free to move. Make sure the load will not tip, spin, roll away, or in any way move uncontrollably.

2.2.3 KNOW YOUR LOAD and make sure you do not exceed the load rating of the crane or any other equipment in the system.

2.2.4 POSITION THE BOOM so the load hook is centered over the load. **Avoid side pulls which could damage the crane or cause the load to tip. See Figure 5.**

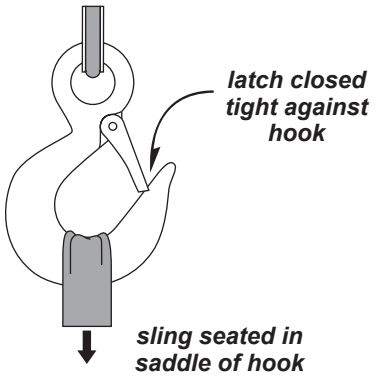
a ADJUST BOOM LENGTH by moving the boom extension in or out. **Do not make adjustments while the crane is loaded. The load rating decreases as you increase boom length. See the Performance Characteristics Tables page 24-25.**

b ADJUST BOOM ANGLE by operating the ratchet jack to raise or lower the boom. **The lift height below base level decreases as you raise the boom. See the Performance Characteristics Tables page 24-25.**

2.2.5 CONFIGURE THE CRANE for single part or two-part line operation. **Load ratings may increase with two-part line, lift height below base level will decrease with two part line. See the Performance Characteristics Tables on page 25.** Study parts drawing on page 22.

2.3 Attaching the Load

Figure 6 – Attaching Load



⚠WARNING

Do not wrap the wire rope around the load. This damages the wire rope and could cause the load to escape. Use a sling or other approved lifting device.

2.3.1 CLEAR OBJECTS from the path of the load so you can move it freely and observe it at all times during the operation.

2.3.2 MAKE SURE THE WIRE ROPE is not twisted. A twisted wire rope could cause the load to spin when it is raised off the ground.

2.3.3 ATTACH THE LOAD using a nylon sling, or other approved lifting device. Follow the recommendations of the sling manufacturer.

a SEAT THE SLING in the saddle of the hook with the hook latch completely closed. See Figure 6.

b CENTER THE LOAD on the hook so it will remain balanced and not tip or rotate to one side.

2.4 Moving the Load

Important!

- Obey a stop signal from anyone.
- Maintain tension on the wire rope to keep it tightly and evenly wound on the drum.
- If the crane and load are not visible during the entire operation, get help from another person.
- Appoint a supervisor if more than one person is involved in the operation. This will reduce confusion and increase safety.
- When lifting a load, use a tag line to keep the load from swinging or twisting, while keeping yourself away from the load.

⚠WARNING

When operating the ratchet jack, avoid fully un-threading. Test the travel limits of the ratchet jack before assembly to the crane and before loading, to verify it does not fully un-thread. Contact Thern if it does fully un-thread.

Do not force the ratchet handle past travel limits. This could shear the travel limit pin and cause damage or injury.

2.4.1 MOVE THE LOAD slowly and smoothly, only a small distance at first. Make sure the load is balanced and securely attached before continuing.

2.4.2 OPERATE THE WINCH to raise or lower the load. Refer to the instructions in the Winch Owner's Manual**.**

2.4.3 OBSERVE THE WIRE ROPE as it winds onto the drum. If it becomes loose, uneven, or overlapped, stop the operation and rewind the wire rope before continuing. **Continued operation with overlapped or uneven wire rope can damage the wire rope and shorten its life.**

2.4.4 OPERATE THE RATCHET JACK if necessary, to adjust the angle of the boom to keep the sheave centered over the load.

2.4.5 ROTATE THE BOOM to move the load side-to-side.

a ROTATE THE BOOM slowly and smoothly to avoid swinging the load or causing shock loads. **Do not jam the boom against other objects.**

b USE THE HANDLE to rotate the boom. **Do not push or pull the load or the wire rope to rotate the boom.**

3.1 Cleaning the Crane

Important!

Increase the frequency of maintenance procedures if the crane is:

- Operated for long periods.
- Used to lift heavy loads.
- Operated in wet, dirty, hot, or cold surroundings.

Clean the crane to remove dirt and help prevent rust and corrosion.

3.1.1 CLEAN THE CRANE every six months or whenever it is dirty.

a WIPE ALL EQUIPMENT to remove dirt and grease.

b LEAVE A LIGHT FILM of oil on all surfaces to protect against rust and corrosion.

c WIPE OFF excessive amounts of oil to avoid the accumulation of dirt.

3.1.2 REMOVE UNNECESSARY OBJECTS from the area surrounding the crane.

3.2 Lubricating the Crane

Important!

- Make sure lubricant has a temperature rating appropriate for the ambient temperatures of the operation.

Lubricate the crane properly to help protect it from wear and rust. Read the following instructions carefully.

3.2.1 LUBRICATE ALL PINS before installation and at least every 3 months. Use a grease brush to apply a light film of NLGI #2 grease to all pins.

3.2.2 LUBRICATE THE BASE PIN located on the bottom of the base before installation and at least every 3 months. Use a grease brush to apply a film of NLGI #2 grease to the pin.

3.2.3 LUBRICATE THE MAST BEARING located on top of the base before installation and at least every 3 months. Use a grease gun to apply NLGI #2 grease to the outside surfaces (between bearing and base).

3.2.4 LUBRICATE THE RATCHET JACK before installation and at least every 3 months. Use a grease gun to apply NLGI #2 grease to the grease fittings on the ratchet jack until excess grease can be seen. Wipe away any excess lubricant.

3.2.5 LUBRICATE THE WINCH. Refer to the Winch Owner's Manual for instructions.

3.2.6 LUBRICATE THE WIRE ROPE and other equipment by following the manufacturer's recommendations.

3.3 Disassembling the Crane

⚠CAUTION

When removing the boom extension, hold the boom extension securely so it does not slide abruptly in or out of the boom causing damage or injury.

When removing the ratchet jack, support the end of the boom so the boom does not fall and the ratchet jack does not swing up causing damage or injury.

3.3.1 STUDY PARTS DRAWINGS to understand how the crane is assembled. See pages 20-23.

3.3.2 REMOVE ANY ATTACHED LOAD from the wire rope.

3.3.3 REMOVE THE WIRE ROPE

a REMOVE THE ROPE KEEPER PIN located at the end of the boom.

b UNWIND THE ROPE from the winch drum and release the anchor.

c REPLACE THE ROPE KEEPER PIN

3.3.4 REMOVE THE WINCH HANDLE on hand winches, or disconnect electric current on power winches. Refer to instructions in the Winch Owner's Manual.

3.3.5 REMOVE THE WINCH and mounting bracket from the boom. Replace the clevis pin to prevent loss.

3.3.6 REMOVE THE BOOM EXTENSION.

a ADJUST THE BOOM ANGLE using the ratchet jack, so the boom is just slightly above horizontal.

b SECURE THE BOOM EXTENSION then remove the lynch pin and clevis pin securing the boom extension to the boom.

c CAREFULLY PULL THE BOOM EXTENSION out of the boom, then reinstall the clevis pin and lynch pin in the boom.

3.3.7 REMOVE THE RATCHET JACK.

a SECURE THE BOOM to prevent it from falling when the ratchet jack is released.

b DISCONNECT THE RATCHET JACK at the mast (bottom) by removing the lynch pin and clevis pin and slowly lower the boom until it is resting against the mast. Be careful that the ratchet jack does not swing up and cause injury.

c REMOVE THE PIN AT THE BOOM (top) to disconnect the ratchet jack from the crane. Hold onto the ratchet jack to prevent it from falling away.

d RECONNECT the clevis pins to the boom and mast with the appropriate lynch pins.

3.3.8 REMOVE THE ROTATION HANDLE from the mast.

3.3.9 DISCONNECT THE BOOM from the mast.

a SECURE THE BOOM to prevent it from falling away when the pins are removed.

b REMOVE THE LYNCH PIN AND CLEVIS PIN and carefully remove the boom.

c REPLACE the clevis pin and lynch pin in the mast.

3.3.10 REMOVE THE MAST from the base by lifting it straight out of the base.

3.3.11 REMOVE THE BEARING from the base. Install a cap over the base to prevent debris and other contaminants from getting into the base.

3.4 Inspecting the Equipment

Important!

- Start an inspection program as soon as you put the crane into use.
- Appoint a qualified person to be responsible for regularly inspecting the equipment.
- Keep written records of inspection. This allows comparison with comments from previous inspections so you can see changes in condition or performance.

Perform frequent inspections:

- Before each operation.
- Every 3 hours during operation.
- Whenever you notice signs of damage or poor operation.

Frequent Wire Rope Inspection:

- Use ASME B30.7 as a guideline for rope inspection, replacement and maintenance.
- Check the wire rope, end connections and end fittings for corrosion, kinking, bending, crushing, birdcaging or other signs of damage.
- Check the number, distribution and type of visible broken wires. See paragraph 3.4.4 b and Figure 7.
- Check the wire rope for reduction of rope diameter from loss of core support, or wear of outside wires. See Figure 9.
- Take extra care when inspecting sections of rapid deterioration such as sections in contact with saddles, sheaves, repetitive pickup points, crossover points and end connections.

⚠WARNING

Do not use damaged or malfunctioning equipment. Place an "OUT OF ORDER" sign on the crane. Do not use the crane until the sign is removed by a qualified person who has completely corrected the problem.

Inspect the crane to detect signs of damage or poor operation before they become hazardous. See Table 2 Inspection Checklist.

3.4.1 CONSULT APPLICABLE CODES AND REGULATIONS for specific rules on inspecting the crane and other equipment.

3.4.2 REFER TO THE WINCH OWNER'S MANUAL for information regarding winch inspection.

3.4.3 **Instructions for Frequent Inspection**

a VISUALLY INSPECT the entire crane and all other equipment involved in the operation.

- Check all equipment for cracks, dents, bending, rust, wear, corrosion and other damage.
- Make sure the wire rope is installed correctly and anchored securely.
- Make sure the entire crane is properly lubricated.
- Make sure all fasteners are tight and secure.
- Make sure mounting fasteners are tightened securely.
- Check the ratchet jack for signs of leakage or damage, and make sure it operates smoothly to raise and lower the boom.
- Make sure the foundation is in good condition, and capable of supporting the crane and its load under all load conditions.

b TEST CRANE PERFORMANCE by operating the crane with a load not exceeding the load rating.

- Listen for unusual noises, and look for signs of damage as you operate the crane.
- Make sure the wire rope winds evenly and tightly onto the drum. If it is loose or uneven, rewind it before continuing.
- Make sure the load moves smoothly, without hesitation or strain.
- On hand operated models, make sure the winch handle rotates freely in both directions.
- On power operated models, make sure the winch responds to the control device. It must rotate as shown on the control labels, and it must turn off when you release the control.
- Make sure the boom rotates freely when you push the handle, and remains stationary when you release it.
- Check the winch brake. Raise the load, then lower it and stop it a few feet off the ground. If the load continues to coast or creep under normal operating conditions, the brake may be worn and in need of repair or replacement. Contact the factory.

Completely correct all problems before continuing. Use the Troubleshooting Chart to help determine the cause of certain problems. See Table 3.

Table 2 – Inspection Checklist

checked boxes indicate damage or problem in need of repair

	damages	problems
general	☐ finish weathered, flaking, otherwise damaged	☐ equipment not properly lubricated
	☐ parts cracked, bent, rusted, worn, otherwise damaged	☐ unusual noises, other signs of malfunction
foundation	☐ loose, unstable, otherwise damaged	☐ not level - boom swerves
fasteners	☐ stripped threads, bent, worn, otherwise damaged	☐ loose, not tightened to the proper torque
boom assembly	☐ holes worn, distorted, or otherwise damaged	☐ does not rotate freely
winch assembly	☐ gears, bearings, and other parts worn, otherwise damaged	☐ winch jerks or hesitates under load
	☐ brake corroded, cracked, worn, otherwise damaged	☐ brake does not operate properly
sheaves	☐ holes worn, distorted, or otherwise damaged	☐ does not rotate freely
wire rope	☐ bent, crushed, otherwise damaged	☐ wire rope loosely or unevenly wound
	☐ broken wires, see Figure 7	
	replace if more than 6 wires in one lay,	number per strand =
	or 3 wires in one strand in one lay, are broken	number per lay =
	☐ diameter reduced, see Figure 9	
	replace if diameter is excessively worn	diameter =
end connections	☐ corroded, rusted, worn, otherwise damaged	☐ not securely attached
load hook	☐ twisted, bent, worn, otherwise damaged, see Figure 8	☐ hook latch fails to close when released
	replace if twist is 10 degrees or more	twist =
	replace if throat width is 15% larger than nominal	throat width =
	replace if thickness is 10% less than nominal	thickness =
labels and plates	☐ dirty, illegible, otherwise damaged	☐ loosely attached or missing

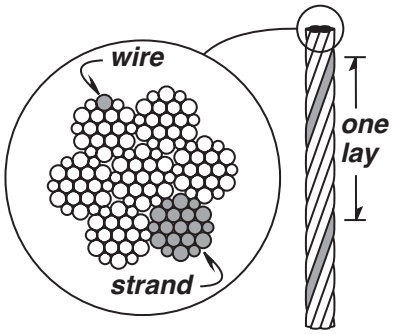
comments:

authorized signature: _____ **date** _____

Perform periodic inspections:

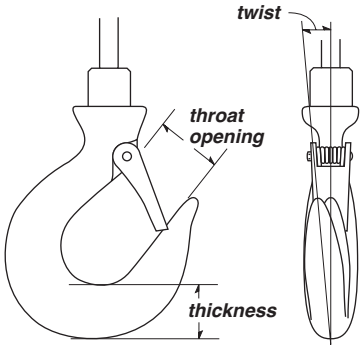
- Every 6 months.
- Whenever you return the crane to service from storage.
- Whenever you notice damage or poor operation in a frequent inspection.
- Whenever you have, or think you may have, overloaded or shock loaded the crane.

Figure 7 – Broken Wires



Wire rope assembly must be replaced if more than 6 wires are broken in one lay, or if more than 3 wires are broken in one strand in one lay.

Figure 8 – Load Hook Inspection



The wire rope assembly must be replaced if the throat opening is 15% wider than nominal, if the thickness is 10% less than nominal, or if the hook is twisted 10° or more.

3.4.4 Instructions for Periodic Inspection

a VISUALLY INSPECT the crane and all other equipment.

- Check the finish for wear, flaking, or other damage.
- Check all equipment for cracks, dents, bending, rust, wear, corrosion and other damage. If the equipment was overloaded, or if you notice cracks and other signs of overloading and damage, promptly remove equipment from use and have it repaired or replaced. **DO NOT CONTINUE TO USE DAMAGED OR OVERLOADED EQUIPMENT OR WIRE ROPE**.
- Check all fasteners for stripped threads, wear, bending, and other damage.
- Make sure the entire crane is properly lubricated.
- Check the ratchet jack for signs of leakage or damage, and make sure it operates smoothly to raise and lower the boom.
- Remove the ratched jack from the crane assembly. Test the travel limits of the ratchet jack. Make sure it does not fully un-thread.
- Make sure all labels and plates are readable, firmly attached, free of damage and clean. Replacements are available from the factory.

b INSPECT THE WIRE ROPE according to the wire rope manufacturer's recommendations, or follow accepted industry standards for wire rope inspection.

- Always wear protective clothing when handling wire rope.
- Check the entire length of wire rope for bent wires, crushed areas, broken or cut wires, corrosion, and other damage. Carefully inspect areas that pass over sheaves or through roller guides.
- Note the location and concentration of broken wires. Replace wire rope if more than 6 wires are broken in one lay, or more than 3 wires are broken in one strand in one lay. See Figure 7.
- Make sure the load hook or other device is securely attached to the wire rope, and the wire rope where it is attached is not frayed, corroded, broken, or otherwise damaged.
- Measure the throat opening, thickness, and twist of the hook. Replace the hook if it shows signs of damage. See Figure 8.
- Make sure hook latch opens without binding and closes when released.
- Check the anchor holes in the drum and the surrounding area for signs of wear or distortion.

c PLACE enough weight to keep the wire rope straight and tightly drawn.

- Measure the diameter of the wire rope, especially in areas where wear is noticeable. Replace the wire rope if the diameter measures below the minimum diameter at any point. See Figure 9.

d REMOVE THE WINCH and inspect it by following the instructions in the Winch Owner's Manual.

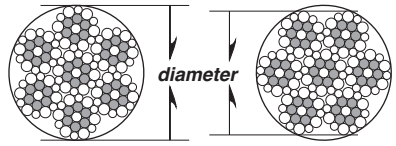
e DISASSEMBLE THE CRANE. Inspect each component for damage.

f REMOVE THE CRANE BASE from the foundation.

- Check fasteners for stripped threads, wear, bending, and other damage.
- Check the foundation for cracks, corrosion, and other damage.

g FASTEN THE CRANE BASE securely to the foundation.

Figure 9 – Rope Diameter



The wire rope assembly must be replaced if the diameter measures less than the minimum diameter at any point.

wire rope size	minimum diameter
3/16 in	11/64 in (.1719 in)
1/4 in	15/64 in (.2344 in)
5/16 in	19/64 in (.2969 in)

h REASSEMBLE THE CRANE.

i TEST CRANE PERFORMANCE by operating the crane with a load equal to the load rating.

- Listen for unusual noises, and look for signs of damage as you operate the crane.
- Make sure the wire rope winds evenly and tightly onto the drum. If it is loose or uneven, rewind it before continuing.
- Make sure the load moves smoothly, without hesitation or strain.
- On hand operated models, make sure the winch handle rotates freely in both directions.
- On power operated models, make sure the winch responds to the control device. It must rotate as shown on the control labels, and it must turn off when you release the control.
- Make sure the boom rotates freely when you push the handle, and remains stationary when you release it.
- Check the brake. Raise the load, then lower it and stop it a few feet off the ground. If the load continues to coast or creep under normal operating conditions, the brake may be worn and in need of repair or replacement. Contact the factory.

Completely correct all problems before continuing. Use the Troubleshooting Chart to help determine the cause of certain problems. See Table 3.

Table 3 – Troubleshooting Chart

problem	cause	correction
overheating	• operated too long without rest	allow to cool
	• load too heavy	lighten load
	• poor lubrication	inspect and lubricate as necessary
	• bearing seized up	inspect and replace as necessary
boom bounces up and down	• load too heavy	lighten load
	• mounting bolts loose	tighten mounting bolts to proper torque
	• sheave worn or damaged	inspect and replace as necessary
	• foundation loose or unlevel	inspect and repair as necessary
	• winch gears worn or damaged	inspect and repair as necessary
boom does not rotate	• rotation points contaminated or worn	inspect and repair as necessary
	• flange bearing broken or locked	inspect and replace as necessary
boom rotates on its own	• foundation loose or unlevel	inspect and repair as necessary
	• mast bent, distorted, or leaning	inspect and repair as necessary
unusual noises		
high pitched squeak	• poor lubrication	lubricate entire crane properly
grinding noise	• contaminated lubricant at rotation points	clean and lubricate rotation points
rattling noise	• loose bolts, set screws or other fasteners	tighten all bolts and other fasteners
resistance felt in ratchet jack - boom not able to raise or lower to the published angle limits	• threaded ends of ratchet jack do not protrude equally from the jack	Adjust the threaded rod ends by removing the jack and turning the ends until an equal amount of threads are showing
ratchet jack fully un-threads	• travel limit pin damaged	contact Thern

Refer to the Winch Owner's Manual for possible problems with the winch and brake.

3.5 Repairing the Crane

Important!

- It is your responsibility to determine when to replace parts. When considering whether to continue using a part or to replace it, remember that replacing it is the best way to avoid further equipment damage.
- Appoint a qualified person to be responsible for all repairs to the equipment.

3.5.1 GET FACTORY AUTHORIZATION for all repairs. Unauthorized repairs will void the warranty, and may lead to damage or failure of the crane.

3.5.2 REPLACE DAMAGED OR POORLY OPERATING PARTS with Thern repair parts.

3.5.3 REFINISH AREAS where the paint is worn or flaking. A good finish helps to protect against corrosion and weather damage.

a REMOVE THE FINISH from damaged areas, down to the bare metal.

b CLEAN THE AREA thoroughly.

c REPAINT with a high quality primer and finishing coat.

3.5.4 TO ORDER REPAIR PARTS, contact your local dealer. Include the following information when ordering:

- model number
- serial number (or code number)
- part number
- date purchased, and from whom
- description of what happened, or what is wrong
- your name and return address

Table 4 – Crane Weight Chart

	Model 5PT10		Model 5PT20	
Component	**LB**	**KG**	**LB**	**KG**
Mast Assembly	36	16.3	66	29.9
Boom Assembly	34	15.4	75	34.0
Boom Ext Assembly	24	10.9	46	20.9
Ratchet Jack	12	5.5	12	5.5
Handle	7	3.2	7	3.2
TOTAL	**113**	**51.3**	**206**	**93.5**
Winch (including bracket)	**LB**	**KG**	**LB**	**KG**
M1 (M4312PB-K)	30	13.6	34	15.4
M3 (M4312PBSS-K)	30	13.6	34	15.4
M2 (4WM2-K)	40	18.2	44	20.0
E2 (4WP2-K)	75	34.0	79	35.8
E4 (4777-K)	97	44.0	101	45.8
E4DC (4777DC-K)	121	54.9	124	56.3

4.1 Transporting the Crane

Important!

- Keep a record of what you ship, and when you send it.

4.1.1 PARTIALLY DISASSEMBLE THE CRANE into components that can be transported.

4.1.2 PACK THE CRANE for transport, using the original packaging materials, if appropriate.

4.1.3 PACK THE WINCH for transport, using the original packaging materials, if appropriate. Please see the winch owner's manual for instructions.

4.1.4 REASSEMBLE THE CRANE at its new location following the instructions under Section 1.2 - Assembling the Crane.

4.1.5 INSPECT THE CRANE according to the Instructions for Frequent Inspection before installing it for operation. See Section 3.4.3 - Instructions for Frequent Inspection.

4.2 Storing the Crane

4.2.1 PARTIALLY DISASSEMBLE THE CRANE and store all parts in a cool clean place away from corrosive chemicals and moisture.

4.2.2 SEAL THE CRANE in plastic with a desiccant to help protect it from rust, corrosion, and other damage.

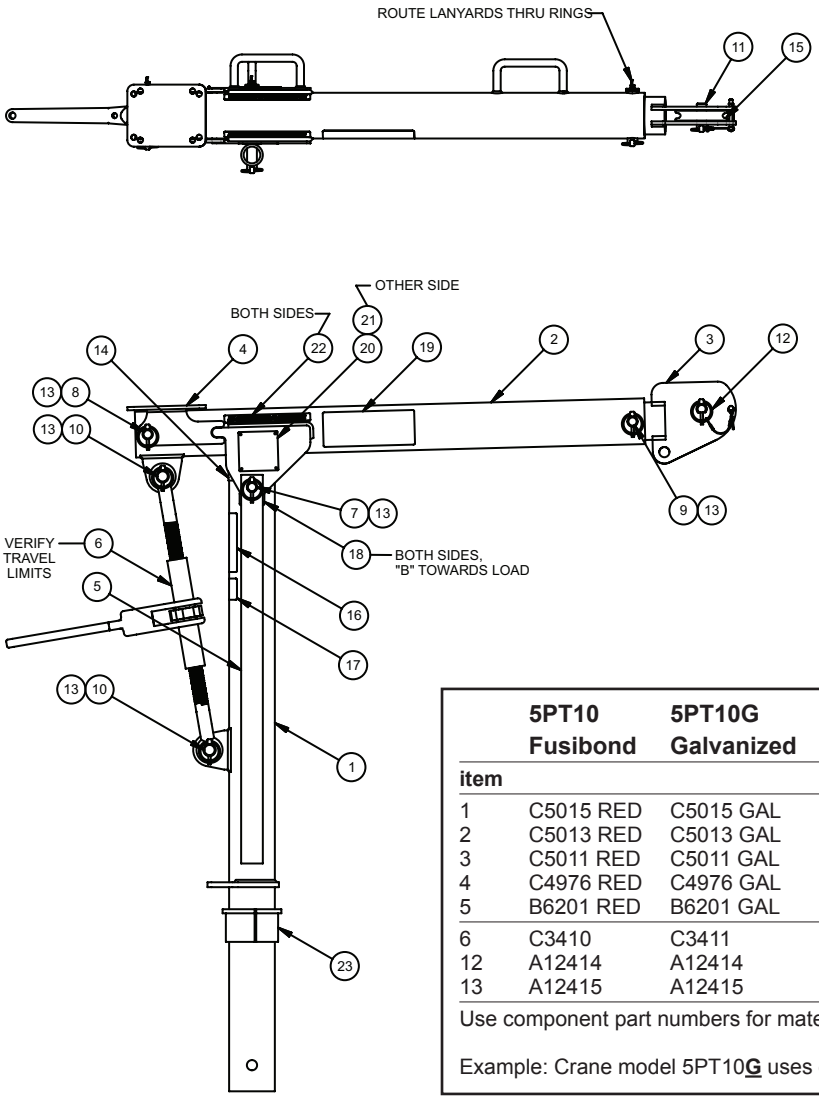
4.2.3 SEAL THE WINCH in plastic with a desiccant to help protect it from rust, corrosion, and other damage. Please see the winch owner's manual for instructions.

4.2.4 REASSEMBLE THE CRANE at its new location according to Section 1.2 - Assembling the Crane.

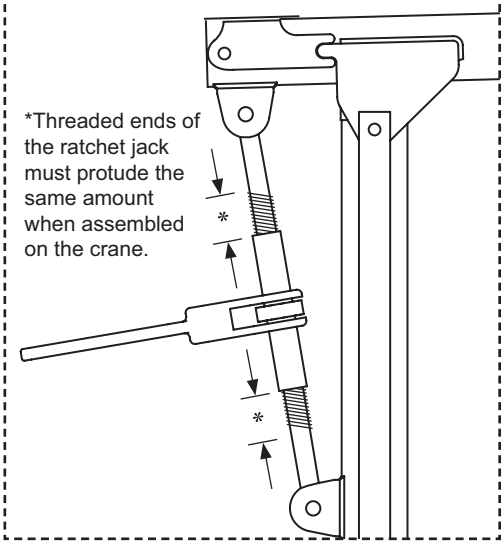
4.2.5 INSPECT THE CRANE according to Section 3.4.4 - Instructions for Periodic Inspection before installing it for operation.

Model 5PT10

item	description	part number	qty.	material
1	WELDMENT MAST 5PT10	C5015	1	SEE TABLE
2	WELDMENT BOOM 5PT10	C5013	1	SEE TABLE
3	WELDMENT BOOM EXTENSION 5PT10	C5011	1	SEE TABLE
4	WELDMENT WINCH MOUNT 5Px10	C4976	1	SEE TABLE
5	HANDLE ROTATION 5PT	B6201	1	SEE TABLE
6	JACK SCREW	SEE TABLE	1	
7	PIN CLEVIS .750 X 6.125 EFF LENGTH SST	A12310	1	
8	PIN CLEVIS .750 X 4.250 EFF LENGTH SST	A12311	1	
9	PIN CLEVIS .750 X 3.750 EFF LENGTH SST	A12312	1	
10	PIN CLEVIS .906 X 2.750 EFF LENGTH SST	A12313	2	
11	PIN CLEVIS .750 DIA 5PT SHEAVE SST	A12314	1	
12	PIN LYNCH D ASSY	SEE TABLE	1	
13	PIN LYNCH ASSY - LANYARD NOT SHOWN	SEE TABLE	5	
14	PLUG FINISH RND 3.000 X SCH 40-160 RED	A13550	1	
15	SHEAVE ASSEMBLY	B2462	1	
16	LABEL WARNING	B5790	1	
17	LABEL WARNING BEFORE LOADING	B6229	1	
18	LABEL BOOM RANGE INDICATOR	B6230	2	
19	LABEL LOAD RATING 5PT10	B6231	1	
20	LABEL NAMEPLATE CRANES CE	A11529	1	
21	LABEL THERN 1.00 X 3.20	A6889	1	
22	LABEL MODEL COMMANDER	B6291	2	
23	FLANGE BEARING	B6592	1	



Adjustable Ratchet Jack - Verify Travel Limits



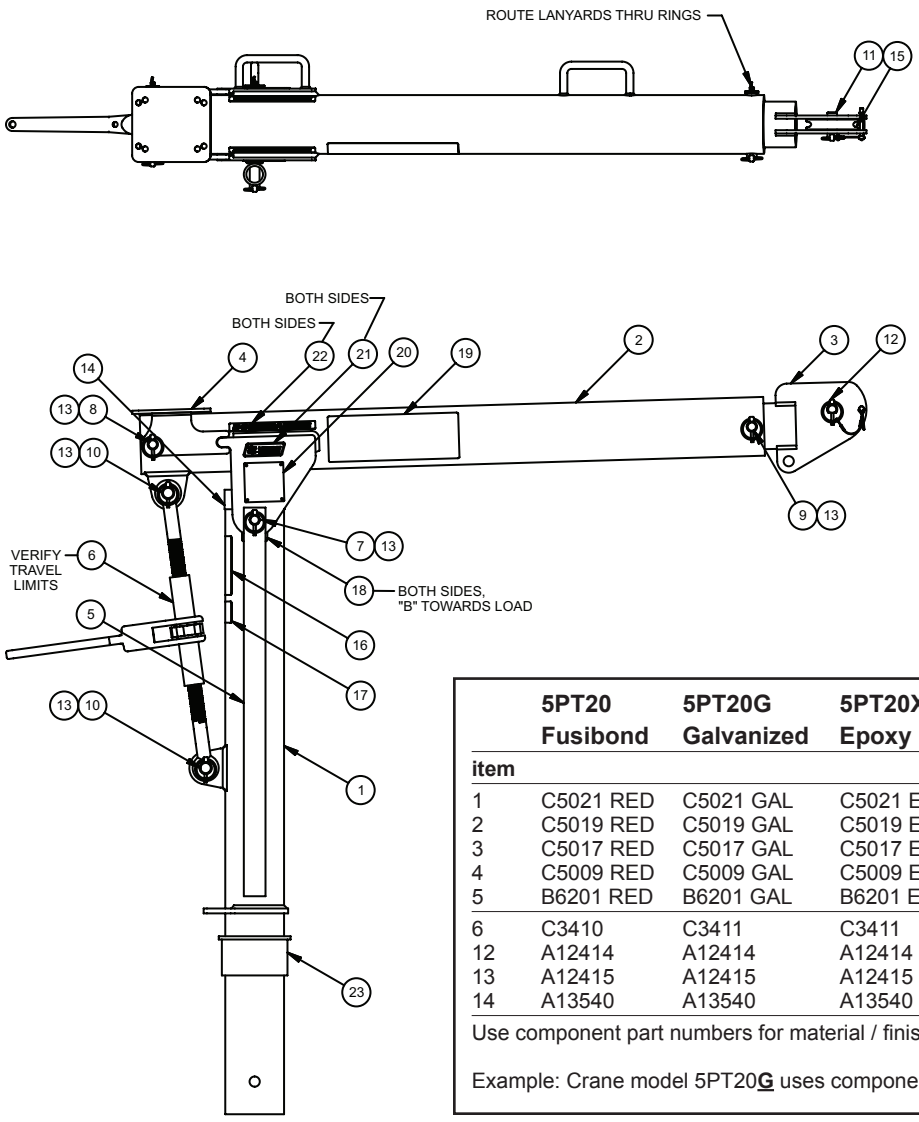
	5PT10 Fusibond	5PT10G Galvanized	5PT10X Epoxy	5PT10S Stainless	5PT10S316 Stainless316
item					
1	C5015 RED	C5015 GAL	C5015 EGRA	C5015 SS	C5015 SS316
2	C5013 RED	C5013 GAL	C5013 EGRA	C5013 SS	C5013 SS316
3	C5011 RED	C5011 GAL	C5011 EGRA	C5011 SS	C5011 SS316
4	C4976 RED	C4976 GAL	C4976 EGRA	C4976 SS	C4976 SS316
5	B6201 RED	B6201 GAL	B6201 EGRA	B6201 SS	B6201 SS316
6	C3410	C3411	C3411	C3411	C3411
12	A12414	A12414	A12414	A12414 SS	A12414 SS
13	A12415	A12415	A12415	A12415 SS	A12415 SS316

Use component part numbers for material / finish that matches crane model number.

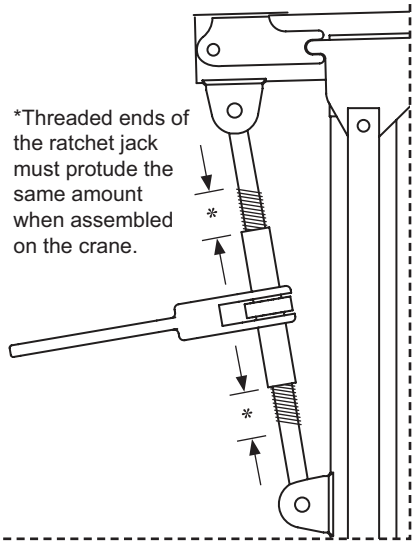
Example: Crane model 5PT10**G** uses components with part numbers XXXXX**GAL**.

Model 5PT20

item	description	part number	qty.	material
1	WELDMENT MAST 5PT20	C5021	1	SEE TABLE
2	WELDMENT BOOM 5PT20	C5019	1	SEE TABLE
3	WELDMENT BOOM EXTENSION 5PT20	C5017	1	SEE TABLE
4	WELDMENT WINCH MOUNT 5Px20	C5009	1	SEE TABLE
5	HANDLE ROTATION 5PT	B6201	1	SEE TABLE
6	JACK SCREW	SEE TABLE	1	
7	PIN CLEVIS 1.250 DIA 5PT MAST SST	A12315	1	
8	PIN CLEVIS .750 X 5.500 EFF LENGTH SST	A12316	1	
9	PIN CLEVIS .750 X 4.750 EFF LENGTH SST	A12317	1	
10	PIN CLEVIS .906 X 2.750 EFF LENGTH SST	A12313	2	
11	PIN CLEVIS .750 DIA 5PT SHEAVE SST	A12314	1	
12	PIN LYNCH D ASSY	SEE TABLE	1	
13	PIN LYNCH ASSY - LANYARD NOT SHOWN	SEE TABLE	5	
14	PLUG FINISH RND 4.000 X 10-16 GA BLK	SEE TABLE	1	
15	SHEAVE ASSEMBLY	B2462	1	
16	LABEL WARNING	B5790	1	
17	LABEL WARNING BEFORE LOADING	B6229	1	
18	LABEL BOOM RANGE INDICATOR	B6230	2	
19	LABEL LOAD RATING 5PT20	B6232	1	
20	LABEL NAMEPLATE CRANES CE	A11529	1	
21	LABEL THERN 1.00 X 3.20	A6889	1	
22	LABEL MODEL COMMANDER	B6291	2	
23	FLANGE BEARING	B6593	1	



Adjustable Ratchet Jack - Verify Travel Limits



item	5PT20 Fusibond	5PT20G Galvanized	5PT20X Epoxy	5PT20S Stainless	5PT20S316 Stainless316
1	C5021 RED	C5021 GAL	C5021 EGRA	C5021 SS	C5021 SS316
2	C5019 RED	C5019 GAL	C5019 EGRA	C5019 SS	C5019 SS316
3	C5017 RED	C5017 GAL	C5017 EGRA	C5017 SS	C5017 SS316
4	C5009 RED	C5009 GAL	C5009 EGRA	C5009 SS	C5009 SS316
5	B6201 RED	B6201 GAL	B6201 EGRA	B6201 SS	B6201 SS316
6	C3410	C3411	C3411	C3411	C3411
12	A12414	A12414	A12414	A12414 SS	A12414 SS
13	A12415	A12415	A12415	A12415 SS	A12415 SS316
14	A13540	A13540	A13540	A13541	A13541

Use component part numbers for material / finish that matches crane model number.

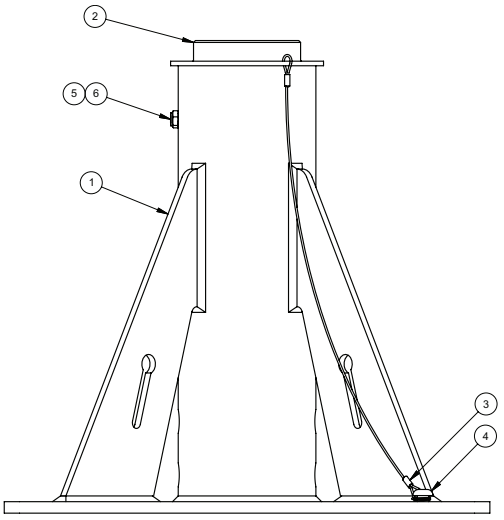
Example: Crane model 5PT20**G** uses components with part numbers XXXXX**GAL**.

Pedestal Base
5BP10, 5BP20[1]

item	part no.	description
1	SEE TABLE	WELDMENT BASE 5PT
2	SEE TABLE	BASE COVER
3	B6254	LANYARD ASSEMBLY
4	A14205	CAPSCR BTNHED .375-16NC x .500 SST
5	A4379	NUT HEX JAM NYLK .312-18NC SST 18-8
6	A13820	CAPSCR SOKLHD .312-18NC X .500 ZNPL

[1] When ordering parts, be sure to specify whether the finish is red, galvanized, epoxy or stainless.

	5BP10	5BP10G	5BP10X	5BP10S	5BP10S316
item					
1	B6181 RED	B6181 GAL	B6181 EGRA	B6181 SS	B6181 SS316
2	B6202	B6202	B6202	B6202	B6202
	5BP20	**5BP20G**	**5BP20X**	**5BP20S**	**5BP20S316**
item					
1	B6191 RED	B6191 GAL	B6191 EGRA	B6191 SS	B6191 SS316
2	B6212	B6212	B6212	B6212	B6212



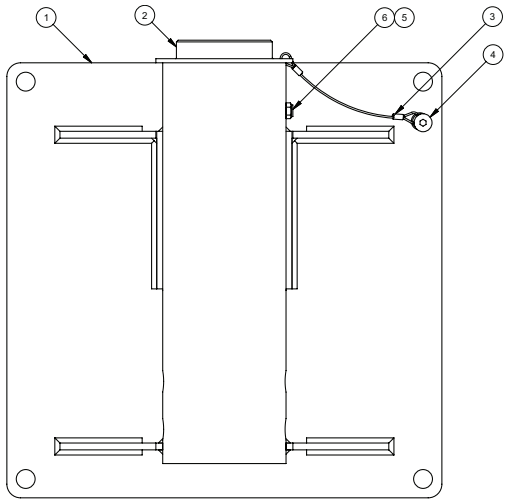
5BP10, 5BP20
Pedestal Base

Wall Base
5BW10, 5BW20[1]

item	part no.	description
1	SEE TABLE	WELDMENT BASE 5PT
2	SEE TABLE	BASE COVER
3	B6255	LANYARD ASSEMBLY
4	A14205	CAPSCR BTNHED .375-16NC x .500 SST
5	A13820	CAPSCR SOKLHD .312-18NC X .500 ZNPL
6	A4379	NUT HEX JAM NYLK .312-18NC SST 18-8

[1] When ordering parts, be sure to specify whether the finish is red, galvanized, epoxy or stainless.

	5BW10	5BW10G	5BW10X	5BW10S	5BW10S316
item					
1	B6179 RED	B6179 GAL	B6179 EGRA	B6179 SS	B6179 SS316
2	B6202	B6202	B6202	B6202	B6202
	5BW20	**5BW20G**	**5BW20X**	**5BW20S**	**5BW20S316**
item					
1	B6189 RED	B6189 GAL	B6189 EGRA	B6189 SS	B6189 SS316
2	B6212	B6212	B6212	B6212	B6212



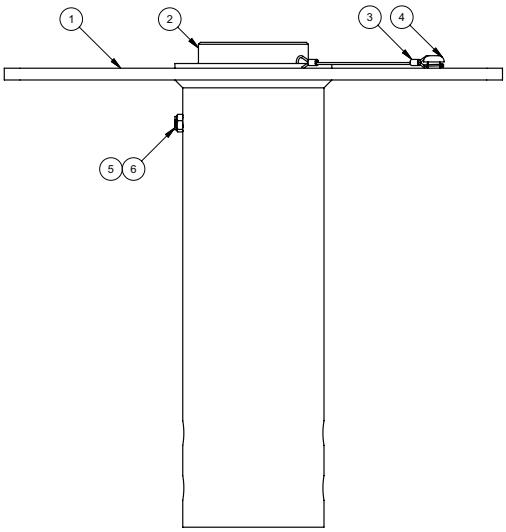
5BW10, 5BW20
Wall Base

Flush Base
5BF10, 5BF20[1]

item	part no.	description
1	SEE TABLE	WELDMENT BASE 5PT
2	SEE TABLE	BASE COVER
3	B6255	LANYARD ASSEMBLY
4	A14205	CAPSCR BTNHED .375-16NC x .500 SST
5	A13820	CAPSCR SOKLHD .312-18NC X .500 ZNPL
6	A4379	NUT HEX JAM NYLK .312-18NC SST 18-8

[1] When ordering parts, be sure to specify whether the finish is red, galvanized, epoxy or stainless.

	5BF10	5BF10G	5BF10X	5BF10S	5BF10S316
item					
1	B6180 RED	B6180 GAL	B6180 EGRA	B6180 SS	B6180 SS316
2	B6202	B6202	B6202	B6202	B6202
	5BF20	**5BF20G**	**5BF20X**	**5BF20S**	**5BF20S316**
item					
1	B6190 RED	B6190 GAL	B6190 EGRA	B6190 SS	B6190 SS316
2	B6212	B6212	B6212	B6212	B6212



5BF10, 5BF20
Flush Base

Two Part Line Option		Model 5PT10TPL and 5PT20TPL	
item	**description**	**part number**	**qty.**
1	BLOCK SNATCH WITH HOOK	A4779	1
2	SWIVEL REGULAR CHAIN GALV	A7306	1
3	PIN CLEVIS .750 X 1.500 EFF LENGTH SST	A12703	1
4	PIN LYNCH .188 X 1.000 SST	A12416	1
5	HOOK LATCH KIT	A9028	1

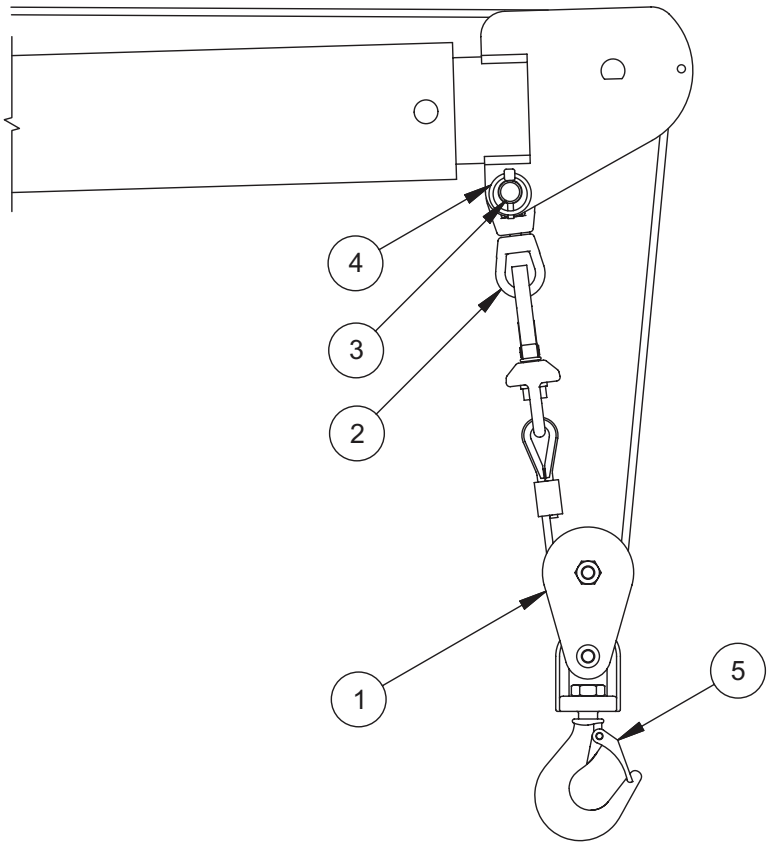


Table 5 – Winch Part Numbers

5PT10 / 20 Series	-M1	-M2	-M2X	-M3
description	**part number**	**part number**	**part number**	**part number**
MANUAL WINCH	M4312PB-K	4WM2-K	4WM2EGRA-K	M4312PBSS-K

	-E2	-E4	-E4DC
description	**part number**	**part number**	**part number**
ELECTRIC WINCH	4WP2-K	4777-K	4777DC-K
ADAPTER PLATE		C3114	C5137

	-E2X	-E4X	-E4DCX
description	**part number**	**part number**	**part number**
ELECTRIC WINCH	4WP2EGRA-K	4777EGRA-K	4777DCEGRA-K
ADAPTER PLATE		C3114EGRA	C5137EGRA

5PT10 Series Lift Below Floor [2]

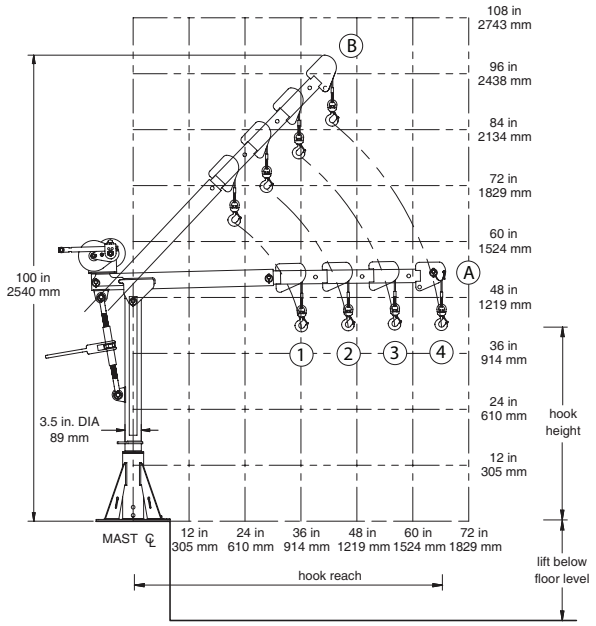
Lift Below [1] Floor				Wire Rope Diameteter		Wire Rope Length		Winch Configurations				
Minimum (B4)		Maximum (B1)						M1	M2	M3	E2	E4
(ft)	(m)	(ft)	(m)	(in)	(mm)	(ft)	(m)					
2	0.6	7	2.1	3/16	5	20	6.0	x	-	x	-	x
10	3.0	15	4.5	3/16	5	28	8.5	x	-	x	-	x
18	5.4	23	7.0	3/16	5	36	10.9	x	-	x	-	x
27	8.2	32	9.7	3/16	5	45	13.7	x	-	x	-	x
42	12.8	47	14.3	3/16	5	60	18.2	x	-	x	-	x
57	17.3	62	18.8	3/16	5	75	22.8	x	-	x	-	x
72	21.9	77	23.4	3/16	5	90	27.4	-	-	-	-	x
2	0.6	7	2.1	1/4	6	20	6.0	x	x	x	x	x
10	3.0	15	4.5	1/4	6	28	8.5	x	x	x	x	x
18	5.4	23	7.0	1/4	6	36	10.9	x	x	x	x	x
27	8.2	32	9.7	1/4	6	45	13.7	x	x	x	x	x
42	12.8	47	14.3	1/4	6	60	18.2	-	x	-	x	x
57	17.3	62	18.8	1/4	6	75	22.8	-	x	-	x	x
2	0.6	7	2.1	5/16	8	20	6.0	x	-	x	-	x
10	3.0	15	4.5	5/16	8	28	8.5	x	-	x	-	x
18	5.4	23	7.0	5/16	8	36	10.9	x	-	x	-	x
27	8.2	32	9.7	5/16	8	45	13.7	-	-	-	-	x
42	12.8	47	14.3	5/16	8	60	18.2	-	-	-	-	x

5PT10 Performance Ratings[2]

Boom Position	Load Rating		Hook Reach		Hook Height	
	(lb)	(kg)	(in)	(mm)	(in)	(mm)
A-1	1000	453	36	914	42	1066
A-2	800	362	46	1168	42	1066
A-3	650	294	56	1422	42	1066
A-4	550	249	66	1676	42	1066
B-1	1200	544	22	558	64	1625
B-2	950	430	29	736	71	1803
B-3	750	340	36	914	78	1981
B-4	650	294	43	1092	85	2159

[1] Lift below floor level varies depending on boom position and base configuration. For longer lifts, including use with two-part lines kits, please contact factory.

[2] Performance Characteristics are for standard products referred to in this manual. Non-standard products may vary from the original design. Contact Thern, Inc. for this information.



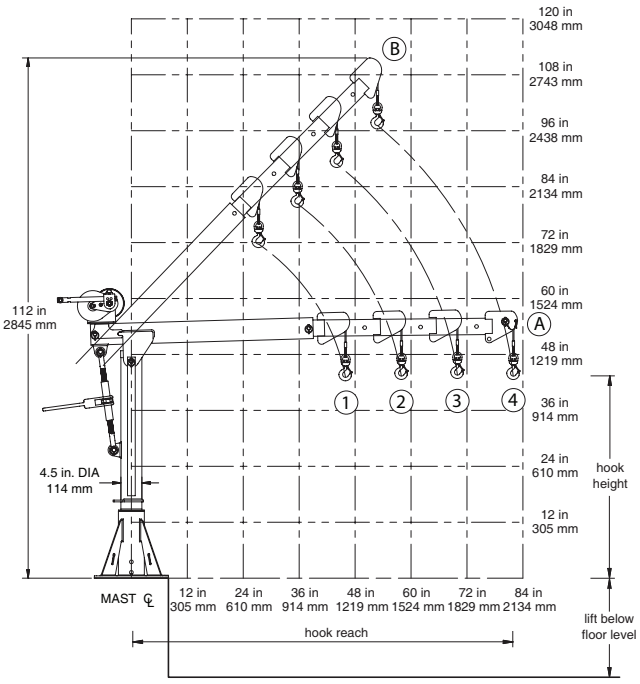
IMPORTANT:
It is the owner or operator's responsibility to determine the suitability of the equipment to its intended use. Study all applicable codes, manuals and regulations. Be sure to read the Owner's Manual supplied with the equipment before operating it.

5PT20 Series Lift Below Floor [2]

Lift Below [1] Floor				Wire Rope Diameteter		Wire Rope Length		Winch Configurations				
Minimum (B4)		Maximum (B1)						M1	M2	M3	E2	E4
(ft)	(m)	(ft)	(m)	(in)	(mm)	(ft)	(m)					
0	0.0	5	1.5	3/16	5	20	6.0	x	-	x	-	x
8	2.4	13	3.9	3/16	5	28	8.5	x	-	x	-	x
16	4.8	21	6.4	3/16	5	36	10.9	x	-	x	-	x
25	7.6	30	9.1	3/16	5	45	13.7	x	-	x	-	x
40	12.1	45	13.7	3/16	5	60	18.2	x	-	x	-	x
55	16.7	60	18.2	3/16	5	75	22.8	x	-	x	-	x
70	21.3	75	22.8	3/16	5	90	27.4	x	-	x	-	x
0	0.0	5	1.5	1/4	6	20	6.0	x	x	x	x	x
8	2.4	13	3.9	1/4	6	28	8.5	x	x	x	x	x
16	4.8	21	6.4	1/4	6	36	10.9	x	x	x	x	x
25	7.6	30	9.1	1/4	6	45	13.7	x	x	x	x	x
40	12.1	45	13.7	1/4	6	60	18.2	-	x	-	x	x
55	16.7	60	18.2	1/4	6	75	22.8	-	x	-	x	x
0	0.0	5	1.5	5/16	8	20	6.0	x	-	x	-	x
8	2.4	13	3.9	5/16	8	28	8.5	x	-	x	-	x
16	4.8	21	6.4	5/16	8	36	10.9	x	-	x	-	x
25	7.6	30	9.7	5/16	8	45	13.7	x	-	x	-	x
40	12.1	45	13.7	5/16	8	60	18.2	-	-	-	-	x

5PT20 Performance Ratings[2]

Boom Position	1st Layer Load Rating		Mid Drum Load Rating		Full Drum Load Rating		Hook Reach		Hook Height	
	(lb)	(kg)	(lb)	(kg)	(lb)	(kg)	(in)	(mm)	(in)	(mm)
A-1	2000	907	1500	680	1200	544	46	1168	43	1092
A-2	1600	725	1500	680	1200	544	58	1473	43	1092
A-3	1300	589	1300	589	1200	544	70	1778	43	1092
A-4	1100	498	1100	498	1100	498	82	2082	43	1092
B-1	2000	907	1500	680	1200	544	28	711	71	1803
B-2	1900	861	1500	680	1200	544	36	914	80	2032
B-3	1500	680	1500	680	1200	544	45	1143	88	2235
B-4	1300	589	1300	589	1200	544	53	1346	97	2463



5PT20 Performance Ratings with Two-Part Line Kit[2]

Boom Position	1st Layer Load Rating		Mid Drum Load Rating		Full Drum Load Rating		Hook Reach		Hook Height	
	(lb)	(kg)	(lb)	(kg)	(lb)	(kg)	(in)	(mm)	(in)	(mm)
A-1	2000	907	2000	907	2000	907	43	1092	31	787
A-2	1600	725	1600	725	1600	725	53	1397	31	787
A-3	1300	589	1300	589	1300	589	67	1701	31	787
A-4	1100	498	1100	498	1100	498	79	2006	31	787
B-1	2400	1088	2400	1088	2400	1088	27	658	59	1498
B-2	1900	861	1900	861	1900	861	35	889	68	1727
B-3	1500	680	1500	680	1500	680	44	1117	76	1930
B-4	1300	589	1300	589	1300	589	52	1320	85	2159

[1] Lift below floor level varies depending on boom position and base configuration. For longer lifts, including use with two-part lines kits, please contact factory.

[2] Performance Characteristics are for standard products referred to in this manual. Non-standard products may vary from the original design. Contact Thern, Inc. for this information.

NOTES:

NOTES:

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5712 Industrial Park Road
Winona, MN 55987

PH 507-454-2996
FAX 507-454-5282

EMAIL: info@thern.com
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Thern Europe
Windmolen 22
7609 NN Almelo
Netherlands

PH +31-548-659-052

EMAIL: europe@therneurope.eu

Downtown Area Collection System and Pump Stations

Pump Station #1

Operation & Maintenance Manual

13.1 Exhaust Inline Blower

United Concrete Products, Inc - Building Group
69 North Plains Highway
Wallingford, CT 06492
(203) 269-3119

UCP Project No: **27087**

TCN

Tubular Centrifugal Inline Fans

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

This publication contains the installation, operation and maintenance instructions for standard units of the *TCN: Inline Blowers.*

- TCN-B
- TCNHE-B
- TCNH-D
- TCNH-B
- TCNHS-B
- TCNU-B
- TCNE-B
- TCNHU-B
- TCNS-B
- TCN-D

Carefully read this publication and any supplemental documents prior to any installation or maintenance procedure.

Loren Cook catalog, *TCN,* provides additional information describing the equipment, fan performance, available accessories and specification data.

For additional safety information, refer to AMCA Publication 410-96, *Safety Practices for Users and Installers of Industrial and Commercial Fans*.

All of the publications listed above can be obtained from:

- lorencook.com
- *info@lorencook.com*
- 417-869-6474 ext. 166

For information and instructions on special equipment, contact Loren Cook Company at 417-869-6474.

Receiving and Inspection

Carefully inspect the fan and accessories for any damage and shortage immediately upon receipt of the fan.

- Turn the wheel by hand to ensure it turns freely and does not bind.
- Inspect dampers for free operation of all moving parts.
- Record on the *Delivery Receipt* any visible sign of damage.

Handling

Lift the fan by foot brackets.

NOTICE! Never lift by the shaft, motor or housing.

TCN-B

⚠WARNING

Rotating Parts & Electrical Shock Hazard:

Fans should be installed and serviced by qualified personnel only.

Disconnect electric power before working on unit (prior to removal of guards or entry into access doors).

Follow proper lockout/tagout procedures to ensure the unit cannot be energized while being installed or serviced.

A disconnect switch should be placed near the fan in order that the power can be swiftly cut off, in case of an emergency and in order that maintenance personnel are provided complete control of the power source.

Grounding is required. All field-installed wiring must be completed by qualified personnel. All field installed wiring must comply with National Electric Code (NFPA 70) and all applicable local codes. Ensure the power supply (voltage, frequency and current carrying capacity of wires) is in accordance with the motor nameplate.

Fans and blowers create pressure at the discharge and vacuum at the inlet. This may cause objects to get pulled into the unit and objects to be propelled rapidly from the discharge. The discharge should always be directed in a safe direction and inlets should not be left unguarded. Any object pulled into the inlet will become a projectile capable of causing serious injury or death.

When air is allowed to move through a non-powered fan, the impeller can rotate, which is referred to as windmilling. Windmilling will cause hazardous conditions due to unexpected rotation of components. Impellers should be blocked in position or air passages blocked to prevent draft when working on fans.

Friction and power loss inside rotating components will cause them to be a potential burn hazard. All components should be approached with caution and/or allowed to cool before contacting them for maintenance.

Under certain lighting conditions, rotating components may appear stationary. Components should be verified to be stationary in a safe manner, before they come into contact with personnel, tools or clothing.

Failure to follow these instructions could result in death or serious injury.

The attachment of roof mounted fans to the roof curb as well as the attachment of roof curbs to the building structure must exceed the structural requirements based on the environmental loading derived from the applicable building code for the site. The local code official may require variations from the recognized code based on local data. The licensed engineer of record will be responsible for prescribing the correct attachment based on construction materials, code requirements and environmental effects specific to the installation.

Storage

If the fan is stored for any length of time prior to installation, completely fill the bearings with grease or moisture-inhibiting oil (refer to *Lubrication*, page 6).Store the fan in its original crate and protect it from dust, debris and weather.

Outdoor Storage

To maintain good working condition of a TCN when it is stored outdoors or on a construction site, follow the additional steps below.

- Cover the inlet, outlet and belt tunnel opening to prevent the accumulation of dirt and moisture in the housing
- Periodically rotate the wheel and operate dampers (if supplied) to keep a coating of grease on all internal bearing parts
- Periodically inspect the unit to prevent damaging conditions

Installation

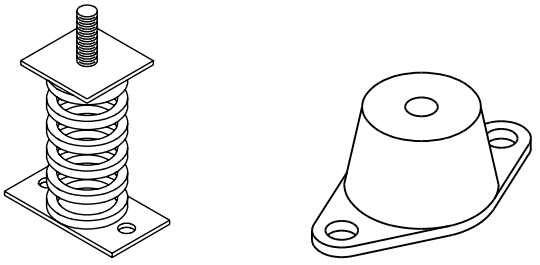
To prevent damage to the fan during shipping, motors 5 HP and larger and extremely heavy motors (cast iron or severe duty) are shipped loose and must be field mounted by bolting the motor on the motor mounting plate in the existing mounting slots.

NOTICE! Extreme vibration is a serious problem that may cause structural and mechanical failure. To help vibration and noise from being transferred to the building, isolators are recommended.

Isolation Installation

Floor Mounted Spring Isolators

1. Mount fan and motor on isolation base (if supplied).
2. Elevate fan (or isolation base) to operating height and insert blocks to hold in position.
3. Position isolators under the fan and vertically align by inserting leveling bolt through mounting holes in the fan or the base. The isolator must be installed on a level surface.
4. Adjust the isolators by turning the leveling nut counterclockwise several turns at a time alternately on each isolator until the fan weight is transferred onto the isolators and the fan raises uniformly off the blocks. Then remove the blocks.
5. Turn lock nut onto leveling bolt and secure firmly in place against the top of the mounting flange or frame.
6. Secure isolators to mounting surface.



Spring Isolator Rubber-in-Shear Isolator

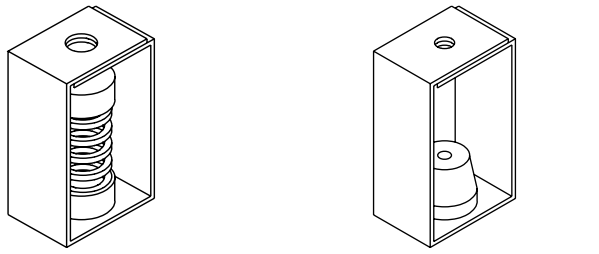
Figure 1 - Floor Mount Isolators

Floor Mounted Rubber-In-Shear (RIS) Isolators

1. Mount fan and motor on an isolation base (if supplied).
2. Elevate fan to provide room to insert isolators between the fan and foundation and block in position.
3. Position isolators under fan and secure bolts.
4. Remove blocks and allow fan to rest on floor. Isolators must be installed on a level surface (leveling should not be required).
5. Secure isolators to mounting surface.

Ceiling Mounted Spring and Rubber-in-Shear (RIS) Isolators

1. Elevate fan to operating height and brace.
2. Attach threaded rod to overhead support structure directly above each mounting hole. Rod should extend to within a few feet of fan.
3. Attach isolator to end of threaded rod using a nut on each side of isolator bracket.
4. Insert another section of threaded rod through the fan mounting hole and isolator.
5. Attach two nuts to threaded rod in isolator.
6. Place adjusting nut and locking nut on threaded rod near fan mounting bracket.
7. Alternately rotate adjusting nut at each mounting location until the fan weight is uniformly transferred to the isolators. Remove bracing.



Ceiling Mounted Spring Isolator Rubber-in-Shear Ceiling Isolator

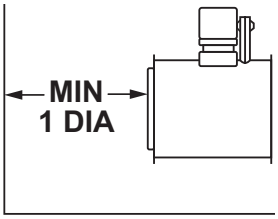
Figure 2 - Ceiling Mount Isolators

Duct Installation

Efficient fan performance relies on the proper installation of inlet and discharge ducts. Be sure your fan conforms to the following guidelines.

Non-Ducted Inlet Clearance

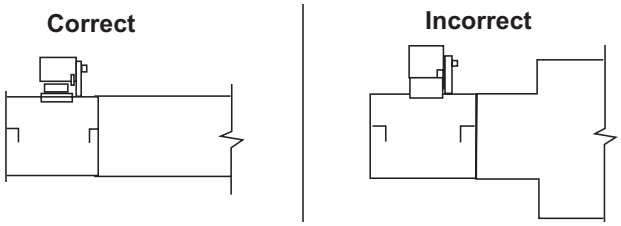
If your fan has an open inlet (no duct work), the fan must be placed one fan wheel diameter away from walls and bulkheads.



Non-ducted Inlet Clearance

Free Discharge

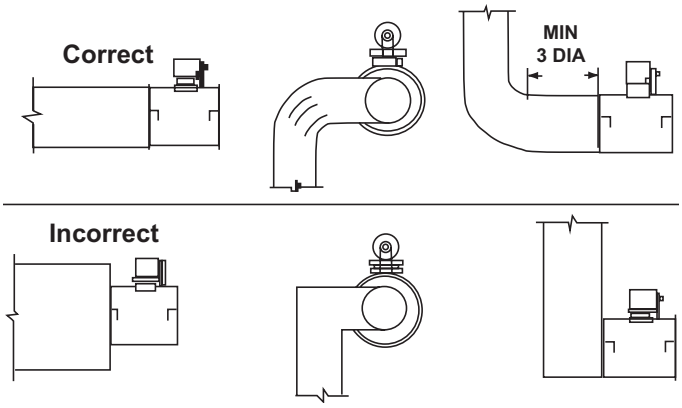
Avoid a free discharge into the plenum. This will result in lost efficiency because it doesn't allow for a static regain.



Free Discharge

Inlet Duct Turns

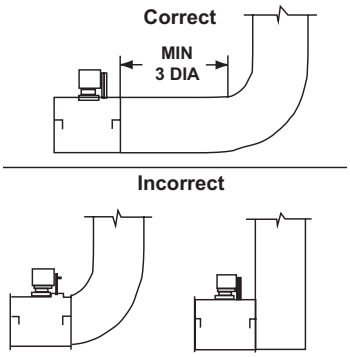
For ducted inlets, allow at least three fan wheel diameters between duct turns or elbows and the fan inlet.



Inlet Duct Turns

Discharge Duct Turns

When possible, allow three duct diameters between duct turns or elbows and the fan outlet.



Discharge Duct Turns

Wheel-to-Inlet Clearance

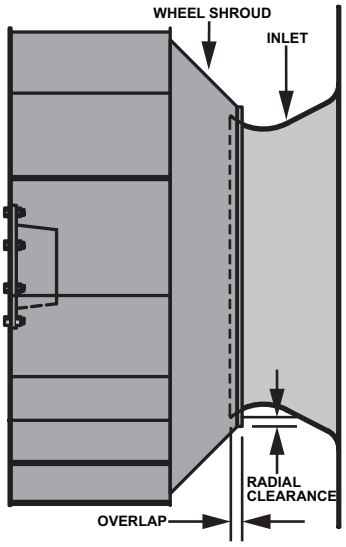
The correct wheel-to-inlet clearance is critical to proper fan performance. This clearance should be verified before initial start-up since rough handling during shipment could cause a shift in fan components. Refer to wheel/inlet drawing below for correct overlap.

Adjust the overlap by loosening the wheel hub and moving the wheel along the shaft to obtain the correct value.

A uniform radial gap (space between the edge of the cone and the edge of the inlet) is obtained by loosening the inlet cone bolts and repositioning the inlet cone.

Wheel/Inlet Overlap

Size	Overlap
60 - 165	3/16”
180 - 245	1/4”
270 - 300	5/16”
330 - 365	3/8”
402	7/16”
445 - 490	1/2”



Belt and Pulley Installation

Belt tension is determined by the sound the belts make when the fan is first started. The belts will produce a loud squeal, which dissipates after the fan is operating at full capacity. If belt tension is too tight or too loose, lost efficiency and damage can occur.

Do not change the pulley pitch diameter to change tension. This will result in a different fan speed.

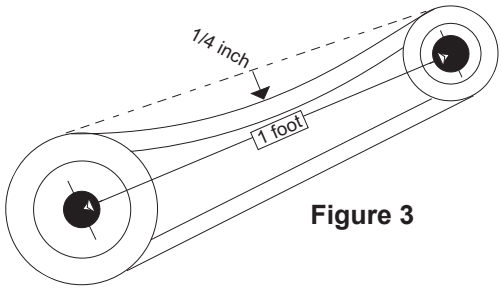


Figure 3

1. Loosen motor plate adjustment bolts and move motor plate in order that the belts can easily slip into grooves on pulleys. Never pry, roll or force the belts over the rim of the pulley.
2. Adjust the motor plate until proper tension is reached. For proper tension, a deflection of approximately 1/4” per foot of center distance should be obtained by firmly pressing the belt. Refer to *Figure 3*.
3. Lock the motor plate adjustment nuts in place.
4. Ensure pulleys are properly aligned. Refer to *Figure 4*.

Pulley Alignment

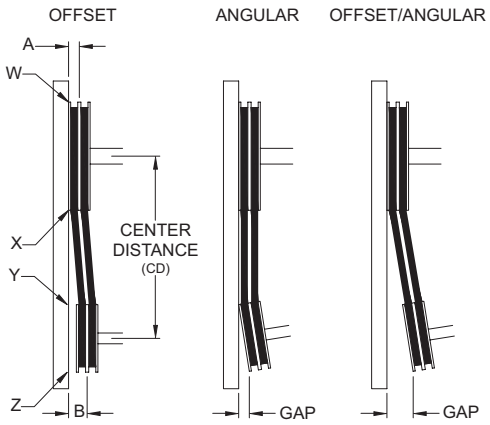
Pulley alignment is adjusted by loosening the motor pulley setscrew and by moving the motor pulley on the motor shaft.

Figure 4 indicates where to measure the allowable gap for the drive alignment tolerance.

Tolerance

Center Distance	Max. Gap
Up through 12”	1/16”
12” up through 48”	1/8”
Over 48”	1/4”

Figure 4



All contact points (indicated by WXYZ) are to have a gap less than the tolerance shown in the table. When the pulleys are not the same width, the allowable gap must be adjusted by half of the difference in width (as shown in A & B of *Figure 4*). *Figure 5* illustrates using a carpenter’s square to adjust the position of the motor pulley until the belt is parallel to the longer leg of the square.

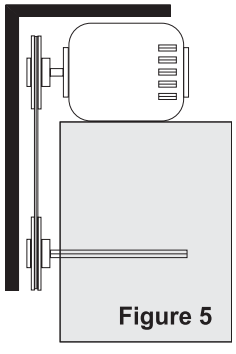


Figure 5

Wiring Installation

Leave enough slack in the wiring to allow for motor movement when adjusting belt tension. Some fractional motors have to be removed in order to make the connection with the terminal box at the end of the motor. To remove motor, remove bolts securing motor base to power assembly. Do not remove motor mounting bolts.

Use of Variable Frequency Drives

Motors

Motors that are to be operated using a Variable Frequency Drive (VFD) must be VFD compatible. Motors that are not supplied by Loren Cook Company should have the recommendation of the motor manufacturer for use with a VFD.

Grounding

The fan frame, motor and VFD must be connected to a common earth ground to prevent transient voltages from damaging rotating elements.

Wiring

Line reactors may be required to reduce over-voltage spikes in the motors. The motor manufacturer should be consulted for recommended line impedance and usage of line reactors or filters if the lead length between the VFD and the motor exceeds 10 ft (3m).

Fan

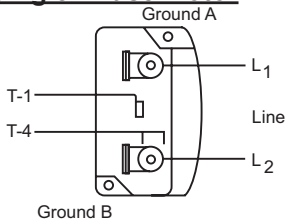
It is the responsibility of the installing body to perform coast-down tests and identify any resonant frequencies after the equipment is fully installed. These resonant frequencies are to be removed from the operating range of the fan by using the “skip frequency” function in the VFD programming. Failure to remove resonant frequencies from the operating range will decrease the operating life of the fan and void the warranty.

Wiring Diagrams

Vari-Flow

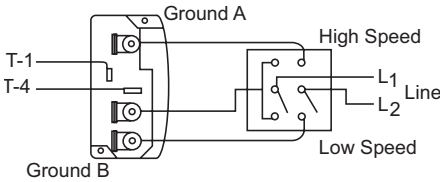
For EC or VF see EC Motor Wiring supplement. For VF2 see PM wiring supplement.

Single Speed, Single Phase Motor



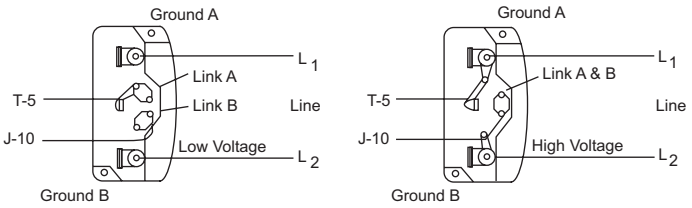
When ground is required, attach to ground A or B with No. 6 thread forming screw. To reverse, interchange T-1 and T-4.

2 Speed, 2 Winding, Single Phase Motor



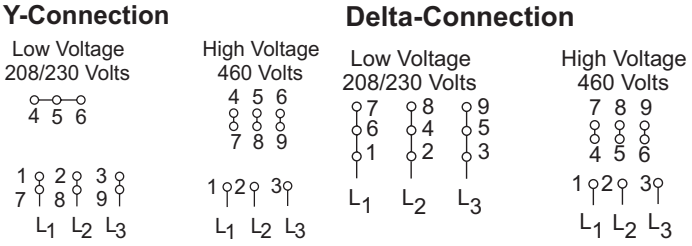
When ground is required, attach to ground A or B with No. 6 thread forming screw. To reverse, interchange T-1 and T-4 leads.

Single Speed, Single Phase, Dual Voltage



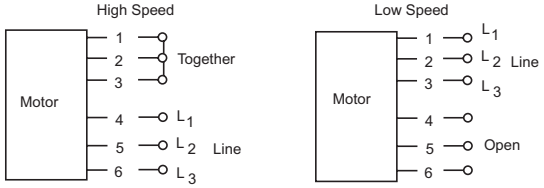
When ground is required, attach to ground A or B with No. 6 thread forming screw. To reverse, interchange T-5 and J-10 leads.

3-Phase, 9 Lead Motor



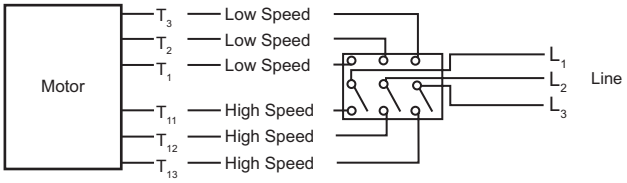
To reverse, interchange any two line leads.

2 Speed, 1 Winding, 3-Phase Motor



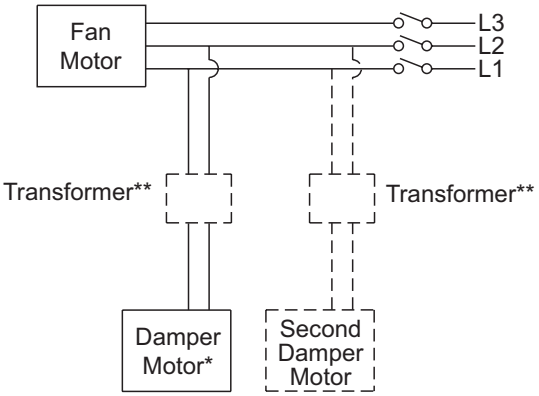
To reverse, interchange any two line leads. Motors require magnetic control.

2 Speed, 2 Winding, 3-Phase



To reverse: High Speed: interchange leads T_{11} and T_{12}. Low Speed: interchange leads T_1 and T_2. Both Speeds: interchange any two line leads.

Typical Fan Motor/Damper Motor Schematic

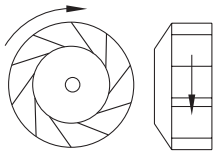


For 3-Phase, damper motor voltage should be the same between L_1 and L_2. For single phase application, disregard L_3.
*Damper motors may be available in 115, 230 and 460 volt models. The damper motor nameplate voltage should be verified prior to connection.
**A transformer may be provided in some installations to correct the damper motor voltage to the specified voltage.

NOTICE! Follow the wiring diagram in the disconnect switch and the wiring diagram provided with the motor. Correctly label the circuit on the main power box and always identify a closed switch to promote safety (i.e., red tape over a closed switch).

Wheel Rotation

Test the fan to ensure the rotation of the wheel is the same as indicated by the arrow marked *Rotation*.



Tubular Centrifugal Inline

115 and 230 Single Phase Motors

Fan wheel rotation is set correctly at the factory. Changing the rotation of this type of motor should only be attempted by a qualified electrician.

208, 230 and 460 3-Phase Motors

These motors are electrically reversible by switching two of the supply leads. For this reason, the rotation of the fan cannot be restricted to one direction at the factory. See *Wiring Diagrams*, page 4, for specific information on reversing wheel direction.

NOTICE! Do not allow the fan to run in the wrong direction. This will overheat the motor and cause serious damage. For 3-phase motors, if the fan is running in the wrong direction, check the control switch. It is possible to interchange two leads at this location so that the fan is operating in the correct direction.

Final Installation Steps

1. Inspect fasteners and setscrews, particularly fan mounting and bearing fasteners then tighten according to the *Recommended Torque* chart.
2. Inspect for correct voltage with a voltmeter.
3. Ensure all accessories are installed.

Operation

Pre-Start Checks

1. Lock out all the primary and secondary power sources.
2. Ensure fasteners and setscrews, particularly those used for mounting the fan, are tightened.
3. Inspect belt tension and pulley alignment.
4. Inspect motor wiring.
5. Ensure belt touches only the pulleys.
6. Ensure fan and ductwork are clean and free of debris.
7. Inspect wheel-to-inlet clearance. The correct wheel-to-inlet clearance is critical to proper fan performance.
8. Close and secure all access doors.
9. Restore power to fan.

Start-Up

Turn on the fan. In variable speed units, set the fan to its lowest speed and inspect for the following:

- Direction of rotation
- Excessive vibration
- Unusual noise
- Bearing noise
- Improper belt alignment or tension (listen for squealing)
- Improper motor amperage or voltage

NOTICE! If a problem is discovered, immediately shut off the fan. Lock out all electrical power and check for the cause of the trouble. Refer to Troubleshooting.

Inspection

Inspection of the fan should be conducted at the first **30 minute**, **8 hour** and **24 hour** intervals of satisfactory operation. During the inspections, stop the fan and inspect as per the *Conditions Chart*.

30 Minute Interval

Inspect bolts, setscrews and motor mounting bolts. Adjust and tighten as necessary.

8 Hour Interval

Inspect belt alignment and tension. Adjust and tighten as necessary.

24 Hour Interval

Inspect belt tension. Adjust and tighten as necessary.

Recommended Torque for Setscrews/Bolts (IN-LB)

Setscrews				Hold Down Bolts	
Size	Key Hex Across Flats	Recommended Torque		Size	Recommended Torque
		Min.	Max.		
#8	5/64”	15	21	3/8”-16	324
#10	3/32”	27	33	1/2”-13	780
1/4	1/8”	70	80	5/8”-11	1440
5/16	5/32”	140	160	3/4”-10	2400
3/8	3/16”	250	290	7/8”-9	1920
7/16	7/32”	355	405	1”-8	2700
1/2	1/4”	560	640	1-1/8”-7	4200
5/8	5/16”	1120	1280	1-1/4”-7	6000
3/4	3/8”	1680	1920	-	-
7/8	1/2”	4200	4800	-	-
1	9/16”	5600	6400	-	-

Maintenance

Establish a schedule for inspecting all parts of the fan. The frequency of inspection depends on the operating conditions and location of the fan.

Inspect fans exhausting corrosive or contaminated air within the first month of operation. Fans exhausting contaminated air (airborne abrasives) should be inspected every three months.

Regular inspections are recommended for fans exhausting non-contaminated air.

It is recommended the following inspections be conducted twice per year:

- Inspect bolts and setscrews for tightness. Tighten as necessary
- Inspect belt wear and alignment. Replace worn belts with new belts and adjust alignment as needed. Refer to *Belt and Pulley Installation*, page 3
- Bearings should be inspected as recommended in the *Lubrication Conditions Chart*
- Inspect variable inlet vanes for freedom of operation and excessive wear. The vane position should agree with the position of the control arm. As the variable inlet vanes close, the entering air should spin in the same direction as the wheel
- Inspect springs and rubber isolators for deterioration and replace as needed
- Inspect for cleanliness. Clean exterior surfaces only. Removing dust and grease on motor housing assures proper motor cooling. Removing dirt from the wheel and housing prevents imbalance and damage

Lubrication

Fan Bearings

TCN bearings are lubricated through a grease fitting on the exterior of the fan housing and should be lubricated by the schedule, *Lubrication Conditions Chart*.

For best results, lubricate the bearing while the fan is in operation. Pump grease in slowly until a slight bead forms around the bearing seals. Excessive grease can burst seals thus reducing bearing life.

In the event the bearing cannot be seen, use no more than three injections with a hand-operated grease gun.

Before lubricating, the grease nipple and immediate vicinity should be thoroughly cleaned without the use of high pressure equipment. The grease should be supplied slowly as the bearing rotates until fresh grease slips past the seal. Excessive pressure should be avoided to prevent seal damage.

Exceptions to the greasing interval chart:

- **Periodic Applications (any break of one week or more):** it is recommended that full lubrication be performed prior to each break in operation
- **Higher Temperature:** it is recommended to halve the intervals for every 30°F increase in operating temperature above 120°F not to exceed 230°F for standard bearings; high temperature bearings (optional) can operate up to 400°F
- **Vertical Shaft:** it is recommended that the intervals should be halved

Loren Cook Company uses petroleum lubricant in a lithium base. Other types of grease should not be used unless the bearings and lines have been flushed clean. If another type of grease is used, it should be a lithium-based grease conforming to NLGI grade 2 consistency. A NLGI grade 2 grease is a light viscosity, low-torque, rust-inhibiting lubricant that is water resistant. Its temperature range is from -30°F to +200°F and capable of intermittent highs of +250°F.

Lubrication Conditions Chart

Fan Class	Fan Status	Shaft Size	Maximum Interval (operation hrs)
TCN Inline Blowers	Normal Conditions (clean, dry & smooth)	> 1-1/2”	10000
		< 1-1/2”	2000
	Extreme Conditions (dirty/wet/rough)	> 1-1/2”	2000
		< 1-1/2”	400

Motor Bearings

Motors are provided with prelubricated bearings. Any lubrication instructions shown on the motor nameplate supersede instructions below.

Motor bearings without provisions for relubrication will operate up to 10 years under normal conditions with no maintenance. In severe applications, high temperatures or excessive contaminates, it is advisable to have the maintenance department disassemble and lubricate the bearings after 3 years of operation to prevent interruption of service.

For motors with provisions for relubrication, follow intervals of the following table.

Relubrication Intervals

Service Conditions	NEMA Frame Size					
	Up to and Including 184T		213T-365T		404T and Larger	
	1800 RPM and Less	Over 1800 RPM	1800 RPM and Less	Over 1800 RPM	1800 RPM and Less	Over 1800 RPM
Standard	3 yrs.	6 months	2 yrs.	6 months	1 yr.	3 months
Severe	1 yr.	3 months	1 yr.	3 months	6 months	1 month

Motors are provided with a polyurea mineral oil NGLI #2 grease. All additions to the motor bearings are to be with a compatible grease such as Exxon Mobil Polyrex EM and Chevron SRI.

The above intervals should be reduced to half for vertical shaft installations.

Motor Services

Should the motor prove defective within a one-year period, contact your local Loren Cook representative or your nearest authorized electric motor service representative.

Changing Shaft Speed

All belt driven fans with motors up to and including 5HP are equipped with variable pitch pulleys. To change the fan speed, perform the following:

1. Loosen setscrew on driver (motor) pulley and remove key, if equipped.
2. Turn the pulley rim to open or close the groove facing. If the pulley has multiple grooves, all must be adjusted to the same width.
3. After adjustment, inspect for proper belt tension.

Speed Reduction

Open the pulley in order that the belt rides deeper in the groove (smaller pitch diameter).

Speed Increase

Close the pulley in order that the belt rides higher in the groove (larger pitch diameter). Ensure that the RPM limits of the fan and the horsepower limits of the motor are maintained.

Pulley and Belt Replacement

1. Loosen and remove belts by lowering motor mounting plate with the four adjusting nuts.
2. Remove pulleys from their respective shafts.
3. Clean the motor and fan shafts.
4. Clean bores of pulleys & coat the bores with heavy oil.
5. Remove grease, rust or burrs from the pulleys and shafts.
6. Remove burrs from shaft by sanding.
7. Place fan pulley on the fan shaft and the motor pulley on the motor shaft. Damage to the pulleys can occur when excessive force is used in placing the pulleys on their respective shafts.
8. Tighten in place.
9. Install belts on pulleys and align as described in *Belt and Pulley Installation*.

Maximum RPM

Size	Non-Reinforced	Reinforced	TCNH-B
60	3899	-	4231
70	3942	-	4231
80	3600	-	4231
100	3382	-	4231
120	2894	-	3404
135	2333	-	2953
150	2116	2162	2656
165	1833	2092	2414
180	1610	1817	2269
195	1429	1578	2095
210	1277	1404	1786
225	1152	1534	1659
245	1015	1485	1532
270	876	1250	1391
300	837	1038	1251
330	716	978	1141
365	624	817	1022
402	539	694	894
445	463	672	846
490	360	573	770

Bearing Replacement

The fan bearings are pillow block ball bearings.

1. Loosen and remove belts by lowering motor mounting plate with the four adjusting nuts.
2. Remove the bearing cover by removing the four bolts around the perimeter of the bearing cover. ***NOTICE! Do not remove fan sheave yet.***
3. Remove inlet cone by removing attaching bolts/nuts around perimeter of the inlet plate.
4. Remove wheel by loosening setscrews and sliding off shaft.
5. Record the location of the fan sheave from end of shaft, and remove the sheave.
6. Record the distance from the bearing to the end of the shaft.
7. Loosen setscrews on bearings and remove shaft.
8. Remove bearings and rub ring and replace with new bearings.
9. Slide shaft through bearings until shaft protrudes the same amount as original shaft. Tighten setscrews.
10. Replace rub ring.
11. Replace fan sheave in original location.
12. Replace wheel but do not tighten yet.
13. Replace inlet cone. Wheel may need to be moved to allow proper alignment. Care should be taken to insure that inlet cone is centered inside wheel before and after tightening attaching bolts.
14. Slide wheel on shaft to achieve proper wheel/inlet overlap. *Refer to Wheel-to-Inlet Clearance*, page 3.
15. Replace and tighten belts.
16. Test run the fan.
17. Re-tighten setscrews on bearings, sheave and wheel. Recheck belt tension and adjust as needed.
18. Replace bearing cover.
19. Trim balance as necessary (0.0785 in/sec max.).

Wheel Replacement for TCN & TCNH

TCN

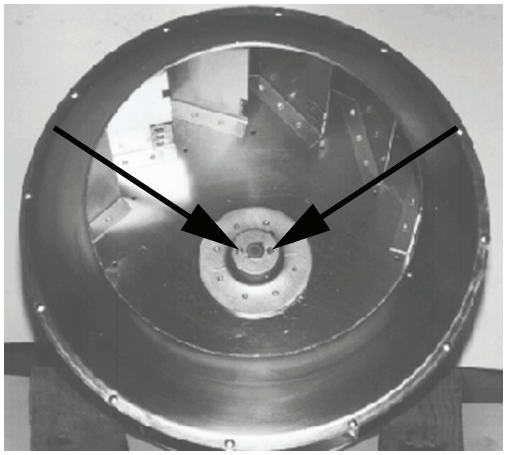
1. Remove inlet cone by removing bolts around perimeter of the inlet plate.
2. Remove wheel by loosening setscrews and sliding off shaft if wheel will slide easily; if not, follow these steps to pull wheel:
   a. Drill two 1/4” diameter holes, 180° apart centered between the shaft and the outside diameter of the hub, 3/8” to 1/2” deep.
   b. Tap 1/4” holes with a 5/16” tap. Do not drill or tap greater than recommended.
   c. Screw puller arms (recommend Lisle No. 45000 Steering Wheel Puller) to full depth of threads into tapped holes. Align center of puller with center of shaft. (See next page for details)
   d. Ensure all setscrews in the hub (normally two) are fully removed.
   e. Slowly remove wheel from shaft.
3. Remove any burrs by filing or sanding shaft surface.
4. Replace wheel but do not tighten set screws.
5. Replace inlet cone. Care should be taken to insure inlet cone is centered inside wheel before and after tightening inlet attachment bolts.
6. Adjust wheel on shaft for proper alignment with inlet (see *Wheel-to-Inlet Clearance*, page 3).
7. Once wheel and inlet are properly aligned, tighten wheel setscrews.
8. Test run fan.
9. Re-tighten wheel setscrews to proper torque values listed on page 5.
10. Trim balance as necessary (0.0785 in/sec max.).

TCNH

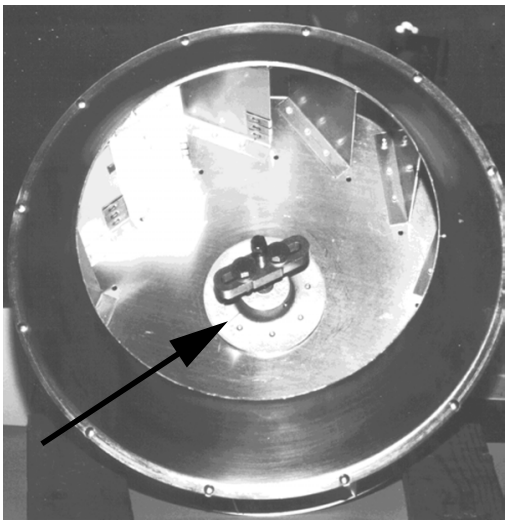
1. Remove inlet cone by removing bolts around perimeter of the inlet plate.
2. Remove wheel by loosening setscrews and sliding off shaft if wheel will slide easily; if not, follow these steps to pull wheel:
   a. The TCNH wheel has a pre-machined shoulder in the hub for the use of most two and three jaw mechanical pullers.
   b. Align center of puller with center of shaft.
   c. Ensure all setscrews in the hub (normally two) are fully removed.
   d. Slowly remove wheel from shaft.
3. Remove any burrs by filing or sanding shaft surface.
4. Replace wheel but do not tighten set screws.
5. Replace inlet cone. Care should be taken to insure inlet cone is centered inside wheel before and after tightening inlet attachment bolts.
6. Adjust wheel on shaft for proper alignment with inlet (see *Wheel-to-Inlet Clearance*, page 3).
7. Once wheel and inlet are properly aligned, tighten wheel setscrews.
8. Test run fan.
9. Re-tighten wheel setscrews to proper torque values listed on page 5.
10. Trim balance as necessary (0.0785 in/sec max.).

Recommended Puller

Lisle No. 45000 Steering Wheel Puller. This puller is available at most automotive parts retail outlets.



Drilled Hole Location



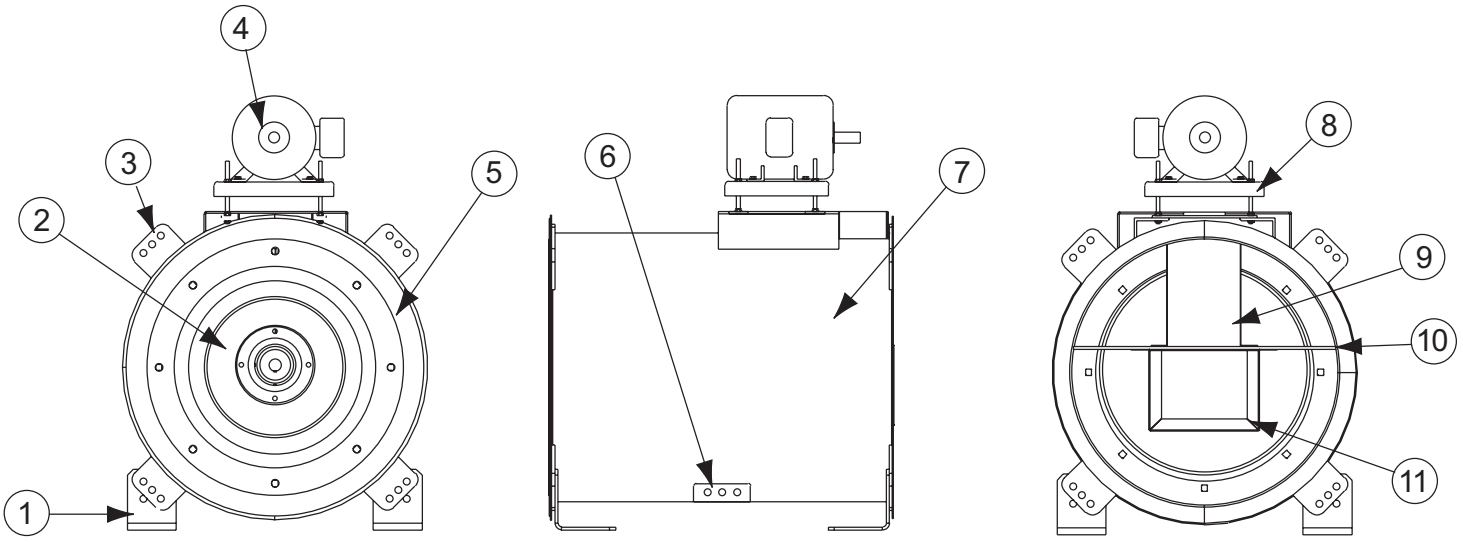
Wheel Puller

Troubleshooting

Problem and Potential Cause
Low Capacity or Pressure: • Incorrect direction of rotation. Make sure the fan rotates in same direction as the arrows on the motor or belt drive assembly • Poor fan inlet conditions. There should be a straight clear duct at the inlet • Improper wheel alignment
Excessive Vibration and Noise: • Damaged or unbalanced wheel • Belts or fasteners too loose; belts worn or oily; belts misaligned • Speed too high • Incorrect direction of rotation. Make sure the fan rotates in same direction as the arrows on the motor or belt drive assembly • Bearings need lubrication or replacement • Bearing setscrews loose • Fan surge • Debris in impeller • See page 4 for issues regarding VFD use
Overheated Motor: • Motor improperly wired • Incorrect direction of rotation. Make sure the fan rotates in same direction as the arrows on the motor or belt drive assembly • Cooling air diverted or blocked • Improper inlet clearance • Incorrect fan RPMs • Incorrect voltage
Overheated Motor: • Improper bearing lubrication • Excessive belt tension

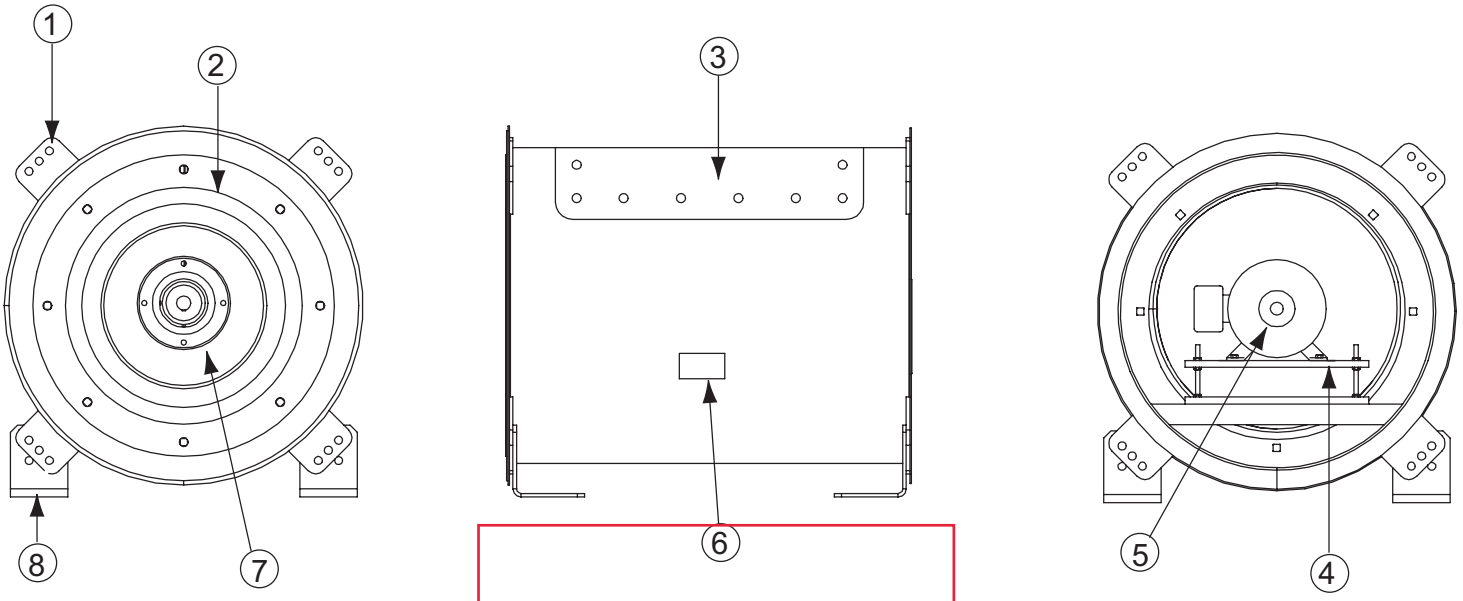
Parts List

TCN-B/TCNH-B



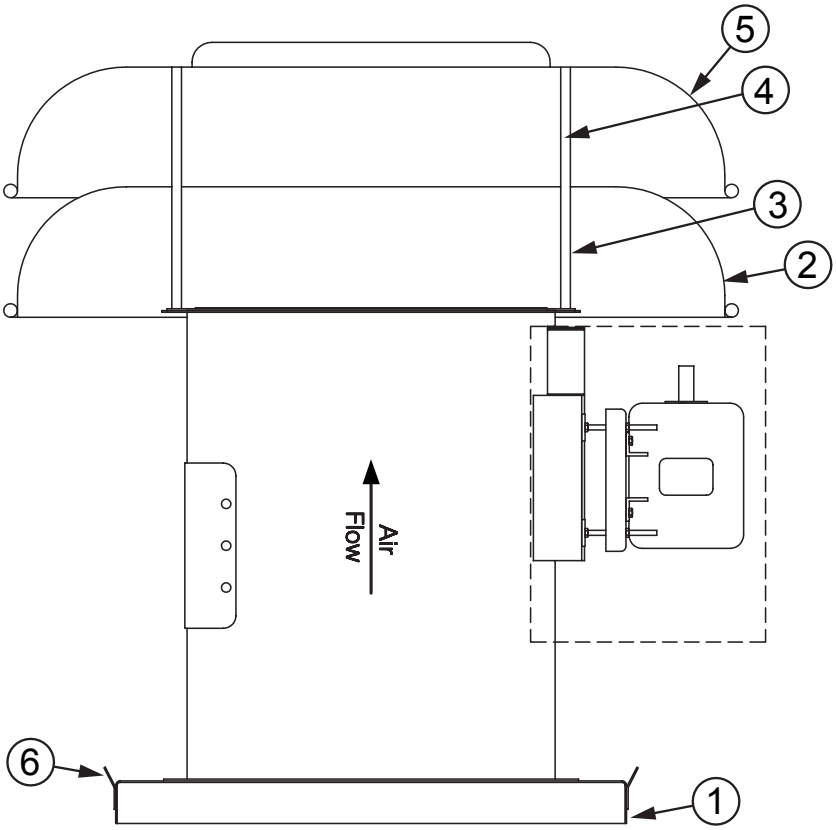
Part No.	Description	Part No.	Description
1	Foot	7	Outer Housing
2	Wheel	8	Motor Plate
3	Foot Bracket	9	Belt Tunnel
4	Motor	10	Bearing Plate
5	Inlet Cone	11	Bearing Cover
6	Inspection Door	Not Shown	Rub Ring

TCN-D/TCNH-D



Part No.	Description	Part No.	Description
1	Foot Bracket	5	TEFC Motor
2	Inlet Cone	6	Field Wiring Compartment
3	Access Door	7	Wheel
4	Motor Plate	8	Foot

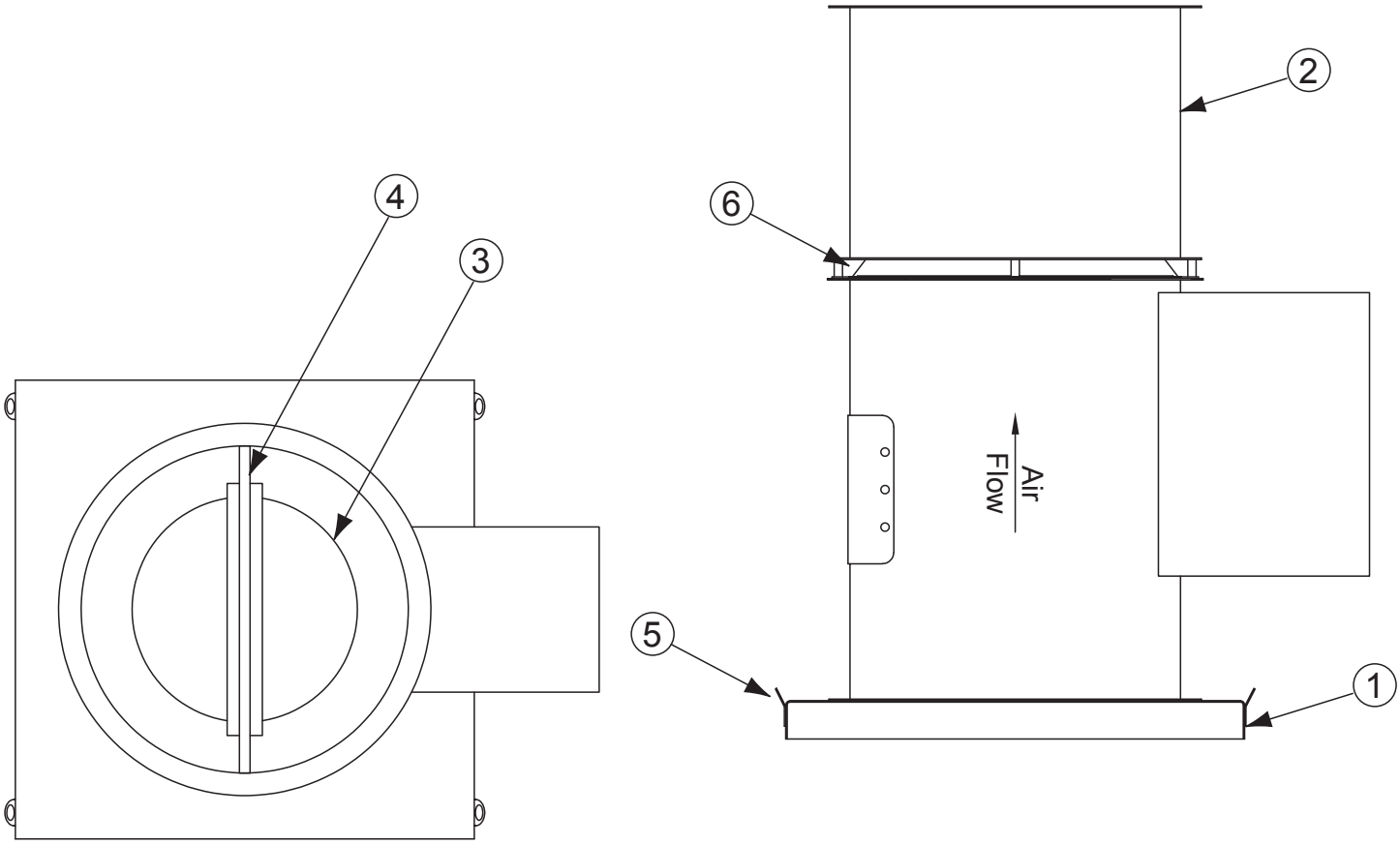
TCNE-B/TCNHE-B
TCNS-B/TCNHS-B



Part No.	Description	Part No.	Description
1	TCNE/S Curb Cap	5	TCNE/S Top Cap Closed
2	TCNE/S Top Cap Open	6	TCNE/S Lifting Lug
3	TCNE/S Top Cap Post (Bottom)	Not Shown	Birdscreen
4	TCNE/S Top Cap Post (Top)		

See common parts listed on page 9.

TCNU-B/TCNHU-B



Part No.	Description	Part No.	Description
1	TCNU Curb Cap	4	TCNU Damper Stop
2	TCNU Windband	5	TCNU Lifting Lug
3	TCNU Damper Assembly	6	TCNU Nozzel

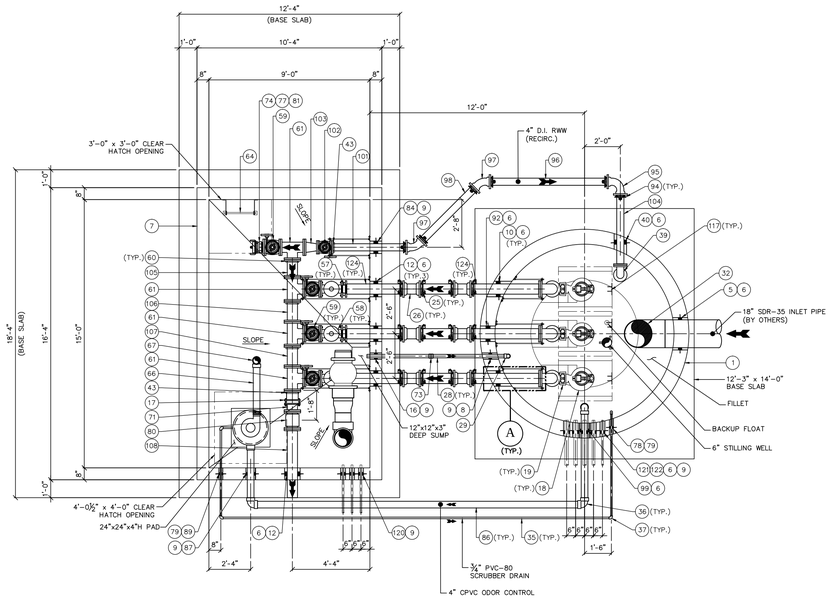
See common parts listed on page 9.

Limited Warranty

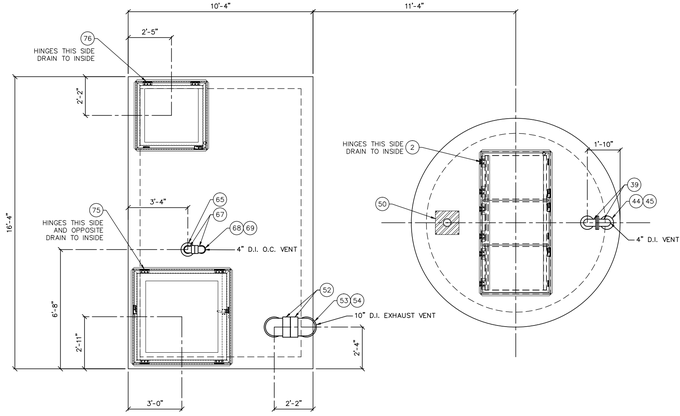
Loren Cook Company warrants that your Loren Cook fan was manufactured free of defects in materials and workmanship, to the extent stated herein. For a period of one (1) year after date of shipment, we will replace any parts found to be defective without charge, except for shipping costs which will be paid by you. This warranty is granted only to the original purchaser placing the fan in service. This warranty is void if the fan or any part thereof has been altered or modified from its original design or has been abused, misused, damaged or is in worn condition or if the fan has been used other than for the uses described in the company manual. This warranty does not cover defects resulting from normal wear and tear. To make a warranty claim, notify Loren Cook Company, General Offices, 2015 East Dale Street, Springfield, Missouri 65803-4637, explaining in writing, in detail, your complaint and referring to the specific model and serial numbers of your fan. Upon receipt by Loren Cook Company of your written complaint, you will be notified, within thirty (30) days of our receipt of your complaint, in writing, as to the manner in which your claim will be handled. If you are entitled to warranty relief, a warranty adjustment will be completed within sixty (60) business days of the receipt of your written complaint by Loren Cook Company. This warranty gives only the original purchaser placing the fan in service specifically the right. You may have other legal rights which vary from state to state. For fans provided with motors, the motor manufacturer warrants motors for a designated period stated in the manufacturer's warranty. Warranty periods vary from manufacturer to manufacturer. Should motors furnished by Loren Cook Company prove defective during the designated period, they should be returned to the nearest authorized motor service station. Loren Cook Company will not be responsible for any removal or installation costs.

LOREN COOK COMPANY

Corporate Offices: 2015 E. Dale St. Springfield, MO 65803
Phone 417-869-6474 | Fax 417-862-3820 | lorencook.com



PLAN VIEW
ROOF SLABS REMOVED FOR CLARITY



VALVE VAULT **WETWELL**

TOP VIEW @ GRADE

GENERAL NOTES:

1. SEE STRUCTURAL CALCULATIONS FOR PRODUCTION SPECIFICATIONS.

2. STRUCTURE SHALL BE WET CAST USING A SELF COMPACTING CONCRETE MIX.

3. REINFORCING STEEL WELDED WIRE FABRIC SHALL CONFORM TO THE LATEST ASTM SPECIFICATION A185.

4. REINFORCING STEEL DEFORMED BARS SHALL CONFORM TO THE LATEST ASTM SPECIFICATION A706, GRADE 60.

5. ALL CONCRETE JOINTS SHALL BE SEALED WITH 1" BUTYL RUBBER.

6. EXTERIOR OF WETWELL AND VALVE VAULT SHALL BE COATED WITH BAY OIL, "AQUA-SAFE".

7. INTERIOR OF STRUCTURE SHALL BE COATED WITH CPP SPRAY LINER.

8. INTERIOR OF VALVE VAULT SHALL BE NATURAL CONCRETE FINISH.

9. MANHOLE STEPS ARE NOT REQUIRED IN WETWELL.

10. ALL HARDWARE SHALL BE 316 SERIES STAINLESS STEEL .

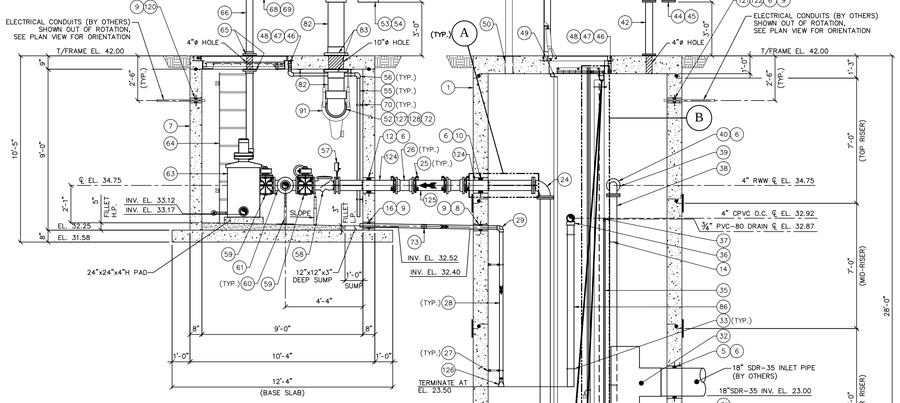
11. CONTRACTOR SHALL VERIFY ALL PENETRATION SIZES AND LOCATIONS.

WETWELL WEIGHT CHART

COMPONENTS (CONCRETE ONLY)	APPROX. WT.
FLAT TOP SLAB w/CAST-IN HATCH	13,200 LBS.
7'-0"H MIDDLE & TOP RISER	29,200 LBS.
8'-0"H LOWER RISER	33,400 LBS.
4'-9"H BASE SECTION w/FILLET	51,300 LBS.

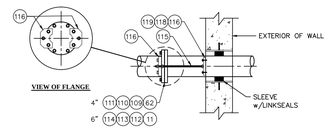
VALVE VAULT WEIGHT CHART

COMPONENTS (CONCRETE ONLY)	APPROX. WT.
ROOF SLAB WITH CAST-IN HATCHES	17,000 LBS.
BASE SECTION w/SLOPED FLOOR	79,000 LBS.

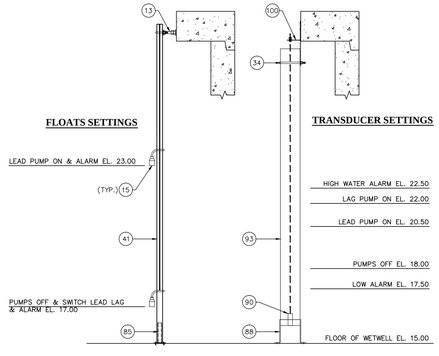


VALVE VAULT

TYPICAL SECTION



A **THRUST RESTRAINT DETAIL**
NOT TO SCALE



B **LEVEL SETTINGS DETAIL**
NOT TO SCALE

Piping Schedule

System	Material	Finish/Coating	Color
Sewage Process Piping	Class 53 Ductile Iron	Primer/Duraplate 235	Ansa #61 Gray
Purafil Vent Line	PVC-80	Natural	N/A
Purafil Suction Line	CPVC-80	Natural	N/A
Purafil Drain Line	CPVC-80	Natural	N/A
Valve Vault Exterior Vent Piping	PVC-80	Natural	N/A
Pump Guide Rails	316 S.S Pipe Sch-40	Natural	N/A
Wet Well Stilling Well	PVC-40	Natural	N/A
Float Pole	316 S.S Pipe Sch-40	Natural	N/A
Wet Well Exterior Vent	Class 53 Ductile Iron	Primer/Duraplate 235	Ansa #61 Gray
Inlet Piping	SDR-35	Natural	N/A

DRAWING LOG

NUMBER	DATE:	DESCRIPTION
4		
3		
2		
1	10/16/20	ISSUED FOR APPROVAL

UNITED CONCRETE PRODUCTS

UNITED CONCRETE PRODUCTS INC.
173 Church Street Yalesville, CT 06492
(800) 234-3119 Fax: (203) 265-4941

CUSTOMER:	ROBERT B. OUR CO., INC.
JOB NAME:	DOWNTOWN AREA COLLECTION SYSTEM & P.S.
JOB LOCATION:	ORLEANS, MA
DWG TITLE:	PUMP STATION #1

DRAWN BY: CJS	DATE: 08/21/20	PM CHK'D: TM	DATE: 10/08/20
CAD CHK'D:	DATE:	QM CHK'D:	DATE:
JOB NO: 27087	SCALE: 1/4" = 1'-0"	DRAWING NO: PS-1	

Job No. 27087 Orleans
Pump Station No. 1

Item	Description	QTY	Part #	Vendor	Manufacturer
1	Concrete Wet Well	1	PS-1	United Concrete	United Concrete
2	Access Hatch Aluminum Wet Well (3)(23-13/16 x 36" Clear Opening)	1	THT 37X90	U.S.F Fabrication	U.S.F Fabrication
3	Concrete Joint Seal	A/R	CS-102	Conseal	Conseal
4	Concrete Joint Wrap 8' Dia	3 Rolls	8' Dia	Mac Wrap	Mar Mac
5	Sleeve 22" x 10" Long 316 S.S (10' Dia.) for 18" SDR-35	1		Beauchemin Steel	Beauchemin Steel
6	Modular Seals LS-400	90	LS-400-S	Ferguson	Thunder Line
7	Concrete Valve Vault	1	PS-1	United Concrete	United Concrete
8	Sleeve 4" x 10" Long 316 S.S (10' Dia.) for 2" Drain	1		Beauchemin Steel	Beauchemin Steel
9	Modular Seals LS-300	70	LS-300-S	Ferguson	Thunder Line
10	Sleeve 10" x 10" Long 316 S.S (10' Dia.) 2 Outside Discharge Pipes	2		Beauchemin Steel	Beauchemin Steel
11	6" Flange gasket (American Toruseal)	30	American Toruseal	Ferguson	Specification Rubber
12	Sleeve 10" x 8" Long 316 S.S - Valve vault Discharge	4		Beauchemin Steel	Beauchemin Steel
13	Upper Float Bracket 316 S.S	1		Beauchemin Steel	Beauchemin Steel
14	4" DI U-Bolt Pipe Support Bracket (RWW Piping) 316 S.S	2		Beauchemin Steel	Beauchemin Steel
15	Floats 50' Cable	2	KA-1L-0-0-16M	R.E Erickson	KARI Level
16	Sleeve 4" x 8" Long 316 S.S Valve Vault Drain	1		Beauchemin Steel	Beauchemin Steel
17	6" Restraint Flange Coupling Adapter	4	RFCA-6	Ferguson	ROMAC
18	Submersible Pumps 30 HP 3/60/460 1762 RPM 552 GPM @ 86' TDH	3	KSB KRT F80-252/224XEG1-S	Atlantic Fluid Technology	KSB
19	Pump Base Elbow	3	KSB KRT F80-252/224XEG1-S	Atlantic Fluid Technology	KSB
20	6" x 3" Eccentric Reducer DI Red Prime	3		Ferguson	Tyler Union
21	2" Guide rail pipe	180'		Tek Mahoney	Ta Chen INT.
22	6" DI Pipe x 16'-0" Long Flg x PE	3		Ferguson	Clearwater
23	Grab link System	3	Fig. 1 442	Atlantic Fluid Technology	KSB
24	6" DI 90° Elbow Red Prime	3		Ferguson	Tyler Union
25	6" Megalug Joint Restraint	12	1106	Ferguson	Ebaa Iron Inc
26	6" DI solid sleeve 12" Long	6		Ferguson	Tyler Union
27	2" PVC U-Bolt Pipe Support Bracket 316 S.S	2		FM Stainless	FM Stainless
28	2" PVC-80 Pipe	20'		Tek Mahoney	Charlotte Pipe
29	2" PVC-80 90° Elbow	1		Tek Mahoney	Spears
30	18" SDR-35 Pipe Support Bracket 316 S.S	2		Beauchemin Steel	Beauchemin Steel
31	18" SDR-35 Pipe	4'		Ferguson	
32	18" SDR-35 Tee	1		Ferguson	Multi-Fittings
33	4" IPS U-Bolt Pipe Support Bracket (O/C Piping) 316 S.S	2		Beauchemin Steel	Beauchemin Steel
34	6" IPS 316 S.S U Bolt	3		FM Stainless	FM Stainless
35	3/4" CPVC-80 Pipe	40'		Tek Mahoney	IPEX Corzan
36	4" CPVC-80 90° Elbow	3		Tek Mahoney	Spears
37	3/4" CPVC-80 90° Elbow	5		Tek Mahoney	Spears
38	4" DI Pipe x 14'-6" Long Flg x PE	1		Ferguson	Clearwater
39	4" DI 90° Elbow Red Prime	3		Ferguson	Tyler Union
40	Sleeve 8" x 10" (10' Dia.) 316 S.S Wet Well RWW	1		Beauchemin Steel	Beauchemin Steel
41	1-1/4" 316 S.S Pipe Float Pole	40'		Tek Mahoney	Ta Chen INT.
42	4" DI Pipe x 3'-0" Long Flg x Flg Pipe	1		Ferguson	Clearwater
43	4" Pipe Support Bracket 316 S.S	2		Beauchemin Steel	Beauchemin Steel
44	4" DI companion Flange Red Prime.	1		Ferguson	Tyler Union
45	4" Bird screen 316 S.S Mesh	1		McMaster Carr	McMaster Carr
46	1-1/2" PVC-80 Male adapter	3		Tek Mahoney	Spears
47	1-1/2" PVC-80 Nipple	3		Tek Mahoney	Charlotte Pipe
48	1-1/2" PVC-80 Coupling	3		Tek Mahoney	Spears
49	Upper Guide Rail bracket 316	3		Atlantic Fluid Technology	KSB
50	Portable Davit Crane 2000 Lb. Max Capacity 316 S.S	1	5PT20-M3	Mass Crane	Thern
51	Davit Crane Flush Mount Base 316 S.S	1	5BF20S316	Mass Crane	Thern
52	10" PVC-80 90° Elbow	3		Tek Mahoney	Spears
53	10" PVC-80 Coupling	1		Tek Mahoney	Spears
54	10" Bird Screen S.S	1		McMaster Carr	McMaster Carr
55	1-1/2" PVC-80 Pipe (VV Drain)	20'		Tek Mahoney	Spears
56	1-1/2" PVC-80 90° Elbow	3		Tek Mahoney	Spears
57	Pressure Gauge Assembly	3	80-06--P-S-S-02T-Q-000-CK	R.E Erickson	ASHCROFT
58	6" Swing-Flex Check Valve	3	506CBFMI	Valmatic	Valmatic
59	6" Plug Valve w/ Worm Gear Actuator	4	5606F/5A08	Valmatic	Valmatic
60	6" Pipe Support Bracket 316 S.S	6		Beauchemin Steel	Beauchemin Steel
61	6" DI Tee Red Prime	4		Ferguson	Tyler Union
62	4" Flange gasket (American Toruseal)	10	American Toruseal	Ferguson	Specification Rubber
63	Drum Scrubber Filtration Unit	1	Scrubber-100	FRMA	Purafil
64	Ladder Access for Valve Vault	1		U.S.F Fabrication	U.S.F Fabrication

Job No. 27087 Orleans
Pump Station No. 1

Item	Description	QTY	Part #	Vendor	Manufacturer
65	4" PVC-80 Van Stone Flange	2		Tek Mahoney	Spears
66	4" PVC-80 Pipe	20'		Tek Mahoney	Charlotte Pipe
67	4" PVC-80 90° Elbow	2		Tek Mahoney	Spears
68	4" PVC-80 Coupling	1		Tek Mahoney	Spears
69	4" S.S Insect Screen	1		McMaster Carr	McMaster Carr
70	1-1/2" Split ring Hanger 316 S.S	5		Tek Mahoney	Empire
71	6" DI Pipe x 1'-0" Long PE x PE Red Prime (FM)	1		Ferguson	Clearwater
72	12" x 10" PVC-80 Reducer	1		Tek Mahoney	Spears
73	2" Griploc Coupling	2	GL429-020G	Tek Mahoney	Spears
74	6" DI Companion Flange	1		Ferguson	Tyler Union
75	Access Hatch Aluminum Valve Vault Equipment (48-1/2" x 48" Clear Opening)	1	THD 55x58	U.S.F Fabrication	U.S.F Fabrication
76	Access Hatch Aluminum Valve Vault Access (	1	THS 36x42	U.S.F Fabrication	U.S.F Fabrication
77	6" Alum Cam & Groove Type F	1	600-F-AL	Tek Mahoney	Dixon
78	Sleeve 2.5" x 10" (10' Dia.) 316 S.S Wet Well O/C Drain	1		Beauchemin Steel	Beauchemin Steel
79	Modular Seals LS-275	14	LS-275-S	Ferguson	Thunder Line
80	6" Flow Meter	1	7ME6580-4HJ14-2AA2	R.E Erickson	Siemens
81	6" Alum Dust Cap Type DC	1	600-DC-AL	Tek Mahoney	Dixon
82	10" PVC-80 Pipe	20'		Tek Mahoney	Charlotte
83	10" PVC-80 Vanstone Flange	2		Tek Mahoney	Spears
84	Sleeve 8" x 8" long 316 S.S Valve Vault RWW	1		Beauchemin Steel	Beauchemin Steel
85	Lower Float Pole Bracket 1" 316 S.S	1		Beauchemin Steel	Beauchemin Steel
86	4" CPVC-80 Pipe	40'		Tek Mahoney	IPEX Corzan
87	Sleeve 6" x 8' Long 316 S.S Valve Vault Odor Control	1		Beauchemin Steel	Beauchemin Steel
88	Lower Stilling Well Bracket 316 S.S	1		Beauchemin Steel	Beauchemin Steel
89	Sleeve 2.5" x 8" Long 316 S.S Valve Vault O/C Drain	1		Beauchemin Steel	Beauchemin Steel
90	Submersible Transducer	1	700S14A0B-C150B	R.E Erickson	KPSI
91	Inline Exhaust Blower 370 CFM	1	12CVB	Air Equipment	Loren Cook
92	Sleeve 10" x 10" (10' Dia.) 316 S.S Wet Well Center Discharge	1		Beauchemin Steel	Beauchemin Steel
93	6" PVC-40 Stilling Well	40'		Tek Mahoney	Charlotte Pipe
94	4" Megalug Joint Restraint	6	1104	Ferguson	Ebaa Iron Inc
95	4" DI MJ 90° Elbow Red Prime	1		Ferguson	Tyler Union
96	4" Di Pipe x 6'-6" Long PE x PE Red Prime	1		Ferguson	Clearwater
97	4" DI MJ 45° Elbow Red Prime	2		Ferguson	Tyler Union
98	4" Di Pipe x 4'-6" Long PE x PE Red Prime	1		Ferguson	Clearwater
99	Sleeve 6" x 10" (10' Dia.) 316 S.S Wet Well Odor Control	1		Beauchemin Steel	Beauchemin Steel
100	Upper Stilling Well Bracket 316 S.S	1		Beauchemin Steel	Beauchemin Steel
101	4" DI Pipe x 4'-6" Long Flg x PE Red Prime	1		Ferguson	Clearwater
102	4" Plug Valve w/ Worm Gear Actuator	1	5804R/7A08	Valmatic	Valmatic
103	6" x 4" DI Concentric Reducer Red Prime	2		Ferguson	Tyler Union
104	4" DI Pipe x 4'-0" Long Flg x PE Red Prime (RWW)	1		Ferguson	Clearwater
105	6" DI Pipe x 0'-11-3/4" Long Flg X Flg Spool Red Prime	1		Ferguson	Clearwater
106	6" DI Pipe x 1'-1-3/4" Long Flg X Flg Spool Red Prime	1		Ferguson	Clearwater
107	6" DI Pipe x 1'-1-3/4" Long Flg X Flg Spool Red Prime	1		Ferguson	Clearwater
108	6" DI Pipe x 3'-6" Long Flg x PE Red Prime (FM)	1		Ferguson	Clearwater
109	5/8" x 3" Long 316 S.S Hex Head Cap Screws	100		Turtle & Hughes	Star Stainless
110	5/8" 316 S.S Nuts	100		Turtle & Hughes	Star Stainless
111	5/8 316 S.S Washers Small O.D	200		Turtle & Hughes	Star Stainless
112	3/4" x 3-1/2" Long 316 S.S Hex Head Cap Screws	250		Turtle & Hughes	Star Stainless
113	3/4" 316 S.S Nuts	250		Turtle & Hughes	Star Stainless
114	3/4" 316 S.S Washers Small O.D	500		Turtle & Hughes	Star Stainless
115	5/8" Threaded Rod 316 S.S	12'		Turtle & Hughes	Star Stainless
116	6" Thrust Bracket 316 S.S	6		Beauchemin Steel	Beauchemin Steel
117	2 Hook Bracket 316 S.S	3		Beauchemin Steel	Beauchemin Steel
118	3/4" Threaded Rod 316 S.S	30'		Turtle & Hughes	Star Stainless
119	4" Thrust Bracket 316 S.S	4		Beauchemin Steel	Beauchemin Steel
120	Conduit Sleeve Assembly 316 S.S (3) 3" Valve Vault	1		Beauchemin Steel	Beauchemin Steel
121	Conduit Sleeve Assembly 316 S.S (3) 4" Wet Well	1		Beauchemin Steel	Beauchemin Steel
122	Conduit Sleeve Assembly 316 S.S (1) 3" (1) 3-1/2" Wet Well	1		Beauchemin Steel	Beauchemin Steel
123	DI Pipe exterior coating (Color to be ANSI Gray #61)	2 Gallons	Dura-Plate 235	Sherwin Williams	Sherwin Williams
124	6" DI Pipe x 4'-0" Long Flg X PE Spool	6		Ferguson	Clearwater
125	6" DI Pipe x 2'-0" Long PE X PE Spool	3		Ferguson	Clearwater
126	2" Molded Check Valve	1	TF-2	Redvalve	Tideflex
127	12" Bird Screen S.S	1		McMaster Carr	McMaster Carr
128	12" PVC-80 Vanstone Flange	2		Tek Mahoney	Spears

DRAWING LOG

NUMBER	DATE	DESCRIPTION
4		
3		
2		
1	10/16/20	ISSUED FOR APPROVAL

UNITED CONCRETE PRODUCTS

UNITED CONCRETE PRODUCTS INC.
173 Church Street Yalesville, CT 06492
(800) 234-3119 Fax: (203) 265-4941

CUSTOMER:	ROBERT B. OUR CO., INC.
JOB NAME:	DOWNTOWN AREA COLLECTION SYSTEM & P.S.
JOB LOCATION:	ORLEANS, MA
DWG TITLE:	PUMP STATION #1 BOM

DRAWN BY: CJS	DATE: 08/21/20	PM CHK'D: TM	DATE: 10/08/20
CAD CHK'D:	DATE:	QM CHK'D:	DATE:
JOB NO: 27087	SCALE: NONE	DRAWING NO: PS-2	

Electrical Department

PROJECT:	Orleans, MA Downtown Area Collection System and Pumping Stations	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-02	DATE RETURNED:	03/31/2021
SUBMITTAL NO:	158 (11398-001)	REVIEWER:	A. Abraham
SUBJECT:	Pump Station 01 - GEN.01-1	SPECIFICATION:	11398

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only (6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	11398 1.04.B.1	1	~~Submit a copy of specification section 11398 with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.~~ Response: Confirmed, attached is a copy of spec section 11398 with addendums indicating specification requirements. AECOM Response: No exceptions taken.
2.	11398 1.04.B.10	1	~~Submit engine generator loading calculation per the requirements of 11398, Attachment A. It is noted that generator load calculation is missing from the submittal. Loads shall be grouped per steps in Attachment A.~~ Response: Confirmed, generator load calculation included in the revised submittal. AECOM Response: No exceptions taken.
3.	11398 2.07.F.4(a)	1	~~Provide 65 kA rated circuit breaker in accordance with Specification requirements. It is noted that the submittal references a 480VAC, 35 kA rated circuit breaker in multiple locations, see attached.~~ Response: Confirmed, a 65kA rated breaker is being provided, this is being accomplished thru an engineering special request. The breaker Square D, PowerPact J frame, model # is JJP36250CU33X. AECOM Response: No exceptions taken.
4.	11398 2.06.C.3 & 2.07, F.1(b) 01 E-002	1	~~Please clarify requirement for "100 Amp main 3-phase panelboard" at generator enclosure. It should be noted that this is a non-walk-in type enclosure. Circuits for generator heaters and support systems shall be provided as 208/120VAC rated from panelboard MPC.01-1 in accordance with Specification Section 11398, Paragraph 2.06.C.3 and Paragraph 2.07, F.1(b) and per Contract electrical drawings.~~ ~~- 208VAC, 20A – Generator jacket water heater (1.5 kW)~~ ~~- 120VAC, 20A – Generator space heater~~ ~~- 120VAC, 20A – Generator battery charger~~ ~~- 120VAC, 20A – Generator alternator heater~~

ITEM NUMBER	REFERENCE	CODE	COMMENT
			~~A single 208VAC, 3-phase power feed could be provided. However, 100A feed requirement for 125 kVA generator ancillary power appears excessive for a non-walk-in enclosure. Please advise if values on Fidelity drawing "sheet 4 of 7" are realistic or could be reduced.~~ Response: A non-walk-in customer enclosure is being provided to meet the specified sound requirements (65 dBA@ 23') per spec section 11398 2.04. The enclosure manufacture assumed a load center/panelboard was required as part of the enclosure package . The load panel/panelboard will be removed from the enclosure package, the generator accessories will be electrically fed from panelboard MPC.01-1 per the specification and drawing. AECOM Response: No exceptions taken.
5.	11398 2.07.A.1	1	~~Confirm fuel storage tank is a double-walled and UL listed and labeled for primary containment aboveground tank for flammable and combustible liquids.~~ Response: Confirmed, a double-wall UL 142 rated sub-base fuel tank is being provided per spec section 11398 207 A 1-6. AECOM Response: No exceptions taken.
6.	Transfer Switch	1	~~Transfer switch to be submitted under submittal # 16900. Provide ASCO 7000 series or equal.~~ Response: Confirmed, Transfer Switch Submittal date included in the revised submittal. AECOM Response: No exceptions taken.
REVIEWER SIGNTATURE			
APPROVER SIGNATURE	Andrea Abraham		

DOWNTOWN AREA COLLECTION SYSTEM AND PUMPING STATIONS
CONTRACT NO. 2019-02 & SRF NO. 4486
ORLEANS, MA

General Contractor: Robert B. Our Co., Inc.

Engineer: AECOM Technical Services, Inc.

Submittal Number: 11398-001-A Resubmittal Diesel Generator for Pump Station 01 Revised 2.19.21

Deviations: None: __X__ ; As Listed:

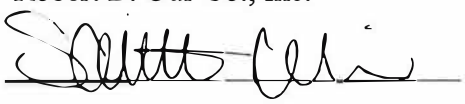
Reference Specification Section: 11398 Part 1.04

Reference Drawing Number:

Space Requirements: As Designed: _X_ Different, As Listed:

Representation is made to the Owner and Engineer that the Contractor has (a) reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents; (b) determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto; (c) determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and (d) determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

Contractor: Robert B. Our Co., Inc.

Signature: 

Date: February 19, 2021

ENGINEER STAMP

24 Great Western Rd., P.O. Box 1539, Harwich, MA 02645 - Tel. 508-432-0530 Fax. 508-432-4385

ELECTRICAL CONTRACTOR

WBE & DBE CERTIFIED

CHAPMAN

CONSTRUCTION GROUP INC.

Master Electrical license #15971 A CS license #CS-100358

DOWNTOWN AREA COLLECTION SYSTEM

PUMPING STATIONS

TOWN OF ORLEANS,

MASSACHUSETTS

Submittal for:

Section Number: Pump Station #1

Generator

Submitted by:

CHAPMAN CONSTRUCTION GROUP INC.

February 18, 2021

17 Jan Sebastian Drive, Units 4&5, Sandwich, MA 02563
www.ccgico.com
Office: 508-888-4060
Fax: 888-880-1358

Electrical Department

PROJECT:	Orleans, MA Downtown Area Collection System and Pumping Stations	PROJECT NUMBER:	60587515
CLIENT CONTRACT:	2019-02	DATE RETURNED:	01/13/2021
SUBMITTAL NO:	109 (11398-001)	REVIEWER:	A. Abraham
SUBJECT:	Pump Station 01 - GEN.01-1	SPECIFICATION:	11398

(1)-No Exception Taken (2)-Make Corrections Noted (3)-Amend and Resubmit (4)-Rejected-See Remarks (5)-For Information Only (6)-Not Required for Review

Engineer's review is for general conformance with the design concept and Contract Documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the Project Drawings and Specifications nor departure there from. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

ITEM NUMBER	REFERENCE	CODE	COMMENT
1.	11398 1.04.B.1	3	Submit a copy of specification section 11398 with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.
2.	11398 1.04.B.10	3	Submit engine generator loading calculation per the requirements of 11398, Attachment A. It is noted that generator load calculation is missing from the submittal. Loads shall be grouped per steps in Attachment A.
3.	11398 2.07.C	3	Submit cutsheets/model number for generator engine starting batteries. It is noted that information is submitted only for the battery charger.
4.	11398 2.07.C	3	Confirm starting batteries are industrial grade, high-output, long-life, lead acid type designed for diesel engine cranking service in accordance with 11398.
5.	11398 2.07.F.4(a)	3	Provide a 65 kA rated generator main circuit breaker in accordance with Specification requirements. It is noted that the submittal references a “JG” type, 480VAC, 35 kA rated circuit breaker in multiple locations throughout the submittal, see attached.
6.	11398 2.07.F.4(b)	3	Provide generator main circuit breaker with an adjustable trip, rating plug, long-time, short-time and instantaneous protective relaying and ground fault (LSIG) protection in accordance with Section 11398. It is noted that the submitted circuit breaker trip unit only has adjustable long-time and instantaneous functions.
7.	11398 2.07.F.4(b)	3	Provide full model number/catalog number and catalog cutsheet for generator main circuit breaker. Submitted tables for the circuit breaker don’t appear to be Square D/Schneider Electric catalog cutsheets and the model number provided as “JG” is incomplete.
8.	11398 2.06.C.3 & 2.07, F.1(b) 01 E-002	3	Please clarify requirement for “100 Amp main 3-phase panelboard” at generator enclosure. It should be noted that this is a non-walk-in type enclosure. Circuits for generator heaters and support systems shall be provided as 208/120VAC rated from panelboard MPC.01-1 in accordance with Specification Section 11398, Paragraph 2.06.C.3 and Paragraph 2.07, F.1(b) and per Contract electrical drawings. - 208VAC, 20A - Generator jacket water heater (1.5 kW) - 120VAC, 20A – Generator space heater - 120VAC, 20A – Generator battery charger - 120VAC, 20A – Generator alternator heater

ITEM NUMBER	REFERENCE	CODE	COMMENT
			The 208VAC, 100A rated feed requirement for a 125 kVA generator set ancillary power appears high for this size unit with a non-walk-in enclosure. Please advise if values on Fidelity drawing “sheet 4 of 7” are realistic or could be reduced.
9.	11398 2.07.A.1	3	Confirm fuel storage tank is double-walled and UL listed and labeled as: Primary containment aboveground tank for flammable and combustible liquids.
10.	Transfer Switch	3	Submit transfer switch for review under submittal # 16900. Provide ASCO 7000 series or equal. Provide service entrance rated transfer switch in accordance with Specification Section 16900.
REVIEWER SIGNTATURE			
APPROVER SIGNATURE			

KRAFTPOWER
The power of performance.

February 18, 2021

Chapman Construction Group, Inc
17 Jan Sebastian Drive, Unit 4&5
Sandwich, MA 02563

Reference: Orleans Area Collection Pump Station #1 Submittal Questions.

Dear Ms. Chapman

Listed below are my answers to the comments made by the engineer.

Question 1- Submit a copy of specification section 11398 with addenda and all referenced specification sections with addenda, with each paragraph check- marked to indicate specification compliance.

Answer 1- Confirmed, attached is a copy of spec section 11398 with addendums indicating specification requirements.

Question 2- Submit engine generator loading calculation per the requirements of 11398, Attachment A. It is noted that generator load calculation is missing from the submittal. Loads shall be grouped per steps in Attachment A

Answer 2- Confirmed, generator load calculation included in the revised submittal.

Question 3- Submit cutsheets/model number for generator engine starting batteries. It is noted that information is submitted only for the battery charger.

Answer 3- Confirmed, spec sheet for generator starting batteries included in the revised submittal.

Question 4- Confirm starting batteries are industrial grade, high-output, long-life, lead acid type designed for diesel engine cranking service in accordance with 11398.

Answer 4- Confirmed, batteries are industrial grade, high output, long life and are the optimal batteries recommend by the generator manufacture (Kohler Power).

Question 5- Provide a 65 kA rated generator main circuit breaker in accordance with Specification requirements. It is noted that the submittal references a “JG” type, 480VAC, 35 kA rated circuit breaker in multiple locations throughout the submittal, see attached

Answer 5- Confirmed, a 65kA rated breaker is being provided, this is being accomplished thru an engineering special request. The breaker Square D, PowerPact J frame, model # is JJP36250CU33X

Question 6- Provide generator main circuit breaker with an adjustable trip, rating plug, long-time, short-time and instantaneous protective relaying and ground fault (LSIG) protection in accordance with Section 11398. It is noted that the submitted circuit breaker trip unit only has adjustable long-time and
instantaneous functions

Answer 6- Confirmed, the breaker has long time, short time, and instantaneous trip (LSI).

Question 7- Provide full model number/catalog number and catalog cutsheet for generator main circuit breaker. Submitted tables for the circuit breaker don't appear to be Square D/Schneider Electric catalog cutsheets and the model number provided as "JG" is incomplete

Answer 7- The catalog for the upsized breaker is Square D, PowerPact, J-Frame, model number JJP36250CU33X with TX termination accessories.

Question 8- Please clarify requirement for "100 Amp main 3-phase panelboard" at generator enclosure. It should be noted that this is a non-walk-in type enclosure. Circuits for generator heaters and support systems shall be provided as 208/120VAC rated from panelboard MPC.01-1 in accordance with Specification Section 11398, Paragraph 2.06.C.3 and Paragraph 2.07, F.1(b) and per Contract electrical drawings.

208VAC, 20A - Generator jacket water heater (1.5 kW)
120VAC, 20A – Generator space heater
120VAC, 20A – Generator battery charger
120VAC, 20A – Generator alternator heater

The 208VAC, 100A rated feed requirement for a 125 kVA generator set ancillary power appears high for this size unit with a non-walk-in enclosure. Please advise if values on Fidelity drawing "sheet 4 of 7" are realistic or could be reduced.

Answer 8 A non-walk-in customer enclosure is being provided to meet the specified sound requirements (65 dBA@ 23') per spec section 11398 2.04. The enclosure manufacture assumed a load center/panelboard was required as part of the enclosure package . The load panel/panelboard will be removed from the enclosure package, the generator accessories will be electrically fed from panelboard MPC.01-1 per the specification and drawing.

Question 9- Confirm fuel storage tank is double-walled and UL listed and labeled as: Primary containment aboveground tank for flammable and combustible liquids.

Answer 9- Confirmed, a double-wall UL 142 rated sub-base fuel tank is being provided per spec section 11398 207 A 1-6.

Question 10- Submit transfer switch for review under submittal # 16900. Provide ASCO 7000 series or equal. Provide service entrance rated transfer switch in accordance with Specification Section 16900

Answer 10- Confirmed, Transfer Switch Submittal date included in the revised submittal.

If you have any further questions, please do not hesitate to call me.

Sincerely,

David Duchesneau
Power Systems Sales Representative
Kraft Power Corporation

KRAFTPOWER
The power of performance.

Submittal Package

Engineering Submittal

for

Orleans Collections

Pump Station #1

Job # MA32336

Customer: Chapman Construction Group

Contact: Sue Chapman

Phone: (508) 989-7643

Email: sue@ccgico.com

We are pleased to offer the following submittal for your consideration.

Thank you, David Duchesneau, Kraft Power Corporation

Kraft Power Corporation • 199 Wildwood Ave., PO Box 2189 • Woburn, MA 01888-0389
781-938-9100 • Fax 781-933-7812 • www.kraftpower.com

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Kraft Power Corporation • 199 Wildwood Ave., PO Box 2189 • Woburn, MA 01888-0389
781-938-9100 • Fax 781-933-7812 • www.kraftpower.com

Kraft Power Corporation
199 Wildwood Avenue
Woburn, MA 01801
Tel: (781) 938-9100
www.kraftpower.com

Job Name: Orleans Collections PS 1

Quote Number: 0026709083

Generator

Kohler Model: 125REOZJG

This diesel generator set equipped with a 4R13X alternator operating at 277/480 volts is rated for 128 kW/160 kVA. Output amperage: 192.

Qty	Description
	125REOZJG Generator System
1	125REOZJG Generator Set

Includes the following:

ES Smart Number 01	14OIC102
ES Description 01	J Rating on 250A LCB1 HJ
Literature Languages	English
Approvals and Listings	UL2200 Listing
Approvals and Listings	IBC Seismic Certification
Engine	125REOZJG, 12V, 60Hz
Nameplate Rating	Standby 130C Rise
Voltage	60Hz, 277/480V, Wye, 3Ph, 4W
Alternator	4R13X
Cooling System	Unit Mounted Radiator, 50C
Skid and Mounting	Skid, 44"
Air Intake	Standard Duty
Controller	APM402
Starting Aids, Installed	1500W,110-120V
Cooling System Acc.,Installed	Radiator Duct Flange
Electrical Accy.,Installed	Battery Charger, 10A
Electrical Accy.,Installed	Run Relay
Electrical Accy.,Installed	2 Input/5 OutputModule
Rating, LCB 1	80% Rated
Amps, LCB 1	250
Trip Type, LCB 1	Electronic, LSI
Interrupt Rating LCB 1	65kA at 480V
Misc. Accy., LCB 1	Alarm Switch
Ground Fault Relay Indication	Ground Fault Relay Indication

Kraft Power Corporation
199 Wildwood Avenue
Woburn, MA 01801
Tel: (781) 938-9100
www.kraftpower.com

Job Name: Orleans Collections PS 1

Quote Number: 0026709083

	Fuel Lines, Installed	Flexible Fuel Lines
	Miscellaneous Accy,Installed	Coolant in Genset
	Warranty	Standard
	Testing, Additional	Power Factor Test,0.8,3Ph Only
1	Flexible Exhaust Connection, 6"	
1	NEC Remote, E-Stop	
1	Lit Kit, Production, 125REOZJG	

Kraft Power Corporation
199 Wildwood Avenue
Woburn, MA 01801
Tel: (781) 938-9100
www.kraftpower.com

Job Name: Orleans Collections PS 1

Quote Number: 0026709083

Automatic Transfer Switch

Kohler Model: KEP-DMTA-0400S-NK

3 Pole, 4 Wire, Solid Neutral, 400 amp, Kohler Service Entrance rated Programmed automatic transfer switch, Model KEP-DMTA-0400S-NK , rated 480V, 60 Hz complete with all standard equipment and housed in a NEMA Type 1 enclosure.

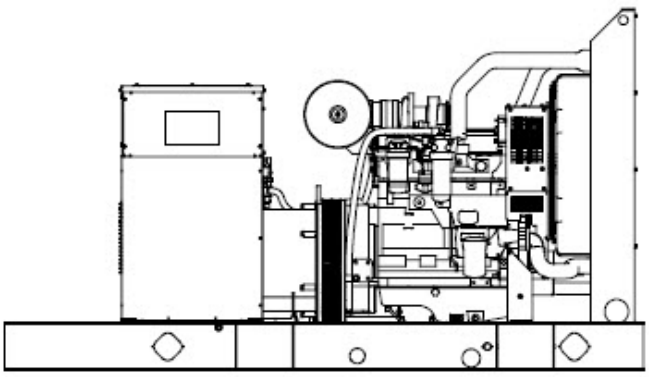
Qty	Description	
	ATS 1500 Transfer Switch System	
1	KEP-DMTA-0400S-NK	
	Includes the following:	
	Literature Languages	English
	Mechanism	Service Entrance
	Transition	Programmed
	Logic	1500
	Voltage	480V / 60 Hz
	Poles & Wires	3 Pole/4 Wire, Solid Neutral
	Enclosure	Nema 1
	Amps	400 Amps
	Connection	Standard
	ATS Utility Switching Device	MCCB ET 250-800A
	ATS Generator Switching Device IBC	MCSW 100-1200A
	Seismic Certification	IBC Seismic Certification
	Warranty	1-YR STANDARD
1	Lit Kit, ATS Production, KEP	

KOHLER®

Spec Sheets

KOHLER®

125REOZJG
Diesel



Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- A one-year limited warranty covers all systems and components. Two-, five-, and ten-year extended warranties are also available.
- Tier 3 EPA-certified for Stationary Emergency Applications
- Alternator Protection
- Battery Rack and Cables
- Customer Connection (standard with Decision-Maker® 6000 controller only)
- Local Emergency Stop Switch
- Oil Drain Extension

Alternator Features

- Operation and Installation Literature
- The unique Fast-Response X excitation system delivers excellent voltage response and short circuit capability using a rare-earth, permanent magnet (PM)-excited alternator.

Other Features

- Kohler designed controllers for one-source system integration and remote communication.
- The low coolant level shutdown prevents overheating (standard on radiator models only).
- Integral vibration isolation eliminates the need for under-unit vibration spring isolators.
- Mount up to three circuit breakers to allow circuit protection of selected priority loads.

Generator Set Ratings

				Standby130C Ratings		
Alternator	Voltage	Ph	Hz	Peak kVA	kW/kVA	Amps
4R13X	277/480	3	60	540	128 / 160	192

RATINGS: All three-phase units are rated at 0.8 power factor. All single-phase units are rated at 1.0 power factor.
Standby Ratings: The standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating.
Prime Power Ratings: At varying load, the number of generator set operating hours is unlimited.
A 10%overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory.
Obtain technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates.
The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

Model: 125REOZJG, continued

Alternator Specifications

Specifications	Alternator
Alternator manufacturer	Kohler
Type	4-Pole, Rotating-Field
Exciter type	Brushless, Rare-Earth Permanent-Magnet
Leads, quantity	4RX: 12, Reconnectable 4TX: 4, 120-240
Voltage regulator	Solid State, Volts/Hz
Insulation	NEMA MG1
Insulation: Material	Class H
Insulation: Temperature Rise	130°C, Standby
Bearing: quantity, type	1, Sealed
Coupling	Flexible disc
Amortisseur windings	Full
Voltage regulation, no-load to full-load RMS	Controller Dependent
One-Step Load Acceptance	100% of rating
Unbalanced load capability	100% of Rated Standby Current

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds.
- Sustained short-circuit current enabling down stream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Vacuum-impregnated windings with fungus-resistant epoxy varnish for dependability and long life.
- Superior voltage waveform from a two-thirds pitch stator and skewed rotor.

Engine

Engine Specification

Engine Manufacturer	John Deere
Engine Model	4045HF285K
Engine: type	4-Cycle, Turbocharged, Charge Air-Cooled
Cylinder arrangement	4 Inline
Displacement, L (cu. in.)	4.5 (276)
Bore and stroke, mm (in.)	106 x 127 (4.19 x 5.00)
Compression ratio	19:01
Piston speed, m/min. (ft./min.)	457 (1500)
Main bearings: quantity, type	5, Replaceable Insert
Rated rpm	1800
Max. power at rated rpm, kWm (BHP)	147 (197)
Cylinder head material	Cast Iron
Crankshaft material	Forged Steel
Valve (exhaust) material Intake	Chromium-Silicon Steel
Valve (exhaust) material Exhaust	Stainless Steel
Governor: type, make/model	JDEC Electronic L16 Denso HP3
Frequency regulation, no-load to-full load	Isochronous
Frequency regulation, steady state	±0.25%
Frequency	Fixed
Air cleaner type, all models	Dry

Model: 125REOZJG, continued

Exhaust

Exhaust System

Exhaust Manifold Type	Dry
Exhaust flow at rated kW, m3/min. (cfm)	27.0 (953)
Exhaust temperature at rated kW, dry exhaust, °C (°F)	580 (1076)
Maximum allowable back pressure, kPa (in. Hg)	7.5 (2.2)
Exh. outlet size at eng. hookup, mm (in.)	98 (3.86)

Engine Electrical

Engine Electrical System

Battery charging alternator	12 Volt
Battery charging alternator: Ground (negative/positive)	Negative
Battery charging alternator: Volts (DC)	12
Battery charging alternator: Ampere rating	65
Starter motor rated voltage (DC)	12
Battery, recommended cold cranking amps (CCA): Qty., CCA rating each	One, 800
Battery voltage (DC)	12

Fuel

Fuel System

Fuel type	Diesel
Fuel supply line, min. ID, mm (in.)	11.0 (0.44)
Fuel return line, min. ID, mm (in.)	6.0 (0.25)
Max. lift, fuel pump: type, m (ft.)	Mechanical, 1.8 (6.0)
Max. fuel flow, Lph (gph)	90.0 (23.8)
Max. return line restriction, kPa (in. Hg)	20 (5.9)
Fuel prime pump	Manual
Fuel Filter Secondary	2 Microns@ 98% Efficiency
Fuel Filter Primary	30 Microns
Fuel Filter Water Separator	Yes
Recommended fuel	Low Sulfur #2 Diesel

Lubrication

Lubrication System

Type	Full Pressure
Oil pan capacity, L (qt.)	27.0 (28.5)
Oil pan capacity with filter, L (qt.)	27.9 (29.5)
Oil filter: quantity, type	1, Cartridge
Oil cooler	Water-Cooled

Model: 125REOZJG, continued

Cooling

Radiator System

Ambient temperature, °C (°F)	50 (122)
Engine jacket water capacity, L (gal.)	8.5 (2.25)
Radiator system capacity, including engine, L (gal.)	19.2 (5.1)
Engine jacket water flow, Lpm (gpm)	180 (48)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	72 (4098)
Heat rejected to air charge cooler at rated kW, dry exhaust, kW (Btu/min.)	26.5 (1508)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	660 (26)
Fan, kWm (HP)	7.7 (10.3)
Max. restriction of cooling air, intake and discharge side of radiator, kPA (in. H20)	.125 (0.5)

* Enclosure with internal silencer reduces ambient temperature capability by 5°C (9°F).

Operation Requirements

Air Requirements

Radiator-cooled cooling air, m3/min. (scfm) *	226.5 (8000)
Combustion air, m3/min. (cfm)	9.65 (341)
Heat rejected to ambient air: Engine, kW (Btu/min.)	30.4 (1730)
Heat rejected to ambient air: Alternator, kW (Btu/min.)	13.5 (770)

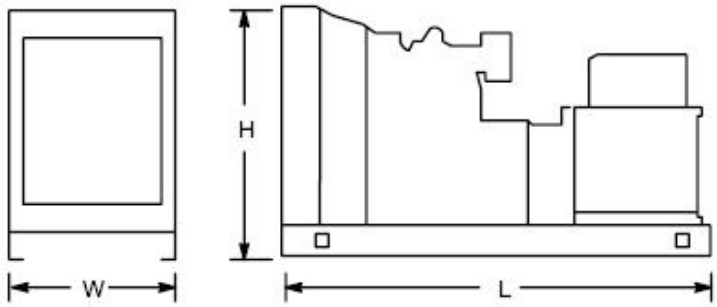
*Air density = 1.20 kg/m3 (0.075 lbm/ft3)

Fuel Consumption

Diesel, Lph (gph), at % load	Rating
Standby Fuel Consumption at 100% load	37.4 Lph (9.9 gph)
Standby Fuel Consumption at 75% load	29.0 Lph (7.6 gph)
Standby Fuel Consumption at 50% load	21.1 Lph (5.6 gph)
Standby Fuel Consumption at 25% load	11.4 Lph (3.0 gph)
Prime Fuel Consumption at 100% load	34.8 Lph (9.2 gph)
Prime Fuel Consumption at 75% load	26.9 Lph (7.1 gph)
Prime Fuel Consumption at 50% load	19.5 Lph (5.1 gph)
Prime Fuel Consumption at 25% load	10.6 Lph (2.8 gph)

Dimensions and Weights

Dim Weight Spec	Dim Weight Value
Fuel	Diesel
Engine Manufacturer	Diesel
Overall Size, L x W x H, mm (in.):	2700 x 1120 x 1527 (106.3 x 44.1 x 60.1)
Weight (radiator model), wet, kg (lb.):	1270 (2800)



NOTE: This drawing is provided for reference only and should not be used for planning installation. Contact your local distributor for more detailed information.

APM402

Kohler® APM402 Controller

General Description and Function

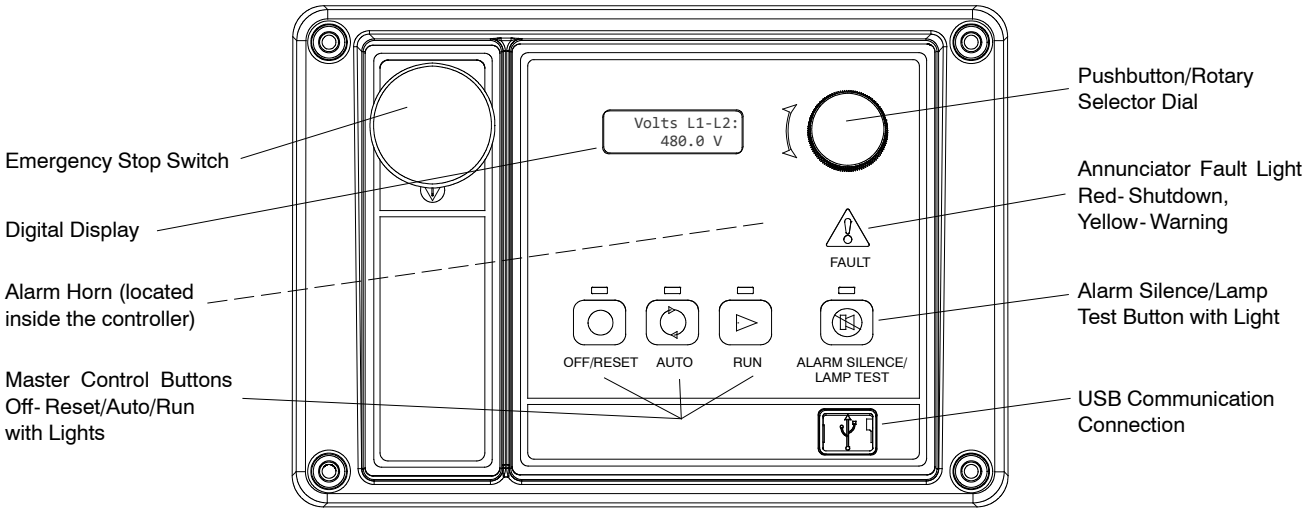
The APM402 generator set controller provides advanced control, system monitoring, and system diagnostics for optimum performance.

The APM402 controller meets NFPA 110, Level 1 when equipped with the necessary accessories and installed per NFPA standards.

The APM402 controller uses a patented hybrid voltage regulator and unique software logic to manage alternator thermal overload protection features normally requiring additional hardware. Additional features include:

- A digital display and pushbutton/rotary selector dial provide easy local access to data.
- Measurements selectable in metric or English units.
- The controller can communicate directly with a personal computer via a network or serial configuration using SiteTech™ or Monitor III software.
- The controller supports Modbus® protocol. Use with serial bus or Ethernet networks. (Ethernet requires an external Modbus®/Ethernet converter module.)
- Scrolling display shows critical data at a glance.
- Digital display of power metering (kW and kVA).
- Integrated hybrid voltage regulator providing ±0.5% regulation.
- Built-in alternator thermal overload protection.

Modbus® is a registered trademark of Schneider Electric.



User Interface Controls and Components

- Emergency stop switch
- Backlit LCD digital display with two lines of 12 characters *(see User Interface Displays for menus)*
- Alarm horn indicates generator set shutdown and warning faults
- Environmentally sealed membrane keypad with three master control buttons with lights
  - Off/Reset (red)
  - Auto (green)
  - Run (yellow)
- Pushbutton/rotary selector dial for menu navigation
  - Rotate dial to access main menus
  - Push dial and rotate to access sub menus
  - Press dial for 3 seconds to return to top of main menu
- Annunciator fault light
  - System shutdown (red)
  - System warning (yellow)
- Alarm silence/lamp test button
  - Alarm silence
  - Lamp test
- USB and RS-485 connections
  - Allows software upgrades
  - Provides access for diagnostics
  - PC communication using SiteTech™ or Monitor III software
- Dedicated user inputs
  - Remote emergency stop switch
  - Remote 2-wire start for transfer switch
  - Auxiliary shutdown
- Integrated hybrid voltage regulator
- Auto-resettable circuit protection mounted on circuit board.
- One relay output standard. Optional five relay output available.
- One analog and three digital inputs standard. Optional two inputs available.

NFPA 110 Requirements

In order to meet NFPA 110, Level 1 requirements, the generator set controller monitors the engine/generator functions/faults shown below.

- Engine functions:
  - Overcrank
  - Low coolant temperature warning
  - High coolant temperature warning
  - High coolant temperature shutdown
  - Low oil pressure shutdown
  - Low oil pressure warning
  - High engine speed
  - Low fuel (level or pressure) *
  - Low coolant level
  - EPS supplying load
  - High battery voltage
  - Low battery voltage
- General functions:
  - Master switch not in auto
  - Battery charger fault *
  - Lamp test
  - Contacts for local and remote common alarm
  - Audible alarm silence button
  - Remote emergency stop *

* Function requires optional input sensors or kits and is engine dependent, see Controller Displays as Provided by the Engine ECM.

User Interface Displays

The listing below has ● denoting main menus and ○ denoting sub-menus.

- Overview
  - Software version
  - Active shutdowns and warnings (if any are present)
  - Engine run time, total hours
  - Average voltage line-to-line
  - Frequency
  - Average current
  - Coolant temperature
  - Fuel level or pressure *
  - Oil pressure
  - Battery voltage
- Engine Metering
  - Engine speed
  - Oil pressure
  - Coolant temperature
  - Battery voltage
- Generator Metering
  - Total power, VA
  - Total power, W
  - Rated power, %
  - Voltage, L- L and L- N for all phases
  - Current, L1, L2, L3
  - Frequency
- GenSet Information
  - Generator set model number
  - Generator set serial number
  - Controller serial number
- GenSet Run Time
  - Engine run time, total hours
  - Engine loaded, hours
  - Number of engine starts
  - Total energy, kWh
- GenSet System
  - System voltage
  - System frequency, 50 or 60 Hz
  - System phase, single or three (wye or delta)
  - Power rating, kW
  - Amp rating
  - Power type, standby or prime
  - Measurement units, metric or English (user selectable)
  - Alarm silence, always or auto only (NFPA 110)
  - Manual speed adjust *
- GenSet Calibration
  - Voltage, L- L and L- N for all phases
  - Current, L1, L2, L3
  - Reset calibration
- Voltage Regulation
  - Adjust voltage, ±10%
- Digital Inputs
  - Input settings and status
- Digital Outputs
  - Output settings and status
- Analog Inputs
  - Input settings and status
- Event Log
  - Event history (stores up to 1000 system events)
- Selector Switch (requires initial activation by SiteTech™)

Controller Features

- **AC Output Voltage Regulator Adjustment**. The voltage adjustment provides a maximum of ±10% of the system voltage.
- **Alarm Silence.** The controller can be set up to silence the alarm horn only when in the AUTO mode for NFPA-110 application or Always for user convenience.
- **Alternator Protection**. The controller provides generator set overload and short circuit protection matched to each alternator for the particular voltage/phase configuration.
- **Automatic Restart**. The controller automatic restart feature initiates the start routine and recrank after a failed start attempt.
- **Common Failure Relay.** This relay is integrated on the controller circuit board. Contacts are rated 2 amps at 32 VDC or 0.5 amp at 120 VAC.
- **Communication.** Controller communication is available.
- **Cyclic Cranking.** The controller has programmable cyclic cranking.
- **ECM Diagnostics.** The controller displays engine ECM fault code descriptions to help in engine troubleshooting.
- **Engine Start Aid**. The starting aid feature provides control for an optional engine starting aid.
- **Event Logging**. The controller keeps a record (up to 1000 entries) for warning and shutdown faults. This fault information becomes a stored record of system events and can be reset.
- **Historical Data Logging**. Total number of generator set successful starts is recorded and displayed.
- **Integrated Hybrid Voltage Regulator**. The voltage regulator provides ±0.5% no-load to full-load regulation with three-phase sensing.
- **Lamp Test**. Press the alarm silence/lamp test button to verify functionality of the indicator lights.
- **LCD Display.** Adjustable contrast for improving visibility.
- **Measurement Units.** The controller provides selection of English or metric displays.
- **Power Metering**. Controller digital display provides kW and kVA.
- **Programming Access (USB)**. Provides software upgrades and diagnostics.
- **Remote Reset**. The remote reset function resets faults and allows restarting of the generator set without going to the master control switch off/reset position.
- **Remote Monitoring Panel.** The controller is compatible with the Kohler® Remote Serial Annunciator.
- **Run Time Hourmeter**. The generator set run time is displayed.
- **Time Delay Engine Cooldown (TDEC)**. The TDEC provides a time delay before the generator set shuts down.
- **Time Delay Engine Start (TDES)**. The TDES provides a time delay before the generator set starts.
- **Voltage Selection Menu.** This menu provides the capability of quickly switching controller voltage calibrations. Requires initial activation using SiteTech™ software. **NOTE:** Generator set output leads require voltage reconnection.

Controller Functions

The following chart shows which functions cause a warning or shutdown. All functions are available as relay outputs.

Warning causes the fault light to show yellow and sounds the alarm horn signaling an impending problem.

Shutdown causes the fault light to show red, sounds the alarm horn, and stops the generator set.

	Warning Function	Shutdown Function
Engine Functions		
Critically high fuel level *	○	
ECM communication loss		●
ECM diagnostics	●	●
Engine over speed		●†
Engine start aid active		
Engine under speed		●
Fuel tank leak *	○	○
High battery voltage	●	
High coolant temperature	●	●†
High fuel level *	○	
Low battery voltage	●	
Low coolant level		●
Low coolant temperature	●	
Low cranking voltage	●	
Low engine oil level *	○	○
Low fuel level (diesel models) *	○	○
Low fuel pressure (gas models) *	○	
Low oil pressure	●	●†
No coolant temperature signal		●
No oil pressure signal		●
Overcrank		●†
Speed sensor fault	●	
General Functions		
Alarm horn silenced		
Analog inputs	○	○
Battery charger fault *	●	
Chicago code active *		
Common fault **(includes †)**		●
Common warning	●	
Digital inputs	○	○
Emergency stop		●†
Engine cooldown (delay) active		
Engine start delay active		
Engine started		
Engine stopped		
EPS supplying load		
Generator running		
Input/output communication loss	●	
Internal failure		●
Master switch not in auto	●	
NFPA 110 alarm active		
Remote start		
System ready		
Generator Functions		
AC sensing loss	●	●
Alternator protection		●
Ground fault input *	●	
kW overload		●
Locked rotor		●
Overfrequency		●
Overvoltage (each phase)		●
Underfrequency		●
Undervoltage (each phase)		●

● Standard function
○ Available user function
* Function requires optional input sensors or kits and is engine dependent; see Controller Displays as Provided by the Engine ECM.
† Items included with common fault shutdown

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Controller Displays as Provided by the Engine ECM	Engine Manufacturer and Model							
	Kohler Diesel (KDI M, TM*)	Kohler Diesel (KDI TCR)	Kohler Gas (KG2204, KG2204T)	GM/PSI and Kohler Gas (KG6208, KG6208T)	DD/MTU	Doosan	John Deere	Volvo
Intake air pressure					S/D			D
Intake air Temperature		D		D	S/D	D	D	D
Coolant level			D	D	D	D	D	D
Coolant temperature		D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D
Crankcase pressure								D
ECM battery voltage	S		S/D	S	S	S		
Engine model number	S	S		S	S	S	S	S
Engine serial number	S	S		S	S	S	S	S
Engine speed	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D
Fuel pressure		D		C/S/D	C/S	C/S/D	C/S†	C/S/D
Fuel rate			S	S		S	S	S
Fuel temperature		D			S		S/D	S
Oil level				S†	S/D†	S†	S†	S†
Oil pressure		C/S/D	D	C/S/D	C/S/D	C/S/D	C/S/D	C/S/D
Oil temperature			S		D			SD

C = Value displayed on controller, S = Value displayed in Site Tech, D = ECU diagnostic is supported

* Electronic governor and ECM are optional on KDI M and TM engines.

† Controller uses local analog input to obtain this information.

NOTE: REOZMD/ROZMC (Mitsubishi engines) have an ECM but do not send signals to the generator set controller.

NOTE: See the generator set specification sheet for engine model identification.

Controller Specifications

- Power source with circuit protection: 12- or 24-volt DC
- Power drain: 200 milliamps at 12 VDC or 100 milliamps at 24 VDC
- Humidity range: 5% to 95% noncondensing
- Operating temperature range: -40°C to +70°C (-40°F to +158°F)
- Storage temperature range: -40°C to +85°C (-40°F to +185°F)
- Standards:
  - CE Directive
  - NFPA 99
  - NFPA 110, Level 1
  - CSA 282-09
  - UL 508
  - ASTM B117 (salt spray test)
- Panel dimensions—W x H, 229 x 160 mm (9.0 x 6.3 in.)

Communication and PC Software Available Options

Refer to G6-76 Monitor III Software and the communication literature for additional communication and PC software information including Modbus® communication.

❑ **Monitor III Software for Monitoring and Control (Windows®-based user interface)**

❑ **Converter, Modbus®/Ethernet.** Supports a power system using controllers accessed via the Ethernet. Converter is supplied with an IP address by the site administrator. Refer to G6-79 for converter details.

❑ **Converter, RS-232/RS-485.** Supports a power system using controllers accessed via a serial (RS-232) connection.

Availability is subject to change without notice. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. Contact your local Kohler® generator set distributor for availability.

APM402 Available Options

❑ **Float/Equalize Battery Charger** available with 6 or 10 amp output for 12 or 24V DC voltage output. The 10 amp model provides NFPA 110 charging and alarming capability.

❑ **Manual Speed Adjust** available for applications using closed transition ATS. Adjustment range for 60 Hz: 1751-1849 rpm (58.2-61.8 Hz) and for 50 Hz: 1451-1549 rpm (48.2-51.8 Hz).

❑ **Prime Power Switch** prevents battery drain during generator set non-operation periods and when the generator set battery cannot be maintained by an AC battery charger.

❑ **Remote Emergency Stop Switch** available as a wall mounted panel to remotely shut down the generator set.

❑ **Remote Monitoring Panel.** The Kohler® Remote Serial Annunciator (RSA) enables the operator to monitor the status of the generator set from a remote location, which may be required for NFPA 99 and NFPA 110 installations, and up to four Automatic transfer switches.

❑ **Run Relay** provides a relay indicating that the generator set is running.

❑ **Shunt Trip Wiring** provides relay outputs to trip a shunt trip circuit breaker and to signal the common fault shutdowns. Contacts rated at 10 amps at 28 VDC or 120 VAC.

❑ **Two Input/Five Output Module** provides a generator set mounted panel with two inputs and five relay outputs.

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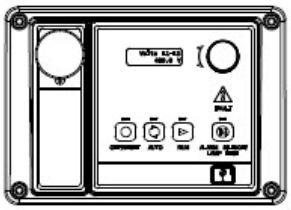
KOHLER®

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

Integral Voltage Regulator with Kohler® APM402/ Decision-Maker® 3000 and Menu-Driven Selections (15-1000 kW Generator Set Models)



APM402 and Decision-Maker® 3000 Controller with Integral Voltage Regulator

The voltage regulator is integral to the controller and uses patented hybrid voltae regulator design providing ±0.5% no-load to full-load regulation using root-mean-square (RMS) voltage sensing. The voltage regulator features three-phase sensing and is available for 12- or 24-volt engine electrical systems.

Voltage Regulators

The following information provides general features, specifications, and functions of available voltage regulators.

This information generally applies to a single generator set and multiple generator sets with paralleling applications. Refer to the respective generator set specification sheet and see your authorized distributor for information regarding specific voltage regulator applications and availability.

Integral Voltage Regulators with APM402/Decision-Maker® 3000 Controllers

Calibration	Digital Display	Range Settings	Default Selection
Voltage Adjustment	Volt Adj	±10% of System Voltage	System Voltage
Underfrequency Unload or Frequency Setpoint	Frequency Setpoint	42 to 62 Hz	2.5 Hz Below Nominal Frequency
Underfrequency Unload Scope	Slope	0-10% of System Voltage (Volts per Cycle)	5% of System Voltage

KOHLER®

Specification/Feature	Integral with APM402/Decision-Maker® 3000
Generator Set Availability	15-1000 kW
Type	Patented Hybrid Design
Status and Shutdown Indicators	LEDs and Text LCD Display
Operating Temperature	-40°C to 70°C (-40°F to 158°F)
Storage Temperature	-40°C to 85°C (-40°F to 185°F)
Humidity	5-95% Non-Condensing
Circuit Protection	Solid-State, Redundant Software and Fuses
Sensing, Nominal	100-240 Volts (L-L), 50-60 Hz
Sensing Mode	RMS, Single- or 3-Phase
Input Requirements	8-36 VDC
Continuous Output	5 VDC @ 100mA max. 5.0 ADC with GM88453 Activator Board
Maximum Output	5 VDC @ 100mA max. 7.8 ADC with GM88453 Activator Board
Transition Frequency	42.0-62.0Hz
Exciter Field Resistance	4-30 Ohms with GM88453 Activator Board
No-Load to Full-Load Voltage Regulation	±0.5%
Thermal Drift	<0.5% (-40°C to 70°C) [-40°F to 158°F] Range
Response Time	Less than 5µS
System Voltage Adjust.	±10%
Voltage Adjustment	Controller Menu Knob
Remote Voltage Adjustment	not available
Paralleling Capability	not available
VAR/PF Control Input	not available

Integral Voltage Regulator with APM402/Decision-Maker® 3000 Controller

- The APM402/Decision-Maker® 3000 digital display and pushbutton/rotary dial provide access to data. A two-line LCD display provides complete and concise information. A two-line vacuum fluorescent display provides complete and concise information.
- The Decision-Maker® 3000 graphical display and pushbutton/rotary dial provide access to data. A five-line, 35-characters per line LCD display provides complete and concise information include gain, ramp rate, reactive droop, VAR control (P, I, D gains) and PF control (P, I, D gains).
- The controllers provide ISO 8528-5, Class G3, compliance for transient response on some 20-300 kW generator set models. Both controllers support Modbus®.
- These controllers can control Fast Response™ II, Fast Response™ X, and wound field alternators using the GM88453 activator board.

Voltage Regulator Menu

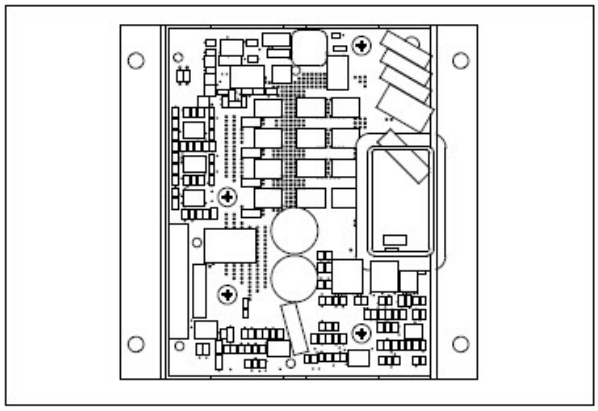
- Voltage adjustment, ±10% of system voltage
- V/Hz cut-in, 42-62 Hz
- Underfrequency unload slope, 0-10% of system voltage

Generator Set Calibration Menu (APM402/DEC 3000)

- L1-L2 volts
- L2-L3 volts (3-phase)
- L3-L1 volts (3-phase)
- L1-N volts
- L2-N volts
- L3-N volts (3-phase)

KOHLER®

Activator Board GM88453



- Interfaces between the controller and alternator assembly using rotor field leads, auxiliary power windings, and optic board leads.
- Allows the Decision-Maker® controllers the ability to control a wound-field alternator using the same control signal as Fast Response™ alternator.
- Permits the generator set controller to control the current to the exciter field of a wound-field excited alternator.
- Contains two isolated relay driver outputs (RDO) rated at 250 mA. Provides RDO outputs indicating a field over-excitation condition and that the alternator is supplying voltage to the activator.

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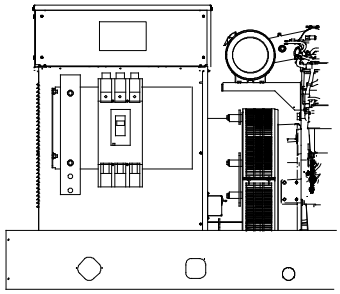
Line Circuit Breakers 15- 300 kW



Single Circuit Breaker Kit with Neutral Bus Bar
15- 300 kW Model Shown

Standard Features

- The line circuit breaker interrupts the generator set output during a short circuit and protects the wiring when an overload occurs. Use the circuit breaker to manually disconnect the generator set from the load during generator set service.
- Circuit breaker kits are mounted to the generator set and are provided with load-side lugs and neutral bus bar.
- Kohler Co. offers a wide selection of molded-case line circuit breaker kits including single, dual, and multiple configurations for each generator set.
- Four types of line circuit breakers are available: (see page 2 for definitions and pages 3 and 4 for application details)
  - Magnetic trip
  - Thermal magnetic trip
  - Electronic trip
  - Electronic with ground fault (LSIG) trip
- In addition, line circuit breakers are offered with 80% and 100% ratings.
- Single line circuit breaker kits allow circuit protection of the entire electrical system load.
- Dual line circuit breaker kits allow circuit protection of selected priority loads from the remaining electrical system load.
- Multiple line circuit breaker kits with field connection barrier allow circuit protection for special application on selected 80- 300 kW models.
- Line circuit breakers comply with the following codes and standards unless otherwise stated.
  - UL 489 Molded Case Circuit Breakers
  - UL 1077 Supplementary Protectors
  - UL 2200 Stationary Engine Generator Assemblies

Line Circuit Breaker Types

Magnetic Trip

The magnetic trip features an electromagnet in series with the load contacts and a moveable armature to activate the trip mechanism. When a sudden and excessive current such as a short circuit occurs, the electromagnet attracts the armature resulting in an instantaneous trip.

Thermal Magnetic Trip

Thermal magnetic trip contains a thermal portion with a bimetallic strip that reacts to the heat produced from the load current. Excessive current causes it to bend sufficiently to trip the mechanism. The trip delay is dependent on the duration and excess of the overload current. Elements are factory- calibrated. A combination of both thermal and magnetic features allows a delayed trip on an overload and an instantaneous trip on a short circuit condition.

Electronic Trip

These line circuit breakers use electronic controls and miniature current transformers to monitor electrical currents and trip when preset limits are exceeded.

LI breakers are a combination of adjustable trip functions including long-time ampere rating, long-time delay, and instantaneous pickup. LSI breakers have all of the LI breaker features plus short-time pickup, short-time delay, and defeatable instantaneous pickup. LSIG breakers have all of the LSI breaker features plus ground-fault pickup and delay.

Electronic with Ground Fault Trip

The ground fault trip feature is referred to as LSIG in this document. Models with LSIG compare current flow in phase and neutral lines, and trip when current unbalance exists.

Ground fault trip units are an integral part of the circuit breaker and are not available as field-installable kits. The ground fault pickup switch sets the current level at which the circuit breaker will trip after the ground fault delay. Ground fault pickup values are based on circuit breaker sensor plug only and not on the rating plug multiplier. Changing the rating plug multiplier has no effect on the ground fault pickup values.

80% Rated Circuit Breaker

Most molded-case circuit breakers are 80% rated devices. An 80% rated circuit breaker can only be applied at 80% of its rating for continuous loads as defined by NFPA 70. Circuit conductors used with 80% rated circuit breakers are required to be rated for 100% of the circuit breaker's rating.

The 80% rated circuit breakers are typically at a lower cost than the 100% rated circuit breaker but load growth is limited.

100% Rated Circuit Breaker

Applications where all UL and NEC restrictions are met can use 100% rated circuit breakers where 100% rated circuits can carry 100% of the circuit breaker and conductor current rating.

The 100% rated circuit breakers are typically at a higher cost than the 80% rated circuit breaker but have load growth possibilities.

When applying 100% rated circuit breakers, comply with the various restrictions including UL Standard 489 and NEC Section 210. If any of the 100% rated circuit breaker restrictions are not met, the circuit breaker becomes an 80% rated circuit breaker.

Line Circuit Breaker Options

❑ Alarm Switch

The alarm switch indicates that the circuit breaker is in a tripped position caused by an overload, short circuit, ground fault, the operation of the shunt trip, an undervoltage trip, or the push-to-trip pushbutton. The alarm resets when the circuit breaker is reset.

❑ Auxiliary Contacts

These switches send a signal indicating whether the main circuit breaker contacts are in the open or closed position.

❑ Breaker Separators (350- 2500 kW)

Provides adequate clearance between breaker circuits.

❑ Bus Bars

Bus bar kits offer a convenient way to connect load leads to the generator set when a circuit breaker is not present.
15- 300 kW. Bus bar kits are available on alternators with leads for connection to the generator set when circuit breakers are not ordered.
350- 2500 kW. A bus bar kit is provided when no circuit breaker is ordered. Bus bars are also available in combination with circuit breakers or other bus bars on the opposite side of the junction box. On medium voltage (3.3 kV and above) units, a bus bar kit is standard (not applicable to KD models).

❑ Field Connection Barrier

Provides installer wiring isolation from factory connections.

❑ Ground Fault Annunciation

A relay contact for customer connection indicates a ground fault condition and is part of a ground fault alarm.

❑ Lockout Device (padlock attachment)

This field-installable handle padlock attachment is available for manually operated circuit breakers. The attachment can accommodate three padlocks and will lock the circuit breaker in the OFF position only.

❑ Lugs

Various lug sizes are available to accommodate multiple cable sizes for connection to the neutral or bus bar.

❑ Overcurrent Trip Switch

The overcurrent trip switch indicates that the circuit breaker has tripped due to overload, ground fault, or short circuit and returns to the deenergized state when the circuit breaker is reset.

❑ Shunt Trip, 12 VDC or 24 VDC

A shunt trip option provides a solenoid within the circuit breaker case that, when momentarily energized from a remote source, activates the trip mechanism. This feature allows the circuit breaker to be tripped by customer-selected faults such as alternator overload or overspeed. The circuit breaker must be reset locally after being tripped. Tripping has priority over manual or motor operator closing.

❑ Shunt Trip Wiring

Connects the shunt trip to the generator set controller. (standard on KD models with the APM802 controller)

❑ Undervoltage Trip, 12 VDC or 24 VDC

The undervoltage trips the circuit breaker when the control voltage drops below the preset threshold of 35%- 70% of the rated voltage.

15- 300 kW Line Circuit Breaker Specifications

80% Rating Circuit Breaker

Alt. Model	Ampere Range	Trip Type	C. B. Frame Size
4RX 4S/4SX 4TX/4V 4UA 4M6226	15- 150	Thermal magnetic	HD
	60- 150	Electronic LI	
		Electronic LSI	
		Electronic LSIG	
	60- 150	Electronic LI	HG
		Electronic LSI	
		Electronic LSIG	
	30	Magnetic 9- 325	HJ
	50	Magnetic 84- 546	
	100	Magnetic 180- 1040	
	150	Magnetic 348- 1690	
	175- 250	Thermal magnetic	JD
	250	Electronic LI	
		Electronic LSI	
		Electronic LSIG	
	250	Electronic LI	JG
		Electronic LSI	
		Electronic LSIG	
	250	Magnetic only 684- 2500	JJ
	300- 400	Thermal magnetic	LA
	400	Magnetic 500- 1000	LA
		Magnetic 750- 1600	
		Magnetic 1000- 2000	
		Magnetic 1125- 2250	
		Magnetic 1250- 2500	
		Magnetic1500- 3000	
		Magnetic 1750- 3500	
		Magnetic 2000- 4000	
	400- 600	Electronic LI	LG
		Electronic LSI	
		Electronic LSIG	
	800	Electronic LSI	PG
		Electronic LSIG	
	700- 800	Thermal magnetic	MG
4UA 4M6226	1000- 1200	Thermal magnetic	PG
		Electronic LSI	
		Electronic LSIG	
	1200	Thermal Magnetic	PJ
		Electronic LSI	
		Electronic LSIG	

Breaker frame JJ will be used and modified by Kohler engineering with electronic LSI trip functions.

15- 300 kW Line Circuit Breaker Specifications

Interrupting Ratings

Circuit Breaker Frame Size	240 Volt, kA	480 Volt, kA	600 Volt, kA
HD	25	18	14
HG	65	35	18
HJ	100	65	25
JD	25	18	14
JG	65	35	18
JJ	100	65	25
LA	42	30	22
LG	65	35	18
MG			
PG			
PJ	100	65	25
PL	125	100	25

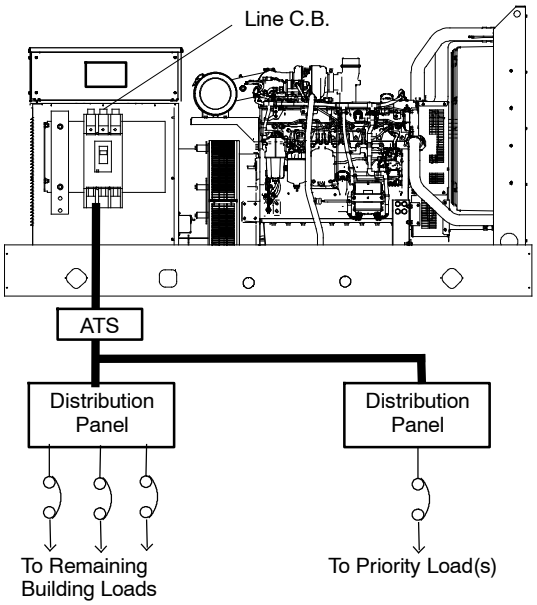
Circuit Breaker Lugs Per Phase (Al/Cu)

Frame Size	Ampere Range	Wire Range
E (480 V max.)	30- 100	Up to two wire terminals fitting 10-32 or 1/4-20 stud
H	15- 150	One #14 to 3/0
J	175	One 1/0 to 4/0
	200- 250	One 3/0 to 350 kcmil
LA	300- 400	One #1 to 600 kcmil or Two #1 to 250 kcmil
LG	400- 600	Two 2/0 to 500 kcmil AL/CU
M	700-800	Three 3/0 to 500 kcmil
P	600-800	Three 3/0 to 500 kcmil
	1000-1200	Four 3/0 to 500 kcmil
Mechanical Load Lugs Included with H, J, and LG LSIG Neutrals		
H	60- 150	One #14 to 3/0 AL/CU
J	250	One 3/0 to 350 kcmil AL/CU
LG	400- 600	Two 4/0 to 500 kcmil AL/CU

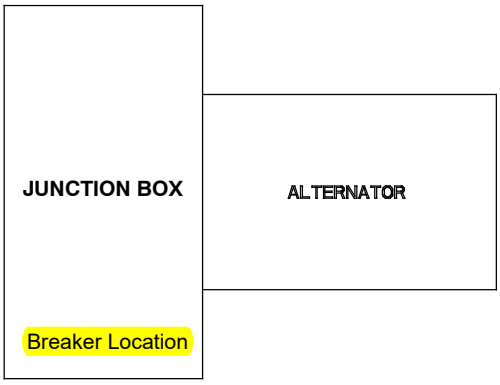
15- 300 kW Line Circuit Breaker Applications

Single Circuit Breaker Installations

A generator set with a single circuit breaker installed typically feeds a single transfer switch and then a distribution panel. This allows protection of the entire system.



Single line circuit breaker configuration where circuit breaker can trip causing all power to building loads including priority load to be disrupted.



Circuit Breaker Combinations

Alternator Model	First C. B. Frame	Second C. B. Frame	Third C. B. Frame	Trip Type
ALL except 4D/4E	H	—	—	All
	J	—	—	
	LA	—	—	
	LG	—	—	
4D/4E	H	—	—	Standard or LSIG
	H	H	—	No LSIG
4P/4PX 4Q/4QX	H	H or J	—	No LSIG
	J		—	
	LA		—	
	LG	H, J or LG	—	
4RX 4S/4SX 4TX 4V	M	—	—	All
	P	—	—	All
	H or J	H or J	—	No LSIG
	LA	H, J, or LA	—	
	LG	H, J, LA, or LG	—	
	M			
	P			
	H or J	H or J	H or J	
4UA 4M6226	M or P	—	—	All
	H or J	H or J	—	All
	LA	H, J, or LA	—	
	LG	H, J, LA, or LG	—	
	M or P	H, J, LA, or LG	—	
	P	P	—	No LSIG
	H or J	H or J	H or J	
	LA	H or J	H or J	
		LA	H, J, or LA	
	LG	H or J	H or J	
		LA	H, J, or LA	
		LG	H, J, LA, or LG	
	M or P	H or J	H or J	
		LA	H, J, or LA	
		LG	H, J, or LG	

Product data sheet
Characteristics

JJP36250
Circuit breaker, PowerPacT J, unit mount, thermal-magnetic, 250A, 3 pole, 25 kA, 600 VAC

Product availability : Non-Stock - Not normally stocked in distribution facility

Price* : 7,238.00 USD

Main

Product or component type	Circuit breaker
Range of product	PowerPact J
Trip unit technology	Thermal-magnetic
Breaking capacity code	J

Complementary

Line Rated Current	250 A
Number of poles	3
Poles description	3P
Breaking capacity	100 kA 240 V AC 65 kA 480 V AC 25 kA 600 V AC 20 kA 250 V DC
[Ue] rated operational voltage	600 V AC 250 V DC
Continuous current rating	80 %
Mounting mode	Unit mount
Electrical connection	Lugs load Terminal nut line
Magnetic hold current	1250 A
Magnetic tripping current	2500 A
AWG gauge	AWG 3/0...350 kcmil aluminium/copper
Tightening torque	230.12 lbf.in (26 N.m) 0.15…0.29 in² (95…185 mm²) AWG 3/0...350 kcmil)
Height	7.52 in (191.01 mm)
Maximum Width	4.12 in (104.65 mm)
Maximum Depth	5 in (127.00 mm)

* Price is “List Price” and may be subject to a trade discount – check with your local distributor or retailer for actual price.

Disclaimer: This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications

Environment

Product certifications	UL Listed CCC IEC CE CSA
Ambient air temperature for operation	104 °F (40 °C)

Ordering and shipping details

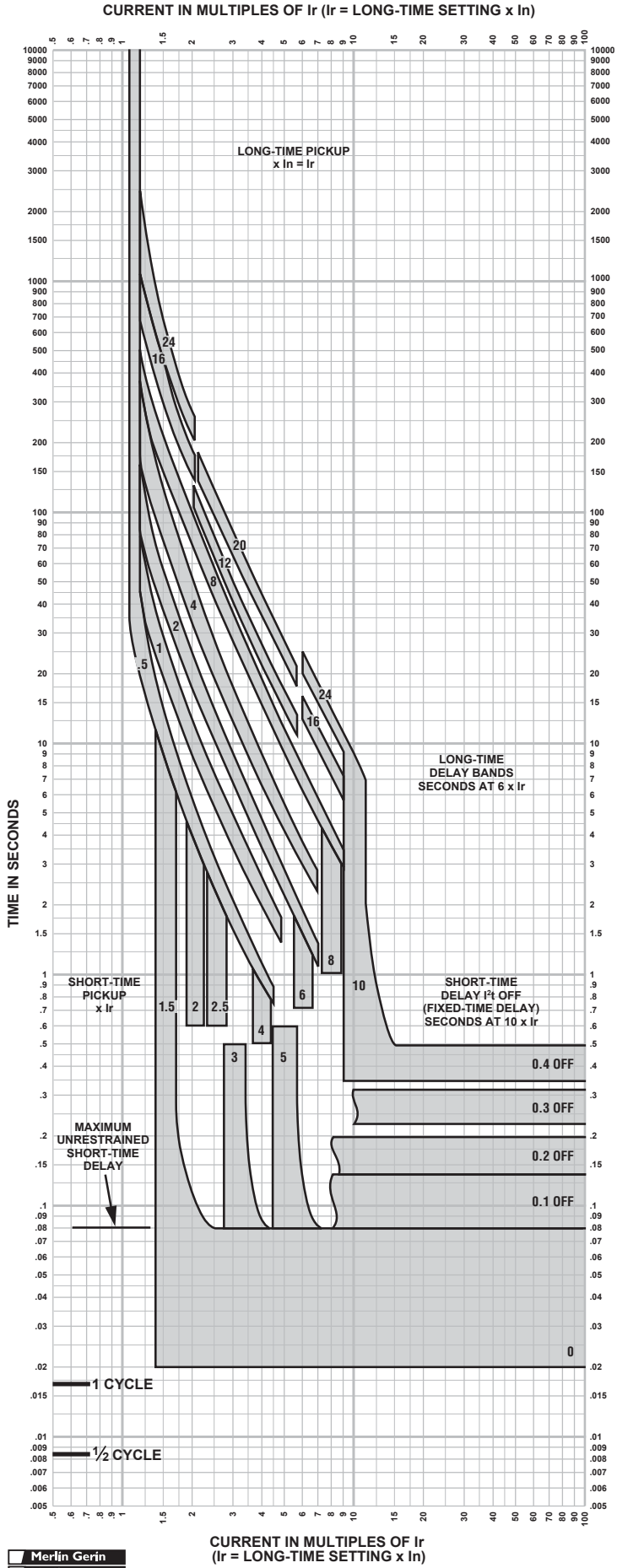
Category	01115 - HG,HJ,JG,JJ UNIT MT BREAKER/SWITCH
Discount Schedule	DE2
GTIN	00785901660972
Nbr. of units in pkg.	1
Package weight(Lbs)	4.82 lb(US) (2.19 kg)
Returnability	Yes
Country of origin	MX

Offer Sustainability

California proposition 65	WARNING: This product can expose you to chemicals including: DINP, which is known to the State of California to cause cancer, and DIDP, which is known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
REACh Regulation	REACh Declaration
EU RoHS Directive	Compliant EU RoHS Declaration
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS declaration Product out of China RoHS scope. Substance declaration for your information.
Environmental Disclosure	Product Environmental Profile
PVC free	Yes

Contractual warranty

Warranty	18 months



MICROLOGIC® 5.0/6.0 A/P/H TRIP UNIT CHARACTERISTIC TRIP CURVE NO. 613-4

Long-time Pickup and Delay
Short-time Pickup and I^2t OFF Delay

The time-current curve information is to be used for application and coordination purposes only.

Curves apply from -30°C to +60°C ambient temperature.

Notes:

1. There is a thermal-imaging effect that can act to shorten the long-time delay. The thermal-imaging effect comes into play if a current above the long-time delay pickup value exists for a time and then is cleared by the tripping of a downstream device or the circuit breaker itself. A subsequent overload will cause the circuit breaker to trip in a shorter time than normal. The amount of time delay reduction is inverse to the amount of time that has elapsed since the previous overload. Approximately 20 minutes is required between overloads to completely reset thermal-imaging.
2. The end of the curve is determined by the interrupting rating of the circuit breaker.
3. With zone-selective interlocking on, short-time delay utilized and no restraining signal, the maximum unrestrained short-time delay time band applies regardless of the setting.
4. Total clearing times shown include the response times of the trip unit, the circuit breaker opening, and the extinction of the current.
5. For a withstand circuit breaker, instantaneous can be turned OFF. See 613-7 for instantaneous trip curve. See 613-10 for instantaneous override values.
6. Overload indicator illuminates at 100%.

Merlin Gerin
Modicon
Square D
Telemecanique
Federal Pioneer
Federal Pacific
Schneider Electric Brands

Schneider Electric

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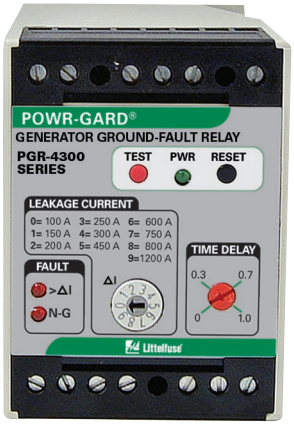
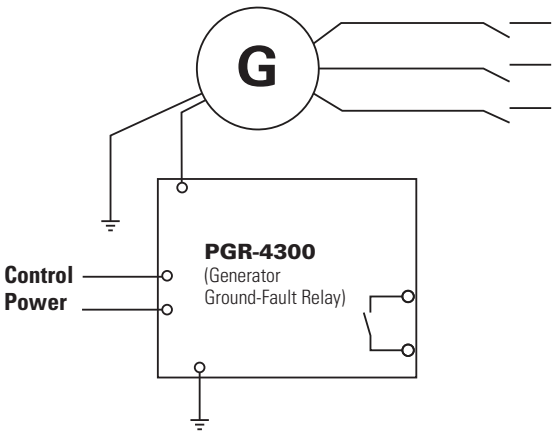
Curve No. 0613TC0004
December 2000
Drawing No. B48095-613-04

PGR-4300 SERIES (GFA300)

Generator Ground-Fault Relay



Simplified Circuit Diagram



Ordering Information

ORDERING NUMBER	CONTROL POWER
PGR-4300-12	12 Vdc
PGR-4300-24	24 Vdc
PGR-4300-120	120 Vac

ACCESSORIES	REQUIREMENT
PGA-0500	Optional
PMA-55	Optional
PMA-60	Optional

Note: For optional conformal coating please consult factory.

Description

The PGR-4300 Generator Ground-Fault Relay provides a simple method for detecting a ground-fault condition on generators without the need for current transformers (CTs). This greatly simplifies the installation. In addition, it is compatible with both three- and four-pole transfer switches. This relay also monitors the neutral-to-ground path for continuity. The PGR-4300 is ideal for any generator or application where there is not sufficient space to install CTs.

Features & Benefits

FEATURES	BENEFITS
No CTs required	Saves space and simplifies installation
Adjustable pickup (100-1200 A)	Adjustable trip setting provides a wide range of protection and allows system coordination
Adjustable time delay (0-1.0 s)	Adjustable trip delay allows quick protection and system coordination
Output contacts	Form C ground-fault output contacts for alarming or tripping purposes
Analog output (0-1 mA)	Provides means for connecting to an optional meter (PGA-0500) or control system
N-G continuity alarm	Monitors neutral-to-ground integrity and alarms if ground path becomes open circuit
Passive filtering	Eliminates nuisance tripping

Accessories

PGA-0500 Analog % Current Meter
Optional panel-mounted analog meter displays ground-fault current as a percentage of the set-point.

Specifications

IEEE Device Numbers	Ground Fault (50G/N, 51G/N)
Input Voltage	See ordering information
Dimensions	**H** 75 mm (3.0"); **W** 55 mm (2.2"); **D** 115 mm (4.5")
Trip Level Settings	100-1200 A
Trip Time Delay Settings	0-1.0 s
Contact Operating Mode	Non-fail-safe
Test Button	Local
Reset Button	Local and remote
Output Contacts	Form C
Analog Output	0-1 mA
Conformally Coated	Consult factory
Approvals	UL Listed (E183688)
Warranty	5 years
Mounting	DIN, Surface (standard) Panel (with PMA-55 or PMA-60 adapter)

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KOHLER®

Alternator Data

TECHNICAL INFORMATION BULLETIN

Alternator Data Sheet

Alternator Model: 4R13X
Frequency: 60 Hz
Speed: 1800 RPM
Leads: 12 (6 Lead, 600 Volt)

Voltage L-N/L-L	Phase	Power Factor	Connection	kW* (kVA)						
				Class B	Class F				Class H	
				80°C Continuous	90°C Lloyds	95°C ABS	105°C Continuous	130°C Standby	125°C Continuous	150°C Standby
139/240	3	0.8	Wye	120.5	127.0	130.0	136.5	150.0	147.0	157.0
277/480				(150.5)	(158.5)	(162.5)	(170.5)	(187.5)	(183.5)	(196.0)
127/220	3	0.8	Wye	117.0	123.0	125.5	132.0	143.0	140.5	150.0
254/440				(146.0)	(153.5)	(156.5)	(165.0)	(178.5)	(175.5)	(187.5)
120/208	3	0.8	Wye	114.0	119.5	122.0	128.0	137.0	134.5	144.0
240/416				(142.5)	(149.0)	(152.5)	(160.0)	(171.0)	(168.0)	(180.0)
110/190	3	0.8	Wye	103.5	108.5	111.0	116.0	124.5	122.0	131.0
220/380				(129.0)	(135.5)	(138.5)	(145.0)	(155.5)	(152.5)	(163.5)
120/240	3	0.8	Delta	114.0	119.5	122.0	128.0	137.0	134.5	144.0
				(142.5)	(149.0)	(152.5)	(160.0)	(171.0)	(168.0)	(180.0)
120/240	1	1.0	Dogleg	91.5	94.5	96.0	99.5	107.0	105.5	109.0
				(91.5)	(94.5)	(96.0)	(99.5)	(107.0)	(105.5)	(109.0)
347/600	3	0.8	Wye	99.0	105.0	108.0	114.0	127.0	124.0	136.0
				(123.0)	(131.0)	(135.0)	(142.0)	(158.0)	(155.0)	(170.0)

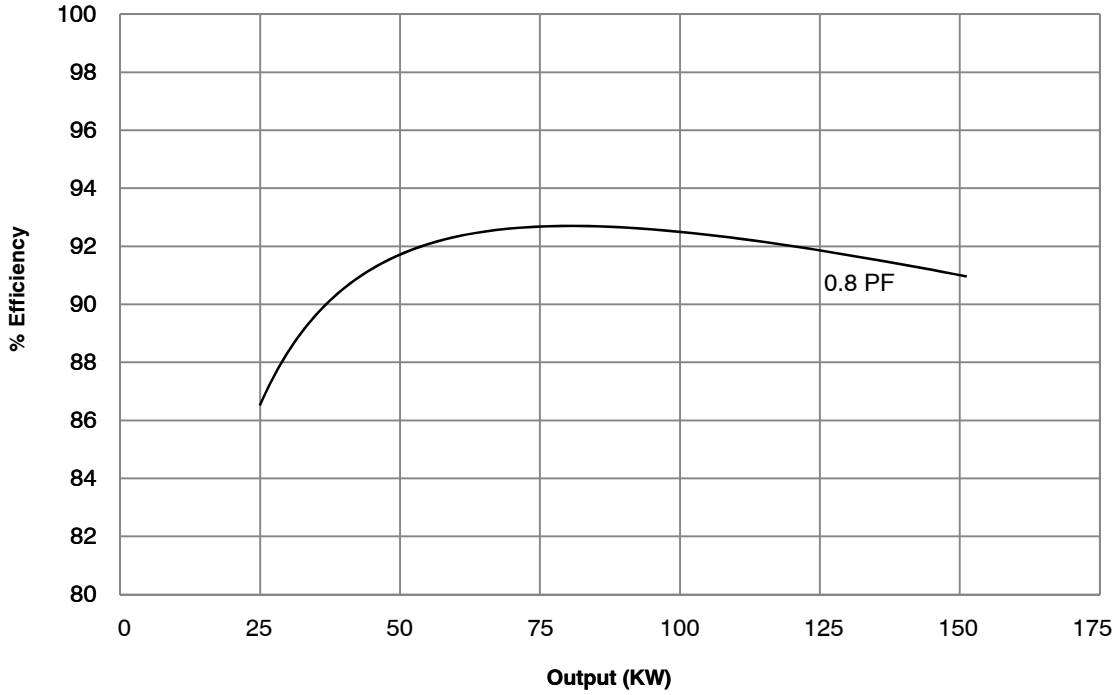
* All data tested in accordance with IEEE Standard 115. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

Submittal Data: 139/240 Volts, 0.8 PF, 1800 RPM, 60 Hz, 3 Phase, 130°C Rise

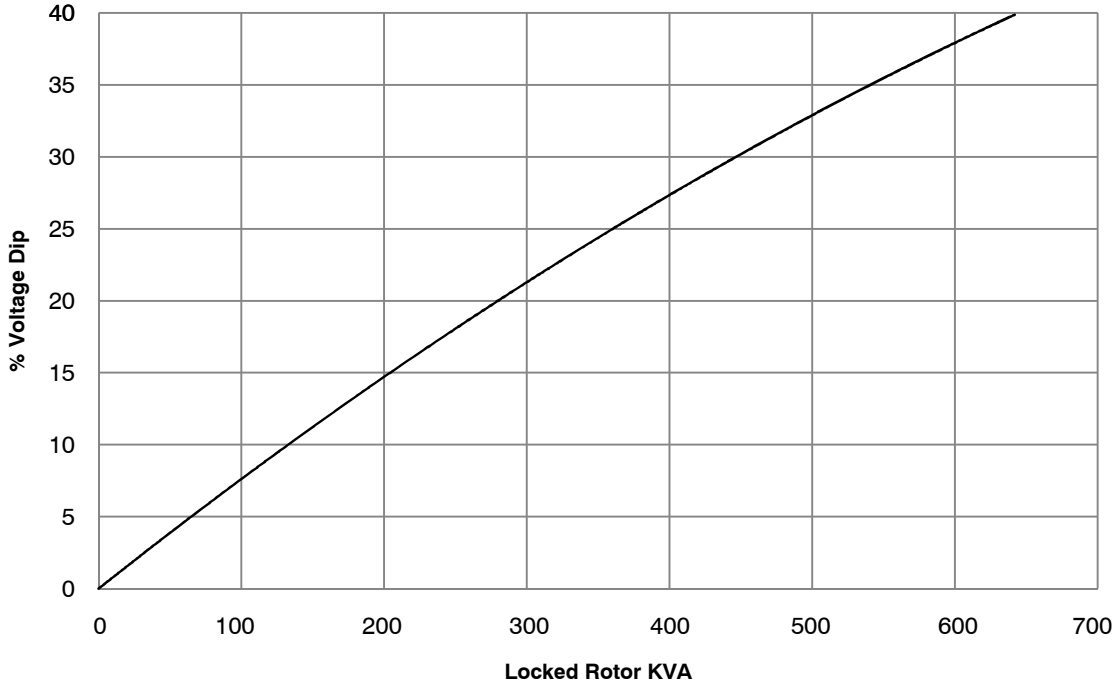
	Symbol	PerUnit	Ohms
Typical Cold Resistances			
Phase Resistance		0.026	0.008
Rotor Resistance		20.96	6.436
Typical Reactances			
Synchronous			
Direct	X_d	2.872	0.882
Quadrature	X_q	1.467	0.451
Transient			
Unsaturated	X'_{du}	0.265	0.082
Saturated	X'_d	0.234	0.072
Subtransient			
Direct	X''_d	0.103	0.032
Quadrature	X''_q	0.098	0.030
Negative Sequence	X_2	0.101	0.031
Zero Sequence	X_0	0.009	0.003

	Symbol	Value
Typical Time Constants		
Armature Short Circuit	T_a	0.008 sec.
Transient Short Circuit	T'_d	0.072 sec.
Transient Open Circuit	T'_{do}	0.885 sec.
Typical Field Current		
Full Load	If_{FL}	18.5 amps
No Load	If_{NL}	5.2 amps
Typical Short Circuit Ratio		0.348
Harmonic Distortion		
RMS Total Harmonic Distortion		3.22%
Max. Single Harmonic		5th
Deviation Factor (No Load, L-L)		<5%
Telephone Influence Factor		<50
Insulation Class		
per NEMA MG1-1.66		H
Phase Rotation		ABC

4R13X, 60 Hz, 139/240, 277/480 Volts, Wye
TYPICAL ALTERNATOR EFFICIENCY*

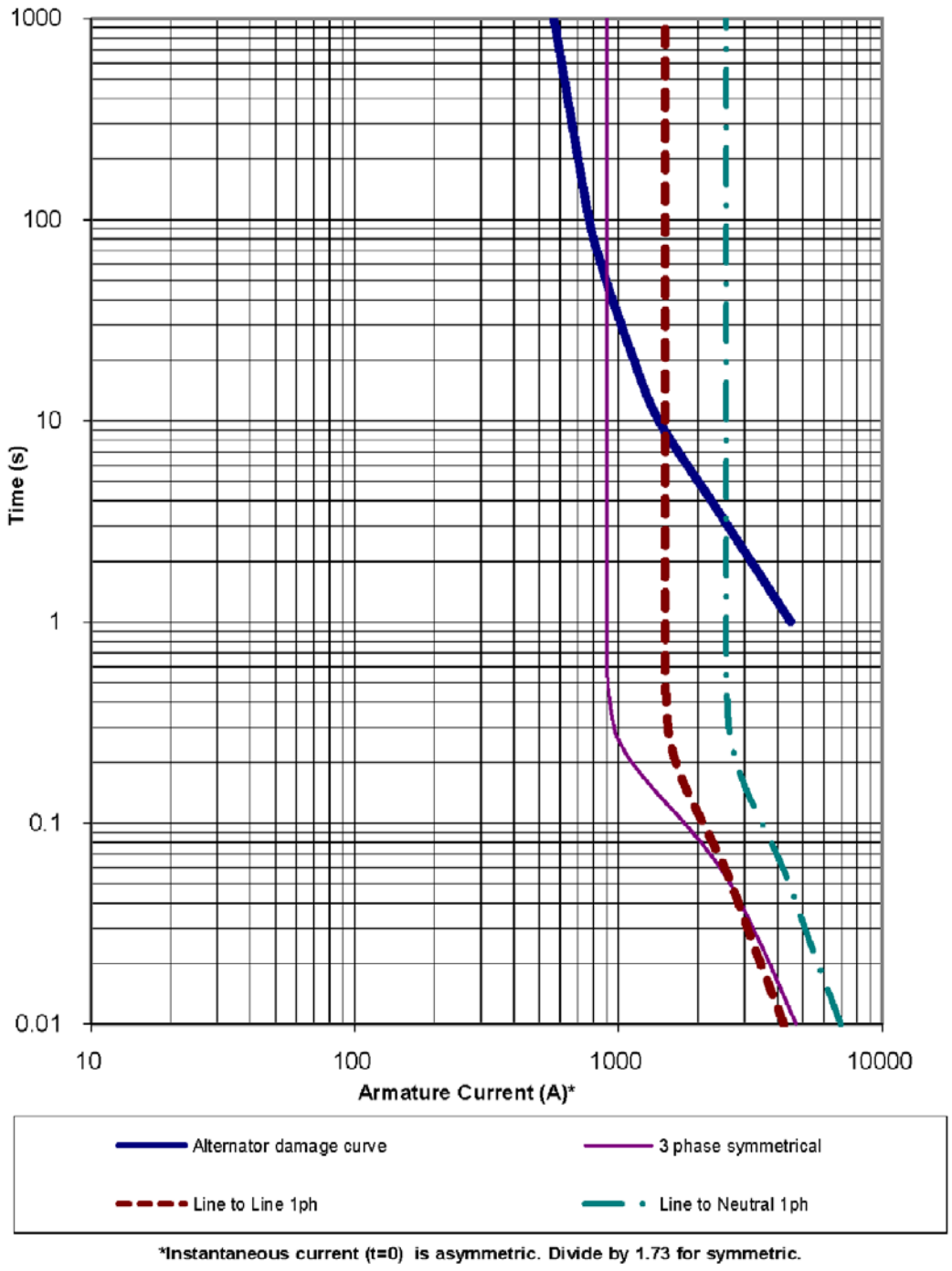


4R13X, 60 Hz, 139/240, 277/480 Volts, Wye
TYPICAL MOTOR STARTING CHARACTERISTICS*



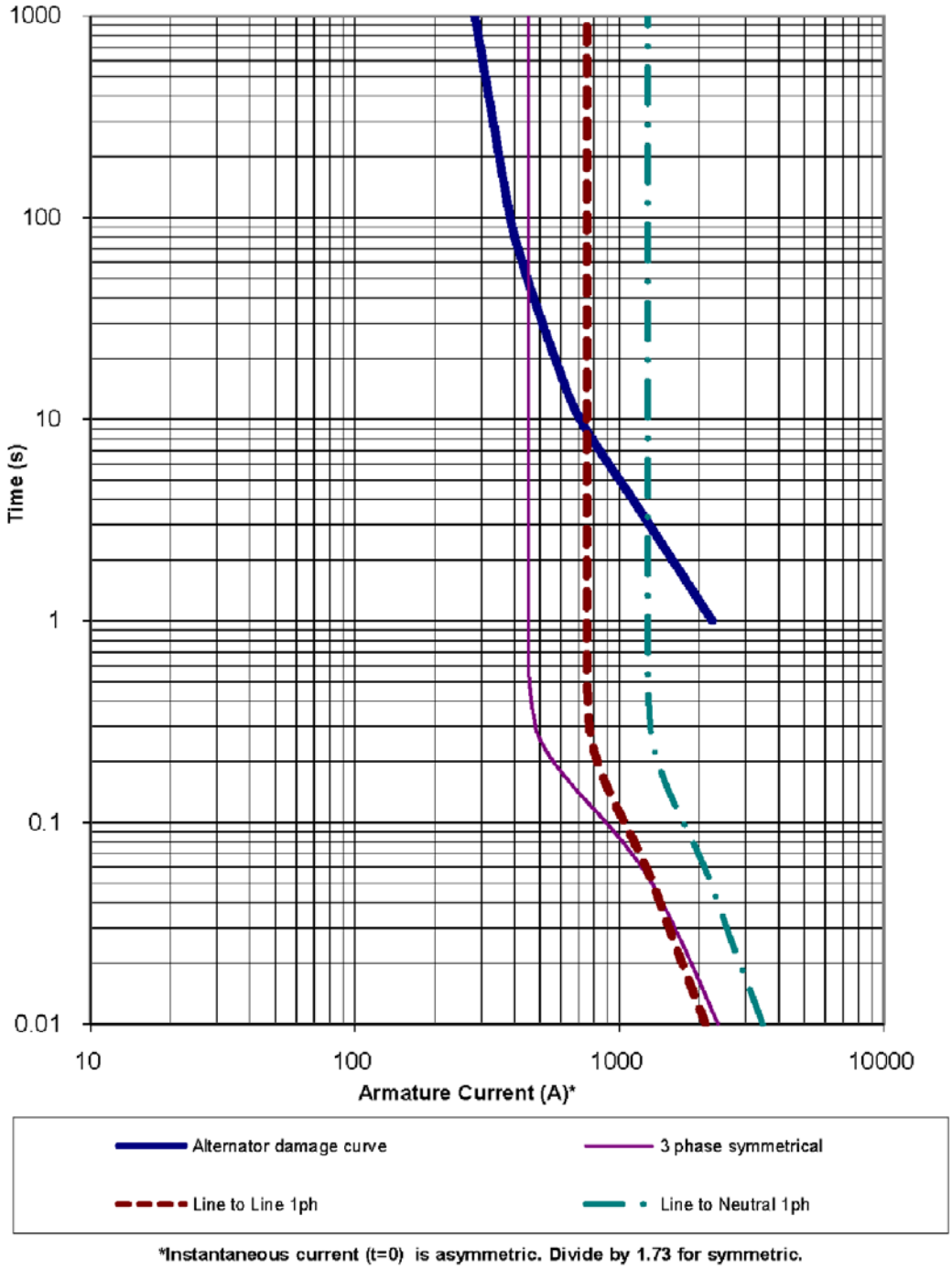
* All data tested in accordance with IEEE Standard 115. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

4R13X, 60 Hz, Low Wye or Delta Connection
SHORT CIRCUIT DECREMENT CURVE



*Instantaneous current (t=0) is asymmetric. Divide by 1.73 for symmetric.

4R13X, 60 Hz, High Wye Connection
SHORT CIRCUIT DECREMENT CURVE



*Instantaneous current (t=0) is asymmetric. Divide by 1.73 for symmetric.

Sound Data

TECHNICAL INFORMATION BULLETIN

Generator Set Sound Data Sheet

			Sound Pressure Data in dB(A)				
Generator Set Model	**Hz**	**Load**	**Raw Exhaust**	**Open Unit, Isolated Exhaust**	**Weather Enclosure**	**Sound Enclosure**	**Snow Sound Enclosure**
125REOZJG	60	100% Load	113.8	88.9	87.0	73.6	72.7
		No Load	98.8	87.4	85.5	71.5	70.1

Note: Sound pressure data is the logarithmic average of eight perimeter measurement points at a distance of 7 m (23 ft.), except Raw Exhaust data which is a single measurement point at 1 m (3.3 ft.) from the mouth of a straight pipe exhaust.

				Sound Pressure Levels, dB(A)								
Load	Distance, m (ft)		Measurement Clock Position	Octave Band Center Frequency (Hz)								Overall Level
				63	125	250	500	1000	2000	4000	8000	
100% Load	7 (23)	Open Unit, Isolated Exhaust	3:00	68.4	63.0	77.6	79.0	82.8	81.4	77.6	71.5	87.4
			1:30	63.1	62.7	78.5	85.5	84.7	81.4	79.9	71.8	89.9
			12:00-Engine	61.7	63.8	78.1	80.3	80.6	79.4	74.8	66.9	86.2
			10:30	68.4	66.4	76.6	82.2	87.6	85.7	81.9	75.5	91.4
			9:00	73.7	68.0	82.1	81.9	84.9	84.0	80.6	75.2	86.5
			7:30	72.0	72.1	83.1	80.6	85.0	82.8	79.0	75.4	86.3
			6:00-Alternator	67.0	67.0	76.3	79.0	80.7	80.1	76.4	72.3	90.0
			4:30	64.3	67.2	74.4	79.6	81.5	80.0	76.3	71.6	90.3
			8-pos. log avg.	69.1	67.3	79.3	81.6	84.1	82.4	78.9	73.2	88.9

The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. © 2015 by Kohler Co. All rights reserved.

KOHLER®

Emissions Data

125REOZJG

60 HZ. DIESEL INDUSTRIAL GENERATOR SET
EMISSION DATA SHEET

ENGINE INFORMATION

Model:	John Deere, 4045HF285K	Bore:	106mm (4.19 in.)
Nameplate BHP @ 1800 RPM:	197	Stroke:	127mm (5.0 in.)
Type:	4-Cycle, 4 Cylinder, Inline	Displacement:	4.5 L (276 cu. in.)
Aspiration:	Turbocharged, Charge Air-Cooled		
Compression Ratio	19.0:1	EPA Family:	MJDXL06.8120
		EPA Certificate:	MJDXL06.8120-004

Table 1

PERFORMANCE DATA:	1/4 Standby	1/2 Standby	3/4 Standby	Full Standby
Engine bkW @ Stated Load	37	74	110	147
Fuel Consumption (g/kWh)	267	245	224	217
Exhaust Gas Flow (m^3/min)				27
Exhaust Temperature (°C)				580

Table 2

EXHAUST EMISSION DATA:	**EPA D2 Cycle 5-mode weighted**
HC (Total Unburned Hydrocarbons)	0.12
NOx (Oxides of Nitrogen as NO2)	3.79
CO (Carbon Monoxide)	1.2
PM (Particulate Matter)	0.12

Values are in g/kWh unless otherwise noted

TEST METHODS AND CONDITIONS

The emission data listed is measured from a laboratory test engine according to the test procedures of 40 CFR 89 or 40 CFR 1039, as applicable. The test engine is intended to represent nominal production hardware, and there is no guarantee that every production engine will have identical test results. The family parent data represents multiple ratings and this data may have been collected at a different engine speed and load. Emission results may vary due to engine manufacturing tolerances, engine operating conditions, fuels used, alternate test methods, or other conditions.

Data and specifications subject to change without notice.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2021 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT

OFFICE OF TRANSPORTATION AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105

Certificate Issued To: **Deere & Company**
(U.S. Manufacturer or Importer)

Certificate Number: MJDXL06.8120-004

Effective Date: 07/01/2020

Expiration Date: 12/31/2021

Byron J. Bunker, Division Director
Compliance Division

Issue Date: 07/01/2020

Revision Date: N/A

Model Year: 2021
Manufacturer Type: Original Engine Manufacturer
Engine Family: MJDXL06.8120

Mobile/Stationary Indicator: Stationary
Emissions Power Category: 130<=kW<225
Fuel Type: Diesel
After Treatment Devices: No After Treatment Devices Installed
Non-after Treatment Devices: Electronic Control, Smoke Puff Limiter, Non-standard Non-After Treatment Device Installed, Engine Design Modification

Pursuant to Section 111 and Section 213 of the Clean Air Act (42 U.S.C. sections 7411 and 7547) and 40 CFR Part 60, and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following engines, by engine family, more fully described in the documentation required by 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new compression-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 60.

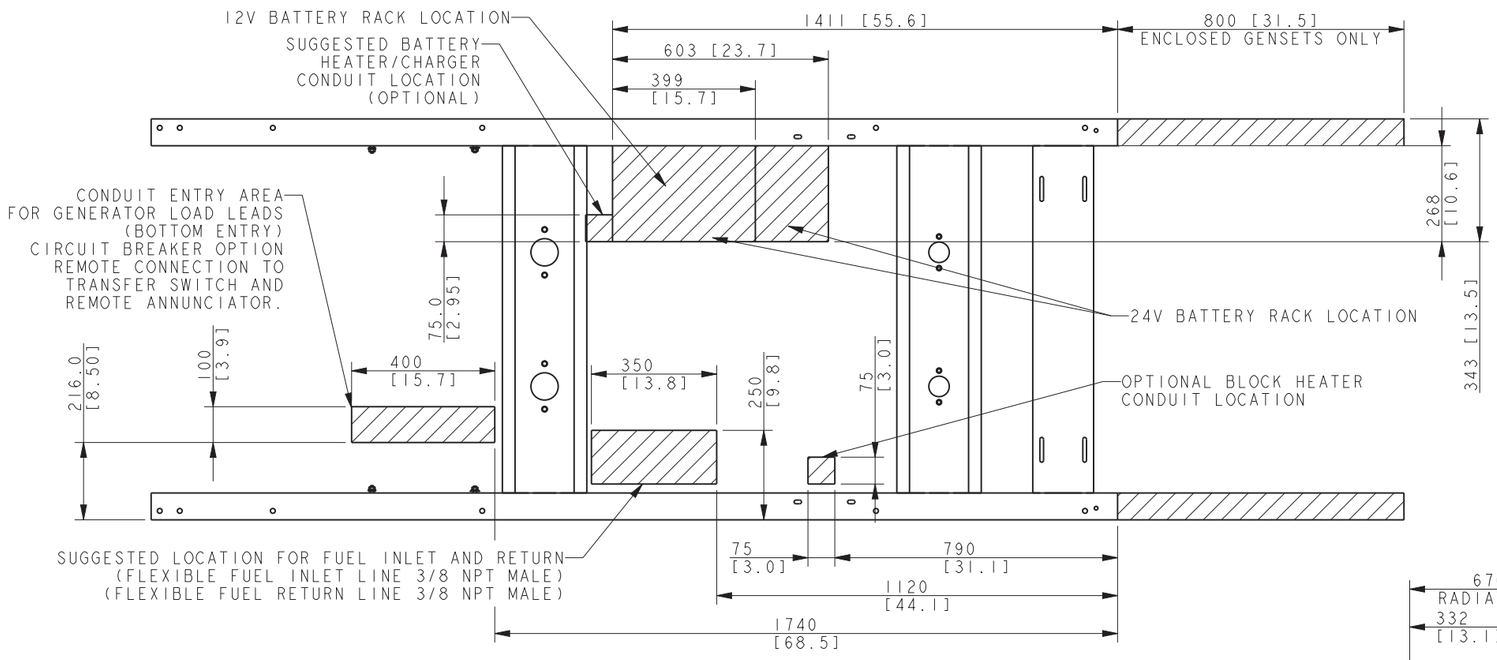
It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 60.

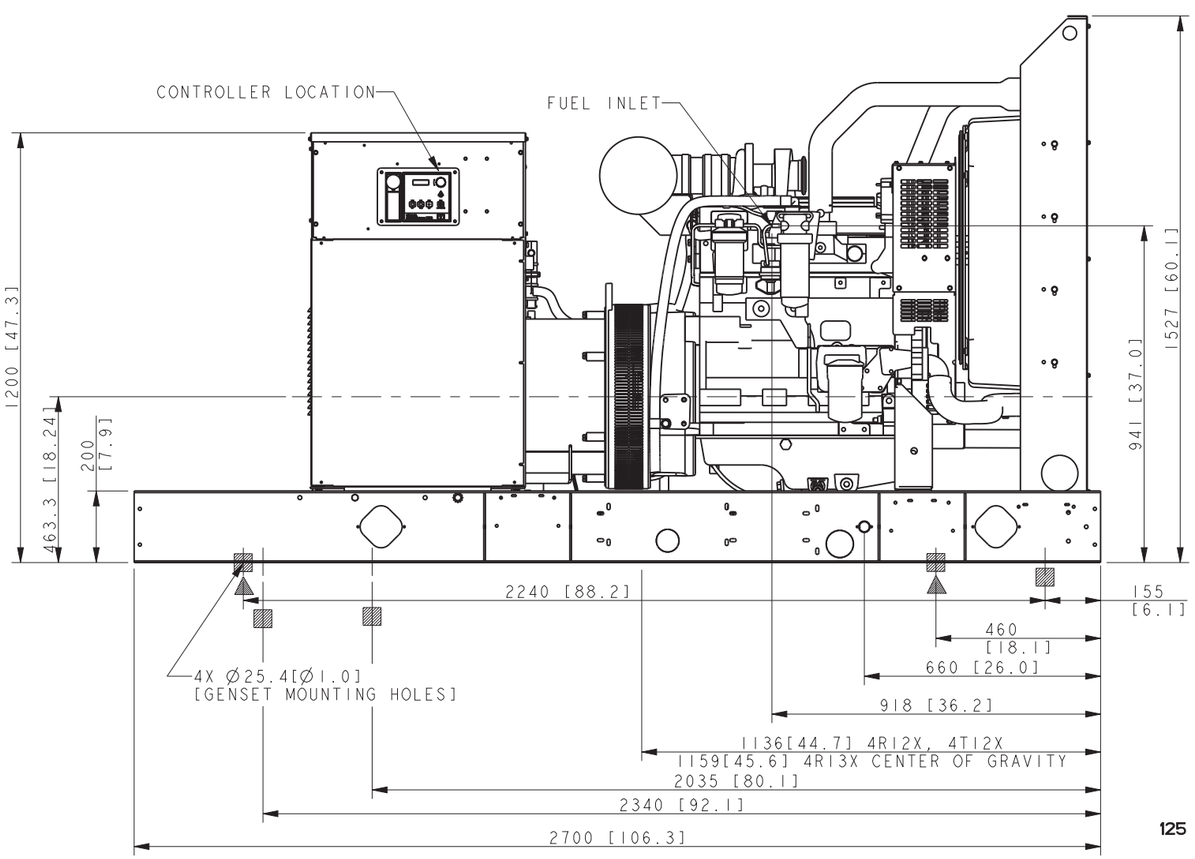
This certificate does not cover engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.

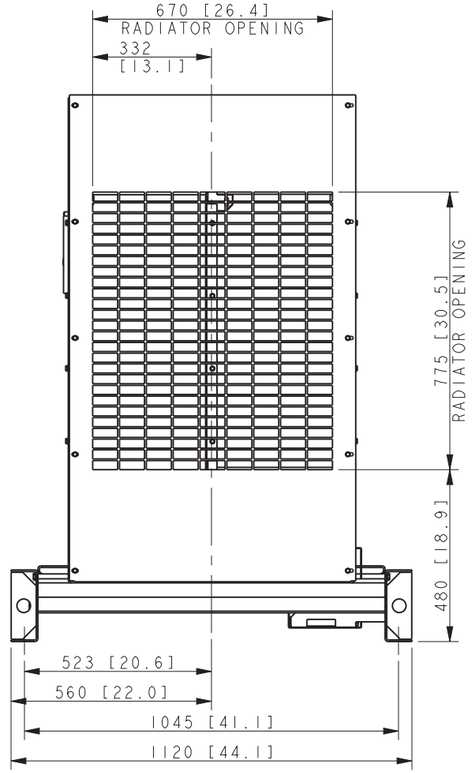
The actual engine power may lie outside the limits of the Emissions Power Category shown above. See the certificate application for details.

KOHLER®

Dimensional Drawings







▲ 4 HOLES FOR STANDARD MOUNTING Ø25.4 [1.00]

▨ 10 HOLES FOR IBC MOUNTING Ø25.4 [1.00]

125 MODEL, 4R12X, 4R13X, 4T13X RECONNECTABLE
IMPROVE MOTOR STARTING (IMS) RECONNECTABLE
600V & 1 PHASE ALTERNATORS
4045HF285 JOHN DEERE, TIER III

INSTALLATION NOTE

IF SUBBASE FUEL TANK AND/OR SOUND HOUSING IS USED, REFER TO SUBBASE FUEL TANK DRAWING TO DETERMINE MOUNTING LOCATIONS

MODEL	GENSET WEIGHT (WET)
125 4R12X	1190 KG [2623 LBS]
125 4R13X, 4T13X	1226 KG [2702 LBS]

NOTES
DIMENSIONS IN [ ] ARE ENGLISH EQUIVALENTS.

IF AN ENCLOUSRE IS USED, THE FUEL LINE MUST BE STUBBED UP FROM DIRECTLY UNDER THE UNIT OR BROUGHT IN FROM THE END OF THE SKID. REFER TO ENCLOUSER ADV.

IF IBC CERTIFICATION IS REQUIRED SEE SEISMIC ADV FOR INSTALLATION INSTRUCTIONS.

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	5-20-11	NEW DRAWING [91379-4]	KMP
A	10-10-13	(A-5) 460 [18.1], (A-6) 2035 [80.1] & 2340 [92.1]	
		ADDED; (A-8) NOTE FOR STANDARD & IBC MOUNTING	
		ADDED [CT59787]	SVP
B	10-13-14	(A-4,B-2) 4T13X ADDED, 4T12X REMOVED [CT95127]	SAM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	KMP	5-20-11
CHECKED	PLD	5-20-11
APPROVED	GDF	5-20-11

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POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
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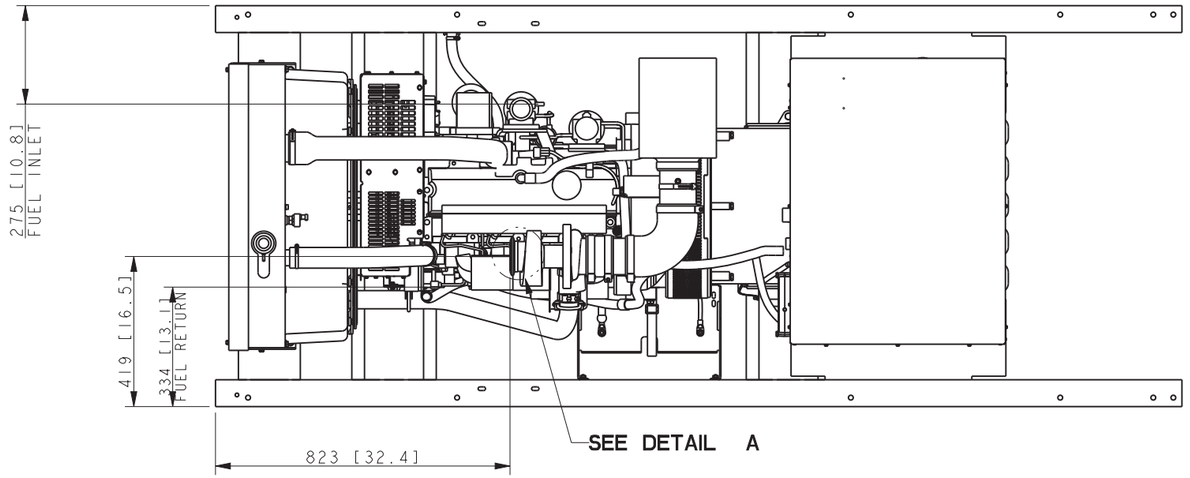
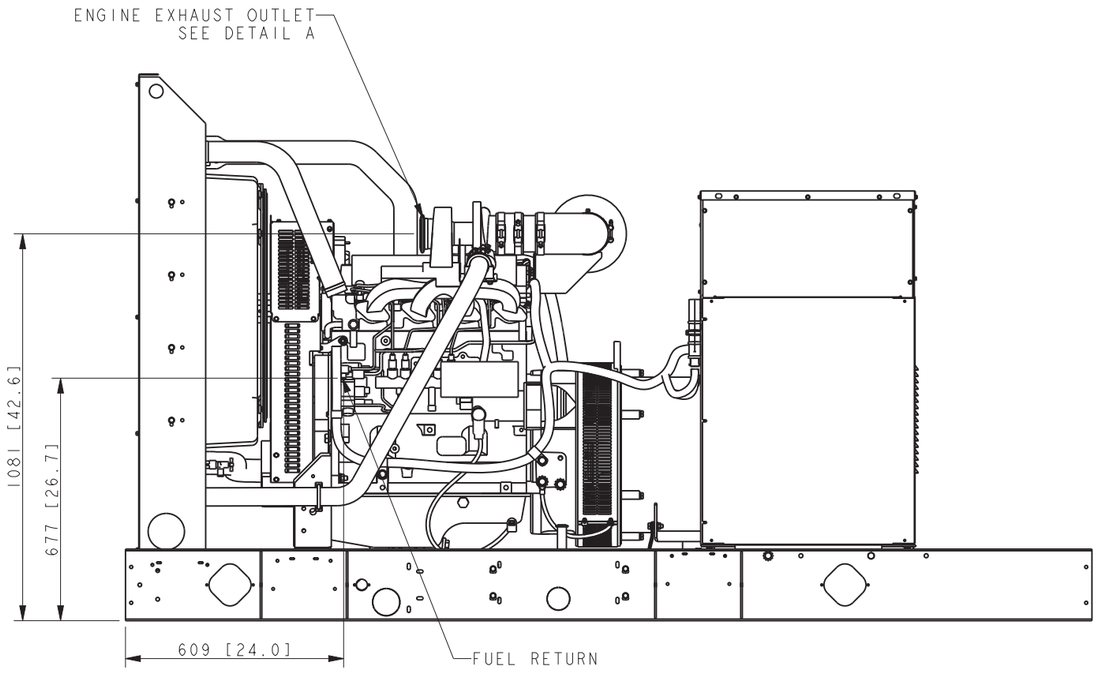
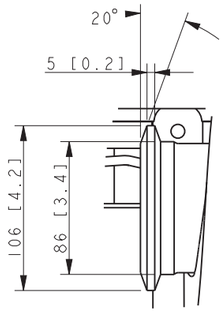
TITLE
DIMENSION PRINT, 125 MODEL

SCALE 0.12 | CAD NO. | SHEET 1 of 2
DWG NO. ADV-8182 | D







DETAIL A
SCALE 0.520
EXHAUST OUTLET

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	5-23-11	NEW DRAWING [91379-4]	KMP
A	10-10-13	SEE SHEET 1 [CT59787]	SVP
B	10-13-14	SEE SHEET 1 [CT95127]	SAM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS	DATE
DRAWN KMP	5-23-11
CHECKED PLD	5-23-11
APPROVED GDF	5-23-11

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POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

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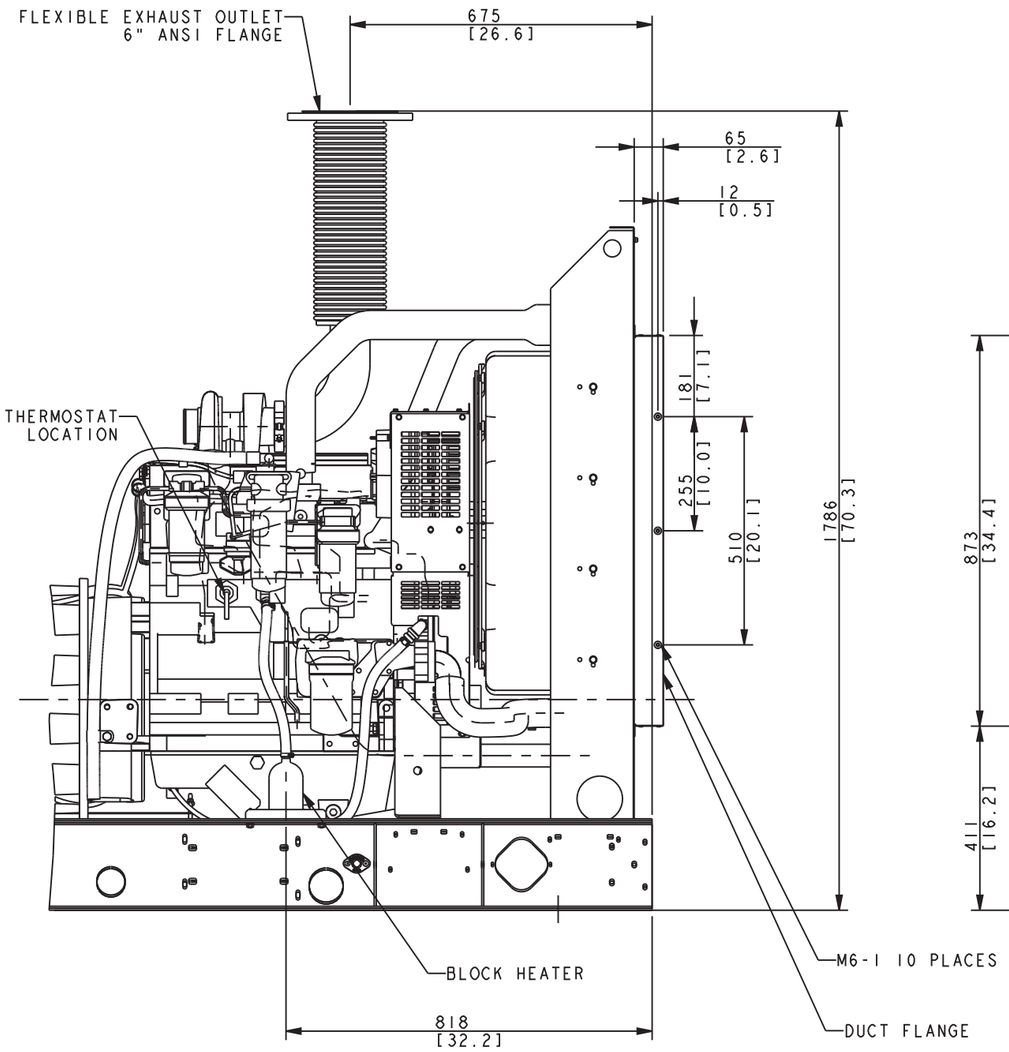
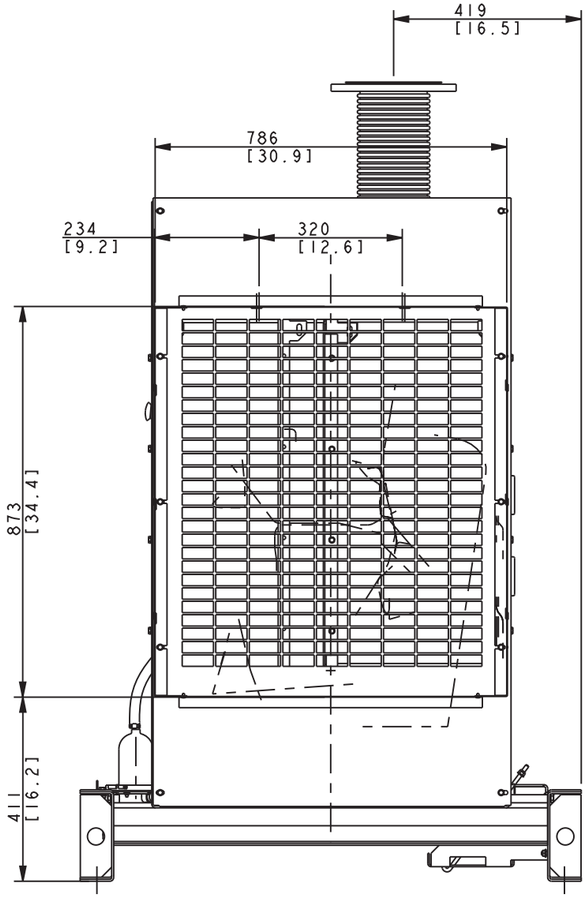
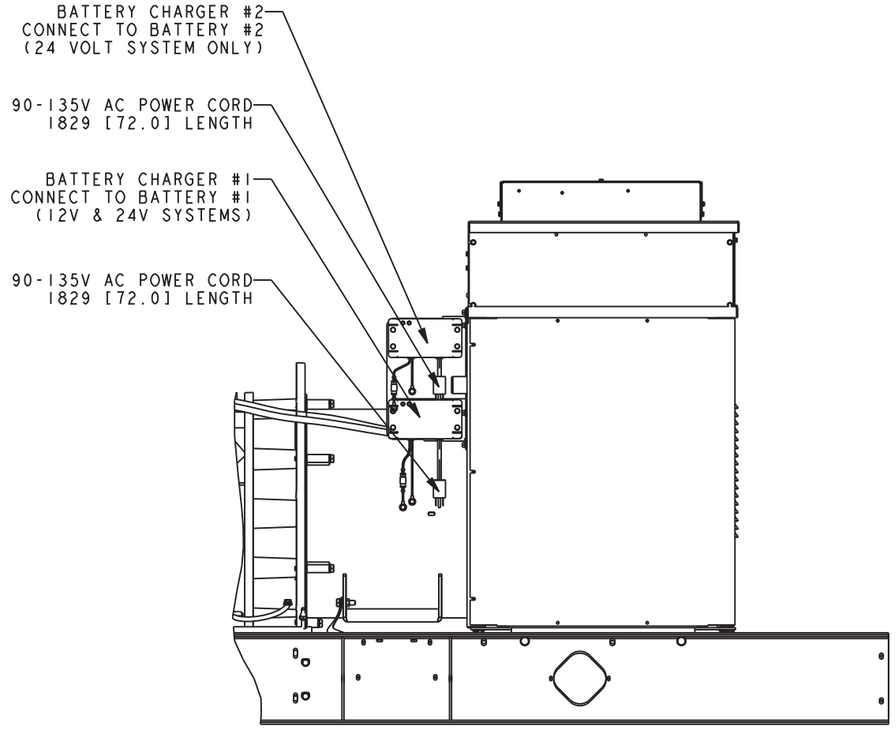
TITLE
DIMENSION PRINT, 125 MODEL

SCALE 0.12 | CAD NO. | SHEET 2 of 2
DWG NO. ADV-8182 | D







NOTES
DIMENSIONS IN [ ] ARE ENGLISH EQUIVALENTS

IF AN ENCLOUSURE IS USED THE FUEL LINE MUST BE STUBBED UP FROM DIRECTLY UNDER THE UNIT OR BROUGHT IN FROM THE END OF THE SKID. REFER TO ENCLOSURE ADV.

IF IBC CERTIFICATION IS REQIURED SEE SEISMIC ADV FOR INSTALLATION INSTRUCTIONS.

125 MODEL, 4S11, 4S13
RECONNECTABLE
IMPROVE MOTOR STARTING (IMS) RECONNECTABLE
600V & 1 PHASE ALTERNATORS
4045HF285 JOHN DEERE, TIER III

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	12-9-09	NEW DRAWING [88770-3]	KDW
A	12-22-10	(D-8) 6" ANSI FLANGE WAS 4" NPT, (D-7) 675 WAS	
		688, (C-6) 1786 WAS 1790, (A-7) 818 WAS 770	
		[90879]	PKD

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH ✓ MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	KDW	12-9-09
CHECKED	KDW	12-9-09
APPROVED	SAH	12-9-09

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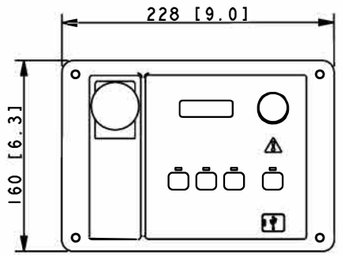
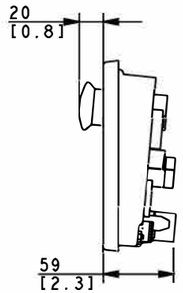
TITLE: **DIMENSION PRINT, ACCESSORIES**

SCALE 0.15 | CAD NO. | SHEET 1 of 1

DWG NO. **ADV-7852** | **D**





APM402

DIMENSIONS IN [] ARE ENGLISH EQUIVALENTS.

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	10-15-10	NEW DRAWING [90099]	DJV

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ±
X.X ±
X ±
ANGLES ±
SURFACE FINISH ✓ MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	DJV	10-15-10
CHECKED	DJV	10-15-10
APPROVED	JDZ	10-15-10

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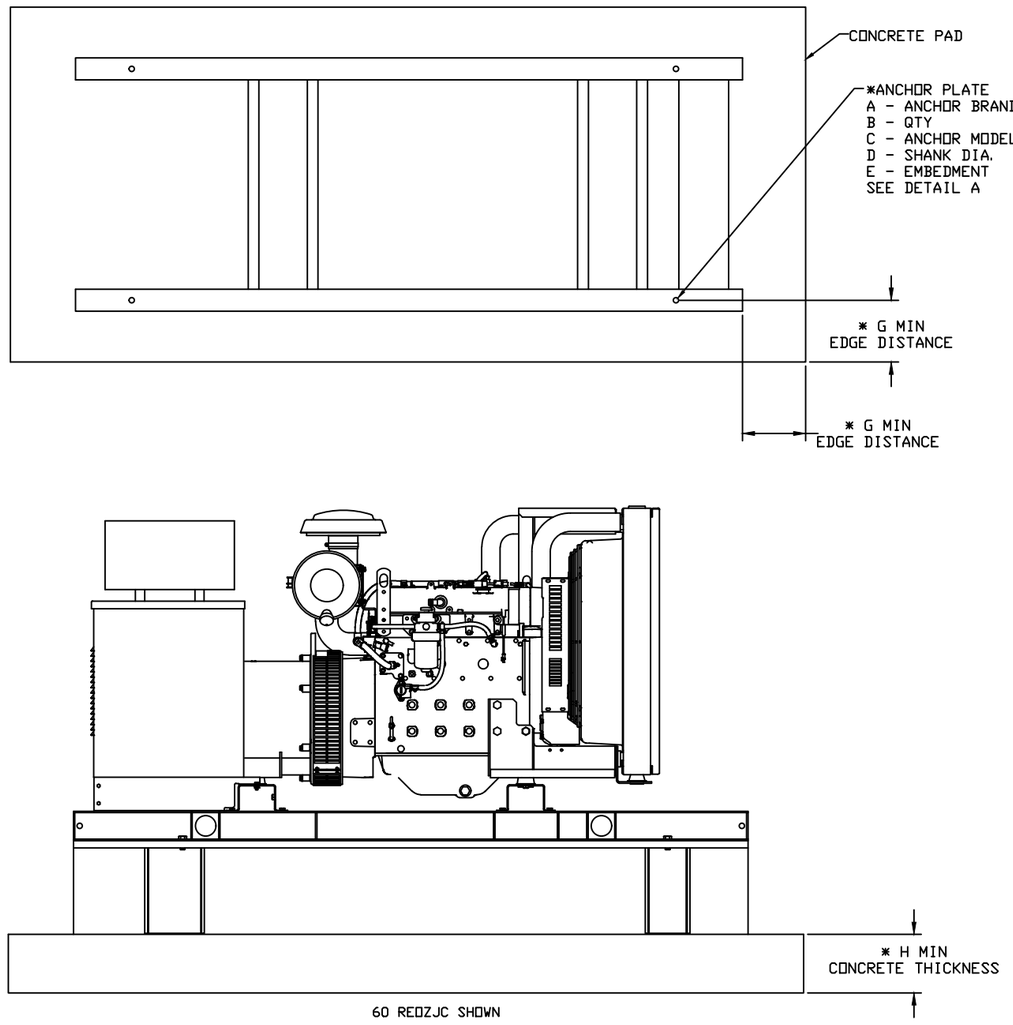
TITLE
DIMENSION PRINT, CONTROLLER

SCALE 0.40 | CAD NO. | SHEET 1 of 1

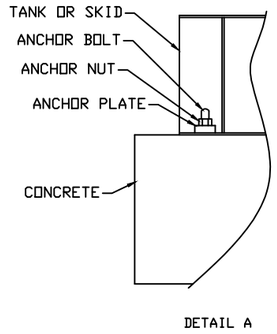
DWG NO. ADV-7935 | D

20-300KW
CONTROLLER

REV	DATE	REVISION	BY
G	4-4-17	SEE SHEET 2 & 3 [CT172432]	RRT
H	3-8-18	SEE SHEET 2 [CT184844]	SRB
J	8-1-18	SEE SHEET 3 [PR07342]	KJT
K	11-19-18	SEE SHEET 2 [CT191432]	SLR
L	1-18-19	SEE SHEET 3 [CT193090]	SLR
M	6-9-20	SEE SHEET 2 [CT204358]	MVT
N	04AUG2020	SEE SHEET 3 [CT205825]	DS



60 REOZJC SHOWN



DETAIL A

NOTE:
1) SPECIAL INSPECTION PER IBC
IS REQUIRED ON ALL INSTALLATIONS.
ALL ANCHORS MUST BE INSTALLED TO MEET COMPLIANCE

2) NO OTHER ANCHORS ARE ALLOWED WITHIN MINIMUM SPACING DISTANCE WITHOUT ADVANCED APPROVAL OF THE STRUCTURAL PROJECT ENGINEER OF RECORD.

3) *SEE NOTES ON SHEET 3

METRIC CAD FILE

DIMENSIONS IN [ ] ARE INCH EQUIVALENT

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0°30'
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	SAM	9-11-13
CHECKED	AJD	9-12-13
APPROVED	AJD	9-12-13

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POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
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TITLE: DIMENSION PRINT
SEISMIC INSTRUCTION

SCALE | CAD NO. | SHEET 1-4

DWG. NO. ADV-8629 | D

PLOTTED DATE

SEISMIC INSTRUCTION

MAXIMUM SEISMIC DESIGN RATING APPLIES AS A SYSTEM TO GENSET, TANKS, ENCLOSURES AND ACCESSORIES						ANCHORING SYSTEM							
GENSET MODELS	ENCLOSURE	FUEL TANK CAPACITY LITERS	FUEL TANK CAPACITY GAL	S_{DS} @ Z/H=0.0	S_{DS} @ Z/H=1.0	ANCHORING PLACEMENT LOCATIONS	A ANCHOR BRAND	B QTY	C ANCHOR MODEL	D SHANK DIA	E EMBEDMENT	G MIN. EDGE DISTANCE	H MIN. THICKNESS
25–45 REZG/B 50–60 REZGB/C	OPEN OR ENCLOSED UNITS	–		2.0	2.0	FOR MTG. HOLES SEE GENSET/ENCLOSURE/ ADVS RESPECTIVELY	HILTI	6	TZ	15.9 [.63]	101.6 [4.0]	203.2 [8.0]	203.2 [8.0]
80 REZGD	OPEN UNITS	–					HILTI	4	HDA–P M16X190/40	16.0 [.63]	190 [7.48]	203.2 [8.0]	304.8 [12.0]
	ENCLOSED	–					HILTI	6	HDA–P M16X190/40	16.0 [.63]	190 [7.48]	203.2 [8.0]	304.8 [12.0]
100 REZGD 125–150 REZGC	OPEN UNITS	–					HILTI	4	HDA–P M16X190/40	16.0 [.63]	190 [7.48]	304.8 [12.0]	355.6 [14.0]
	ENCLOSED	–					HILTI	6	HDA–P M16X190/40	16.0 [.63]	190 [7.48]	304.8 [12.0]	304.8 [12.0]
180–200REZXB	OPEN UNITS ONLY	–		2.0	2.0	FOR MTG. HOLES SEE GENSET/ENCLOSURE/ ADVS RESPECTIVELY	HILTI	6	HDA–P M20X250/50	20.0 [.79]	254 [10.0]	762.0 [30.0]	609.6 [24.0]
	ENCLOSED UNITS ONLY						HILTI	8	HDA–P M20X250/50	20.0 [.79]	254 [10.0]	635.0 [25.0]	635.0 [25.0]
250 REZXB/ 300REZXC	OPEN UNITS ONLY	–					HILTI	8	HDA–P M20X250/100	20.0 [.79]	250 [9.84]	228.6 [9.0]	355.6 [14.0]
	ENCLOSED UNITS ONLY						HILTI	8	HDA–P M20X250/100	20.0 [.79]	250 [9.84]	228.6 [9.0]	355.6 [14.0]
300–500REZXD	OPEN UNITS	–		2.0	2.0		HILTI	6	HDA–P	20.0 [.79]	250 [9.84]	228.6 [9.0]	355.6 [14.0]
	ENCLOSED							10	HDA–P	20.0 [.79]	250 [9.84]	228.6 [9.0]	355.6 [14.0]
20–60 REOZJC 50–60 REOZJD	OPEN OR ENCLOSED UNITS	UP THROUGH 908	240	1.93	1.93		HILTI	4	DUC–34–500L	19.05 [.75]	127 [5.0]	215.9 [8.5]	254.0 [10.0]
20–60 REOZJD	OPEN UNITS	–	–	1.93	1.93			4	TZ	15.9 [0.63]	101.6 [4.0]	152.4 [6.0]	152.4 [6.0]
	ENCLOSED							4	TZ	15.9 [0.63]	101.6 [4.0]	203.2 [8.0]	203.2 [8.0]
20–60 REOZJC 50–60 REOZJD 40–50 REOZJE	OPEN OR ENCLOSED UNITS	439/473	116/125	1.93	1.93			8	TZ	19.05 [.75]	120.7 [4.75]	304.8 [12.0]	304.8 [12.0]
		556	147					8	TZ	19.05 [.75]	120.7 [4.75]	355.6 [14]	304.8 [12.0]
		958/886	253/234					6	HDA–P	20.0 [.79]	250 [9.84]	254 [10]	355.6 [14.0]
		1408/1305	372/344					6	HDA–P	20.0 [.79]	250 [9.84]	355.6 [14]	355.6 [14.0]
80–100 REOZJF	OPEN UNITS	SET ONLY NO TANK		1.93	1.93			6	TZ	19.05 [.75]	95.3 [3.75]	152.4 [6.0]	152.4 [6.0]
	ENCLOSED							6	TZ	19.05 [.75]	95.3 [3.75]	203.2 [8.0]	203.2 [8.0]
	OPEN OR ENCLOSED UNITS	815	215					16	HY 200 + HAS	19.05 [.75]	254 [10]	228.6 [9.0]	304.8 [12.0]
		1570	415					16	HY 200 + HAS	19.05 [.75]	254 [10.0]	228.6 [9.0]	304.8 [12.0]
125REOZJG 150REOZJF	OPEN UNITS	SET ONLY NO TANK		1.93	1.93			8	TZ	19.05 [.75]	101.6 [4.0]	304.8 [12.0]	203.2 [8.0]
	ENCLOSED							12	TZ	19.05 [.75]	120.7 [4.75]	177.8 [7.0]	203.2 [8.0]
	OPEN OR ENCLOSED UNITS	1196	316			FOR MTG. HOLES		10	HDA–P	20.0 [.79]	250 [9.84]	304.8 [12.0]	355.6 [14.0]
		2252	595					10	HDA–P	20.0 [.79]	250 [9.84]	304.8 [12.0]	355.6 [14.0]
180 REOZJG 200 REOZJF	OPEN UNITS	SET ONLY NO TANK		1.93	1.93			10	TZ	19.05 [.75]	120.7 [4.75]	254 [10]	203.2 [8.0]
	ENCLOSED							10	HY 200 +HAS	19.05 [.75]	203.2 [8]	228.6 [9.0]	279.4 [11.0]
	OPEN OR ENCLOSED UNITS	1576	416			FOR MTG. HOLES SEE GENSET/ENCLOSURE/ TANK ADVS RESPECTIVELY		14	HDA–P	20.0 [.79]	250 [9.84]	254 [10]	355.6 [14.0]
		2896	765					14	HDA–P	20.0 [.79]	250 [9.84]	254 [10]	355.6 [14.0]
230–275 REOZJE	OPEN UNITS	SET ONLY NO TANK		1.93	1.93		HILTI	10	HY 200 + HAS	19.05 [.75]	228.6 [9.0]	228.6 [9.0]	304.8 [12.0]
	ENCLOSED							12	TZ	19.05 [.75]	120.7 [4.75]	304.8 [12.0]	355.6 [14.0]
	OPEN OR ENCLOSED UNITS	2101	555				HILTI	14	HDA–P	20.0 [.79]	250 [9.84]	330.2 [13]	355.6 [14.0]
		3573	944										
300 REOZJ	OPEN UNITS	SET ONLY NO TANK		1.93	1.93		HILTI	10	HY 200 + HAS	19.05 [.75]	228.6 [9.0]	228.6 [9.0]	304.8 [12.0]
	OPEN OR ENCLOSED UNITS							12	TZ	19.05 [.75]	120.7 [4.75]	304.8 [12.0]	355.6 [14.0]
		2101	555					14	HDA–P	20.0 [.79]	250 [9.84]	330.2 [13.0]	355.6 [14.0]
		4066	1074										
350–500 REOZJB	OPEN UNITS	SET ONLY		1.93	1.93		HILTI	10	HY 200 + HAS	19.05 [.75]	304.8 [12.0]	279.4 [11.0]	355.6 [14.0]
	ENCLOSED	NO TANK						14	HY 200 + HAS	19.05 [.75]	381.0 [15.0]	304.8 [12.0]	431.8 [17.0]
	OPEN OR ENCLOSED UNITS	1529–4394 [404–1161]						18 20 22 24 24	HDA–P	20.0 [.79]	250 [9.84]	330.2 [13.0]	355.6 [14.0]
		5046	1333										
		5765	1523										
		6674	1763										
		10008	2644										
20 REOZK (FOR GM94622–SA1 & –SA2 ONLY)	OPEN OR ENCLOSED UNITS	231–598 [61–158]		2.0	2.0			8	HY 200 + HAS	16.0 [.63]	171 [6.75]	254 [10]	304.8 [12.0]
							KWIK BOLT	4	TZ	16.0 [.63]	101.6 [4.0]	152 [6.0]	203.2 [8.0]

REV	DATE	REVISION	BY
J	8–1–18	SEE SHEET 3 [PR07342]	KJT
K	11–19–18	(C–8) GENSET MODELS : 300–450REZXB WAS 300–400REZXB	
		AND SPECIFICATION UPDATED FOR 300–450REZXB [CT191432]	SLR
L	1–18–19	SEE SHEET 3 [CT193090]	SLR
M	6–9–20	300–500REZXD WAS 300–450REZXB & ITS SPECIFICATIONS	
		UPDATED [CT204358]	MVT
N	04AUG2020	SEE SHEET 3 [CT205825]	DS

NOTE:
1) SPECIAL INSPECTION PER IBC IS REQUIRED ON ALL INSTALLATIONS. ALL ANCHORS MUST BE INSTALLED TO MEET COMPLIANCE

2) NO OTHER ANCHORS ARE ALLOWED WITHIN MINIMUM SPACING DISTANCE WITHOUT ADVANCED APPROVAL OF THE STRUCTURAL PROJECT ENGINEER OF RECORD.

3) *SEE NOTES ON SHEET 3

4) Z/H=0.0 EQUATES TO AT GRADE
Z/H=1.0 EQUATES TO AT ROOF TOP

METRIC CAD FILE

DIMENSIONS IN [ ] ARE INCH EQUIVALENT

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0°30'
SURFACE FINISH 125 MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	SAM	9–11–13
CHECKED	AJD	9–12–13
APPROVED	AJD	9–12–13

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TITLE: DIMENSION PRINT SEISMIC INSTRUCTION
SCALE | CAD NO. | SHEET 2–4
DWG. NO. ADV–8629 | D
PLOTTED DATE

REV	DATE	REVISION	BY
G	4-4-17	SEE SHEET 2 & 3 [CT172432]	RRT
H	3-8-18	SEE SHEET 2 [CT184844]	SRB
J	8-1-18	SEE SHEET 3 [PR07342]	KJT
K	11-19-18	SEE SHEET 2 [CT191432]	SLR
L	1-18-19	SEE SHEET 3 [CT193090]	SLR
M	6-9-20	SEE SHEET 2 [CT204358]	MVT
N	04AUG2020	SEE SHEET 3 [CT205825]	DS

SEISMIC INSTALLATION REQUIREMENTS:

The following are requirements for seismic installation:

1. The design of post-installed anchors in concrete used for the component anchorage is pre-qualified for seismic applications in accordance with ACI 355.2 and documented in a report by a reputable testing agency. (ex. The Evaluation Service Report issued by the International code Council)
2. Anchors must be installed to an embedment depth as recommended in the pre-qualification test report as defined in Note 1.
3. Anchors must be installed in minimum 4000 psi compressive strength normal weight concrete. Concrete aggregate must comply with ASTM C33. Installation in structural lightweight concrete is not permitted unless otherwise approved by the structural engineer of record.
4. Anchors must be installed to the torque specification as recommended by the anchor manufacturer to obtain maximum loading
5. Anchors must be installed in the locations specified the Kohler ADV dimension print.
6. Anchor bolt design loads or specific anchors are specified on seismic Kohler ADV.
7. Anchor plates from Kohler must be installed at each anchor location between anchor head and equipment to tension load distribution.
8. Concrete floor slab and concrete housekeeping pads must be designed and rebar reinforced for seismic applications in accordance with ACI 318.
9. All housekeeping pad thickness must be designed in accordance with pre-qualification test report as defined in Note 1 or a minimum of 1.5x the anchor embedment depth, whichever is largest
10. All housekeeping pads must be doweled or cast into the building structural floor slab and designed for seismic application per ACI 318 and as approved by the structural engineer of record
11. Wall mounted equipment must be installed to a rebar reinforced structural concrete wall that is seismically designed and approved by the engineer of record to resist the added seismic loads from the components being anchored to the wall.
12. Floor mounted equipment (with or without housekeeping pad) must be installed to a rebar reinforced structural concrete floor that is seismically designed and approved by the engineer of record to resist the added seismic loads from components being anchored to the floor.
13. When installing to a floor or wall, rebar interference must be considered.
14. Attaching seismic certified equipment to any floor or wall other than those constructed of structural concrete and designed to accept the seismic loads form said equipment is not permitted by this specification and beyond the scope of this certification.
16. Attaching seismic certified equipment to any concrete block walls or cinder block walls is not permitted by this specification and beyond the scope of this certification.
17. For installations upon rooftop, steel dunnage shall be coordinated with the Structural Engineer of Record.
18. Installation upon only rooftop curb shall be coordinated with the curb manufacturer and the Structural Engineer of Record. Any curb or concrete pad that supports the RTU unit is beyond the scope of this certification.
19. Anchor locations, size, type and load requirements are specified on the installation drawing. Mounting requirements details such as brand, type, embedment depth, edge spacing, anchor spacing, concrete strength, wall bracing, and special inspection must be outlined and approved by the project Structural Engineer of Record to withstand the seismic anchor loads as defined on the seismic installation drawing. The installing contractor is responsible for the proper installation of all anchors and mounting hardware, observing the mounting requirement details outlined by the Engineer of Record. Contact Kohler if a detail Seismic Installation Calculation Package is required.
20. Electrical wiring, piping, duct and other connections to the equipment is the responsibility of the installing contractor. It is necessary that these remain in tact, functional and do not inhibit the functionality of the generator set after a seismic event. Adequate slack shall be allowed cable and piping to allow for motions of set during a seismic event.

*21. Concrete pad dimensions are minimum values to satisfy only the anchor bolt requirements. The pad must be designed by the project structural engineer of record.

*22 Anchor bolt and concrete recommendations are for the maximum seismic design levels shown. If the specific application has a lower level, thinner concrete or alternate anchors may be acceptable. Consult Kohler.

METRIC CAD FILE

DIMENSIONS IN [ ] ARE INCH EQUIVALENT

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
XX ± 1.0
X ± 1.5
ANGLES ± 0°30'
SURFACE FINISH 63 MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	SAM	9-11-13
CHECKED	AJD	9-11-13
APPROVED	AJD	9-12-13

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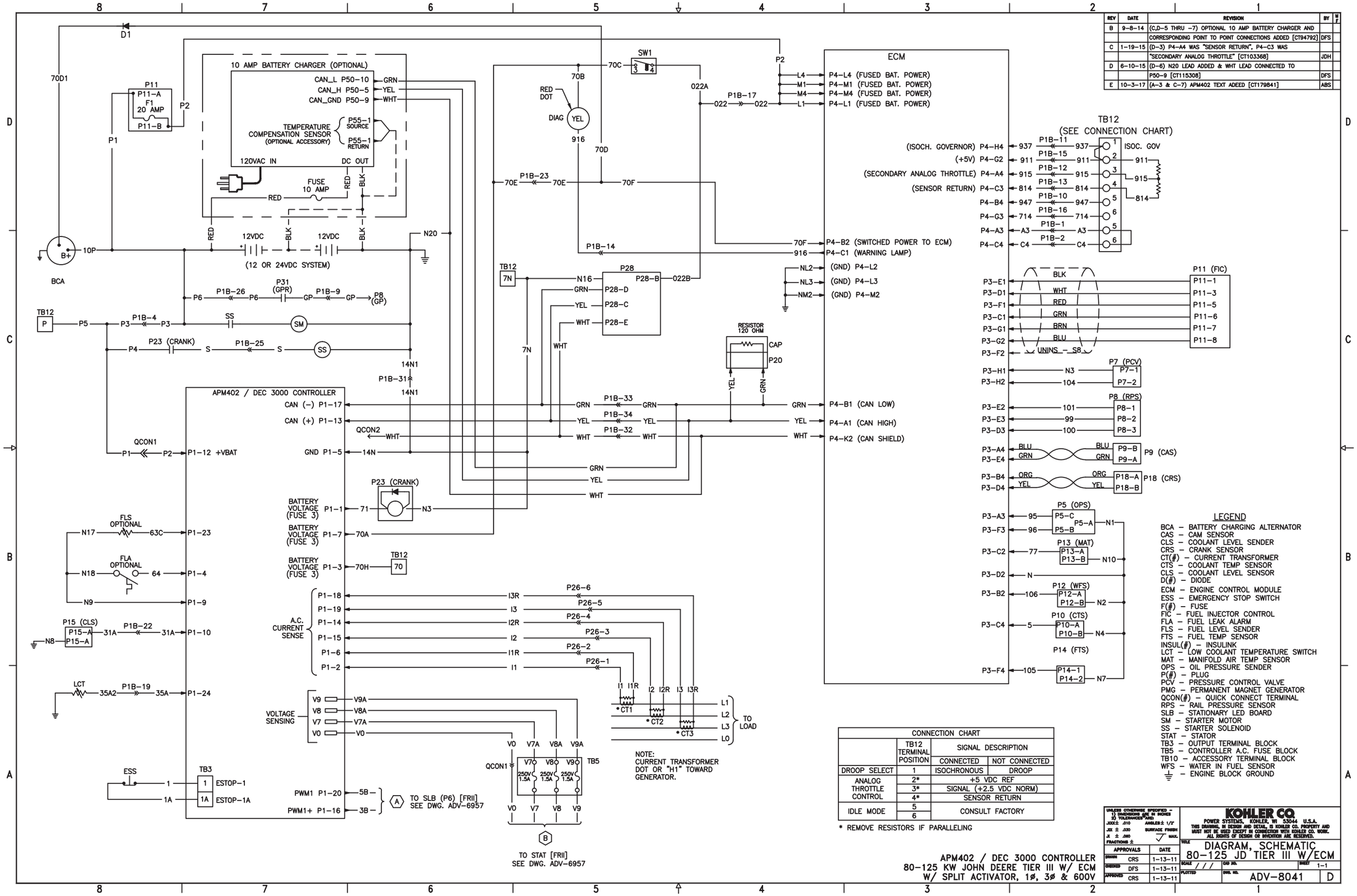
TITLE: DIMENSION PRINT SEISMIC INSTRUCTION
SCALE | CAD NO. | SHEET 4-4
DWG. NO. ADV-8629 | D
PLOTTED DATE

SEISMIC INSTRUCTION

KOHLER®

Wiring Schematics

REV	DATE	REVISION	BY	MT
B	9-8-14	(C,D-5 THRU -7) OPTIONAL 10 AMP BATTERY CHARGER AND		
		CORRESPONDING POINT TO POINT CONNECTIONS ADDED [CT94792]	DFS	
C	1-19-15	(D-3) P4-A4 WAS "SENSOR RETURN", P4-C3 WAS		
		"SECONDARY ANALOG THROTTLE" [CT103368]	JDH	
D	6-10-15	(D-6) N20 LEAD ADDED & WHT LEAD CONNECTED TO		
		P50-9 [CT115308]	DFS	
E	10-3-17	(A-3 & C-7) APM402 TEXT ADEED [CT179841]	ABS	



CONNECTION CHART			
	TB12 TERMINAL POSITION	SIGNAL DESCRIPTION	
		CONNECTED	NOT CONNECTED
DROOP SELECT	1	ISOCHRONOUS	DROOP
ANALOG THROTTLE CONTROL	2*	+5 VDC REF	
	3*	SIGNAL (+2.5 VDC NORM)	
	4*	SENSOR RETURN	
IDLE MODE	5	CONSULT FACTORY	
	6		

* REMOVE RESISTORS IF PARALLELING

APM402 / DEC 3000 CONTROLLER
80-125 KW JOHN DEERE TIER III W/ ECM
W/ SPLIT ACTIVATOR, 1ø, 3ø & 600V

UNLESS OTHERWISE SPECIFIED – 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: .XX± .010 ANGLES± 1/2° .XX ± .030 SURFACE FINISH .X ± .060 MAX. FRACTIONS ±

APPROVALS	DATE
DRAWN CRS	1-13-11
CHECKED DFS	1-13-11
APPROVED CRS	1-13-11

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TITLE: DIAGRAM, SCHEMATIC
80-125 JD TIER III W/ECM

SCALE: /// DWG NO. SHEET 1-1
PLOTTED DWG. NO. ADV-8041 D

REV	DATE	REVISION	BY	APP'D
–	1-13-11	NEW DRAWING [90751-4]	CRS	
A	5-29-12	(C-1) P1B: A3 & C4 LEADS ADDED [CT14764]	CRS	
B	9-8-14	SEE SHEET 2 [CT94792]	DFS	
C	6-10-15	SEE SHEET 2 [CT116330]	DFS	
D	9-27-17	(D-4,-5 & A-3) APM402 TEXT ADDED; SEE SHEET 2		
		[CT179572]	ABS	
E	6-4-19	(C-5) 70H ADDED TO P1-7 [CT196263]	TEV	

JUNCTION BOX

SEE DWG. GM35943 TO STAT [FRII] SEE DWG. GM35943

TO SLB (P6) [FRII] SEE DWG. GM35943

QCON28: V7 (STAT) — V7 (TB5-V7)
QCON29: V8 (STAT) — V8 (TB5-V8)
QCON30: V9 (STAT) — V9 (TB5-V9)
QCON31: V0 (STAT) — V0 (CONT-V0)

CT1 (I1R, I1) CT2 (I2R, I2) CT3 (I3R, I3)

NOTE: CURRENT TRANSFORMER DOT OR 'H1' TOWARD GENERATOR

P26

P26 CONNECTIONS

PIN #		
1	I1	(P1-2)
2	I1R	(P1-6)
3	I2	(P1-15)
4	I2R	(P1-14)
5	I3	(P1-19)
6	I3R	(P1-18)

P23 (CRANK)

P23 CONNECTIONS

PIN #		
1	P4	(W14)
2	N3	(W10)
3	71	(P1-1)
4	N/C	.
5	14S	(P1B-9)

P28

P28 CONNECTIONS

PIN #		
A	N16	(TB12-7N)
B	022	(P1B-17)
C	YEL	YELLOW (W13)
D	GRN	GREEN (W12)
E	WHT	WHITE (W11)
F	N/C	.
G	N/C	.
H	N/C	.
J	N/C	.

70K (W15) — DIAG — YEL — RED DOT — 916 (P1B-14)

CONTROLLER BOX

A/C COVER

V9 (QCON30) — TB5 V9 — V9A
V8 (QCON29) — TB5 V8 — V8A
V7 (QCON28) — TB5 V7 — V7A

V7 — V7A
V8 — V8A
V9 — V9A
V0 — V0 (QCON31)

APM402 / DEC-3000 CONTROLLER

P21: GND (+) (–) (+) (–)

P23 REMOTE I/O

P1 CONNECTIONS

PIN #					
1	71	(P23-3)	13	YEL	YELLOW (W13)
2	I1	(P26-1)	14	I2R	(P26-4)
3	70	(W15)	15	I2	(P26-3)
4	64	(QCON8)	16	3B	(P6-2) (FRII)
5	14N	(W10)	17	GRN	GREEN (W12)
6	I1R	(P26-2)	18	I3R	(P26-6)
7	70H	(TB12-70)	19	I3	(P26-5)
8	N/C	.	20	5B	(P6-1) (FRII)
9	N9	(W16)	21	N/C	.
10	31A	(P1B-22)	22	N/C	.
11	N/C	.	23	63C	(ACON6)
12	P2	(QCON1)	24	35A	(P1B-19)

TB1: GND AI1 AI2 DI3 DI2 DI1

P1

24						4
35A	5B	3B	P2	.	64	
63C	I3	I2	.	70H	70	
.	I3R	I2R	31A	I1R	I1	
.	GRN	YEL	N9	14N	71	
21						1

P2

TB2: COM NC — COM NO

TB3: AUX 4 — AUX 3 — 1A — 1 AUX

1A (ESS-2) — ESS 2
1 (ESS-1) — ESS 1

QCON2 — WHT (W11)

QCON1: P2 (P1-12) — P1 (W14)

TB12

P	P5 (W14)	
70	70H (P1-7)	
7NO	N16 (P28-A)	
7N	N16 (P28-A)	7N (W10)
1	937 (P1B-11)	ISOC GOV
2	911 (P1B-15)	
3	915 (P1B-12)	
4	814 (P1B-13)	
5	947 (P1B-10)	
6	714 (P1B-16)	
7	A3 (P1B-1)	
8	C4 (P1B-2)	
9		
10		
11		
12		
13		
14		
15		
16		
17		

RESISTOR 510 OHM — 917 — 915
RESISTOR 4.7K OHM — 915 — 814
JUMPER

N12 (P31-2) — W10 — 14N1 (P4A-31)
7N (TB12-7N) — W10
14N (P1-5) — W10
N3 (P23-2) — W10

WHT (P28-E) — W11 — WHT (P1B-32)
WHT (QCON2) — W11

GRN (P28-D) — W12 — GRN (P1B-33)
GRN (P1-17) — W12

YEL (P28-C) — W13 — YEL (P1B-34)
YEL (P1-13) — W13

P5 (TB12-P) — W14 — P3 (P1B-4)
P4 (P23-1) — W14
P1 (QCON1) — W14

70 (P1-3) — W15 — 70E (P1B-23)
70K (DIAG) — W15

CONNECTION CHART			
	TB12 TERMINAL POSITION	SIGNAL DESCRIPTION	
		CONNECTED	NOT CONNECTED
DROOP SELECT	1	ISOCHRONOUS	DROOP
ANALOG THROTTLE CONTROL	2*	+5 VDC REF	
	3*	SIGNAL (+2.5 VDC NORM)	
	4*	SENSOR RETURN	
IDLE MODE	5	CONSULT FACTORY	
	6		

* REMOVE RESISTORS IF PARALLELING

FUEL TANK

N17 (W16) — QCON5 — N2
63C (P1-23) — QCON6 — 63C
N18 (W16) — QCON7 — N
64 (P1-4) — QCON8 — 64

FUEL LEVEL SENDER (OPTIONAL)
FUEL LEAK ALARM (OPTIONAL)

N18 (QCON7) — N17 (QCON5) — W16 — N9 (P1-9)

P1B

		1		3					
4	P3					14S	9		
947	937	915	814	916	911	714	022		
	35A			31A	70E				
26						14N1	31		
		WHT	GRN	YEL					
		32		34					

P1B CONNECTIONS

PIN #					
1	A3	(TB12-7)	18	N/C	.
2	C4	(TB12-8)	19	35A	(P1-24)
3	N/C	.	20	N/C	.
4	P3	(W14)	21	N/C	.
5	N/C	.	22	31A	(P1-10)
6	N/C	.	23	70E	(W15)
7	N/C	.	24	N/C	.
8	N/C	.	25	N/C	.
9	14S	(P23-5)	26	N/C	.
10	947	(TB12-5)	27	N/C	.
11	937	(TB12-1)	28	N/C	.
12	915	(TB12-3)	29	N/C	.
13	814	(TB12-4)	30	N/C	.
14	916	(DIAG)	31	14N1	(W10)
15	911	(TB12-2)	32	WHT	YELLOW (W11)
16	714	(TB12-6)	33	GRN	GREEN (W12)
17	022	(P28-B)	34	YEL	WHITE (W13)

LEGEND

BCA – BATTERY CHARGING ALTERNATOR
CAS – CAM SENSOR
CLS – COOLANT LEVEL SENDER
CT(#) – CURRENT TRANSFORMER
CTS – COOLANT TEMPERATURE SENDER
D(#) – DIODE
DIAG – DIAGNOSTIC LAMP
EBG – ENGINE BLOCK GROUND
ESS – EMERGENCY STOP SWITCH
GP – GLOW PLUGS
GPR – GLOW PLUG RELAY
MAT – MANIFOLD AIR TEMP SENSOR
OPS – OIL PRESSURE SENDER
P(#) – PLUG
QCON(#) – QUICK CONNECT TERMINAL
SLB – STATIONARY LED BOARD
SM – STARTER MOTOR
SS – STARTER SOLENOID
STAT – STATOR
TB1 – CONTROLLER BOARD TERMINAL BLOCK
TB2 – A/D TERMINAL BLOCK
TB3 – OUTPUT TERMINAL BLOCK
TB5 – CONTROLLER A.C. FUSE BLOCK
TB10 – ACCESSORY TERMINAL BLOCK

FOR SCHEMATIC SEE ADV-8041

80-125 JD TIER III
APM402 / DEC 3000 W/ECM
SPLIT ACTIVATOR 1ø, 3ø AND 600V

UNLESS OTHERWISE SPECIFIED – 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: XXX± .010 ANGLES± 1/2° XX ± .030 SURFACE FINISH X ± .060 MAX. FRACTIONS ±

APPROVALS	DATE
DRAWN CRS	1-13-11
CHECKED DFS	1-13-11
APPROVED CRS	1-13-11

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TITLE: DIAGRAM, WIRING
80-125 JD TIER III W/ECM

SCALE: NONE | CAD NO. | SHEET 1-2
PLOTTED | DWG. NO. GM79690 | D

REV	DATE	REVISION	BY	N/P
A	5-29-12	SEE SHEET 1 [CT14764]	CRS	
B	9-8-14	(B-3,-4,-5 & C-5,-6) OPTIONAL 10 AMP BATTERY CHARGER AND		
		CORRESPONDIN POINT TO POINT CONNECTIONS ADDED [CT94792]	DFS	
C	6-10-15	(D-4) P50-9: WHT (W11) WAS N/C; (C-3 & -6) N20 LEAD		
		ADDED BETWEEN W11 AND W12 [CT116330]	DFS	
D	9-27-17	(A-3) APM402 TEXT ADDED; SEE SHEET 1 [CT179572]	ABS	
E	6-4-19	SEE SHEET 1 [CT196263]	TEV	

ENGINE

OPTIONAL 10 AMP BATTERY CHARGER
(FRONT J-BOX PANEL)

(FOR BATTERY CHARGER CONNECTIONS SEE DWG GM94439)

P50

P50 CONNECTIONS
PIN #1 N/C .
2 N/C .
3 N/C .
4 N/C .
5 YEL (W10)
6 N/C .
7 N/C .
8 N/C .
9 WHT (W11)
10 GRN (W9)

P1

P1 CONNECTIONS
PIN #1 N/C .
2 N/C .
3 N/C .
4 P3 (SS)
5 N/C .
6 N/C .
7 N/C .
8 N/C .
9 14S (SS)
10 947 (P4-B4)
11 937 (P4-H4)
12 915 (P4-A4)
13 814 (P4-C3)
14 916 (P4-C1)
15 911 (P4-G2)
16 714 (P4-G3)
17 022 (W15)
18 N/C .
19 35A (W1)
20 N9 (CTS)
21 N/C .
22 31A (P15-A)
23 70E (W2)
24 N/C .
25 N/C .
26 N/C .
27 N/C .
28 N/C .
29 N/C .
30 N/C .
31 14N1 (EBG)
32 WHT (W11)
33 GRN (W9)
34 YEL (W10)

35A (P1-19) — W1 — 35A1 (CTS), 35A2
70E (P1-23) — W2 — 70D (D1), 70B (P4-B2)
GRN (P1-33) — W9 — GRN (P50-10), GRN (P4-B1), ORG (P6-B)
YEL (P1-34) — W10 — YEL (P50-5), YEL (P4-A1), YEL (P6-A)
WHT (P1-32) — W11 — WHT (P50-9), WHT (P4-K2), N20 (W12)

P2 CONNECTIONS
PIN A P1 (SS)
B P2 (W15)

P6 CONNECTIONS
PIN A YEL (W10)
B ORG (W9)

022 (P1-17) — W15 — L1 (P4-L1), M1 (P4-M1), L4 (P4-L4), M4 (P4-M4), P2 (P2-B)
N20 (W11), N8 (P15-B), N11 (EBG) — W12 — NL2 (P4-L2), NL3 (P4-L3), NM2 (P4-M2)

N2 (P12-B), N10 (P13-B), N1 (P5-A), N4 (P10-B), N7 (P14-2) — W13 — N (P3-D2)

P4

P4 CONNECTIONS
PIN #A1 YEL (W10)
A2 N/C .
A3 N/C .
A4 915 (P1-12)
B1 GRN (W9)
B2 70B (W2)
B3 N/C .
B4 947 (P1-10)
C1 916 (P1-14)
C2 N/C .
C3 814 (P1-13)
C4 N/C .
D1 N/C .
D2 N/C .
D3 N/C .
D4 N/C .
E1 N/C .
E2 N/C .
E3 N/C .
E4 N/C .
F1 N/C .
F2 N/C .
F3 N/C .
F4 N/C .
G1 N/C .
G2 911 (P1-15)
G3 714 (P1-16)
G4 N/C .
H1 N/C .
H2 N/C .
H3 N/C .
H4 937 (P1-11)
J1 N/C .
J2 N/C .
J3 N/C .
J4 N/C .
K1 N/C .
K2 WHT (W11)
K3 N/C .
K4 N/C .
L1 L1 (W15)
L2 NL2 (W12)
L3 NL3 (W12)
L4 L4 (W15)
M1 M1 (W15)
M2 NM2 (W12)
M3 N/C .
M4 M4 (W15)

P3

P3 CONNECTIONS
PIN #A1 N/C .
A2 N/C .
A3 95 (P5-C)
A4 BLU (P9-B)
B1 N/C .
B2 106 (P12-A)
B3 N/C .
B4 ORG (P18-A)
C1 GRN (P11-6)
C2 77 (P13-A)
C3 N/C .
C4 5 (P10-A)
D1 WHT (P11-3)
D2 N (W13)
D3 100 (P8-3)
D4 YEL (P18-B)
E1 BLK (P11-1)
E2 101 (P8-1)
E3 99 (P8-2)
E4 GRN (P9-A)
F1 RED (P11-5)
F2 S8 UNINSULATED (P11)
F3 96 (P5-B)
F4 105 (P14-1)
G1 BRN (P11-7)
G2 BLU (P11-8)
G3 N/C .
G4 N/C .
H1 N3 (P7-1)
H2 104 (P7-2)
H3 N/C .
H4 N/C .

P5 (OPS)

P5 CONNECTIONS
PIN A N1 (W13)
B 96 (P3-F3)
C 95 (P3-A3)

P10 (CTS)

P10 CONNECTIONS
PIN A 5 (P3-C4)
B N4 (W13)

P9 (CAS)

P9 CONNECTIONS
PIN A GRN (P3-E4)
B BLU (P3-A4)

P13 (MAT)

P13 CONNECTIONS
PIN A 77 (P3-C2)
B N10 (W13)

P18 CONNECTIONS
PIN A ORG (P3-B4)
B YEL (P3-D4)

P11 (FIC)

P11 CONNECTIONS
PIN #1 BLK (P3-E1)
2 N/C .
3 WHT (P3-D1)
4 N/C .
5 RED (P3-F1)
6 GRN (P3-C1)
7 BRN (P3-G1)
6 BLU (P3-G2)

P12 (WFS)

P12 CONNECTIONS
PIN A 106 (P3-B2)
B N2 (W13)

P18 (CRS)

P7 (PCV)

P7 CONNECTIONS
PIN #1 N3 (P3-H1)
2 104 (P3-H2)

P8 (RPS)

P8 CONNECTIONS
PIN #1 101 (P3-E2)
2 99 (P3-E3)
3 100 (P3-D3)

14N1 (P1-31), N11 (W12) — EBG

P14 (FT)

P14 CONNECTIONS
PIN #1 105 (P3-F4)
2 N7 (W13)

70D (W2) — D1 — 70D1 — BCA B+ — 10P

P13 CONNECTIONS
PIN #1 70D1 (D1)

N9 (P1-20)
35A (W1)
NOT USED — 35A2 (W1)

CTS

P15 CONNECTIONS
PIN A 31A (P1-22)
B N8 (W12)

P15 (CLS)

P1 (P2-A)
P3 (P1-4)
14S (P1-9)

SS
SM

BATTERY 12 VDC
BATTERY 12 VDC
(12 or 24VDC SYSTEM)

80-125 JD TIER III
APM402 / DEC 3000 W/ECM
SPLIT ACTIVATOR 1ø, 3ø AND 600V

UNLESS OTHERWISE SPECIFIED —
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .020 SURFACE FINISH
.X ± .060 125
FRACTIONS ± 1/64

APPROVALS	DATE
DRAWN CRS	1-13-11
CHECKED DFS	1-13-11
APPROVED CRS	1-13-11

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TITLE: DIAGRAM, WIRING
80-125 JD TIER III W/ECM

SCALE NONE | CAD NO. | SHEET 2-2
PLOTTED | DWG. NO. GM79690 | D

REV	DATE	REVISION	BY	M E
F	04-26-18	(D-2,-3) COMMENT "NOT AVAILABLE AS A STANDALONE KIT",		
		"OPTIONAL, INCLUDED IN SHUNT TRIP KIT" ARE ADDED,		
		SEE SHEET 2 [CT186997]	SBR	
G	2-6-19	(A,B-6,-7,-8) ADDED GROUND FAULT RELAY INPUT; TB1-DI1		
		LOW FUEL PRESSURE WAS EXCITATION OVER VOLTAGE (4M,5M,7M)		
		(A,B-1,-2,-3) ADDED NOTE 5 AND 6 IN INSTALLATION NOTES		
		[CT193515]	SBR	

P29 2 AMP RELAY OUPUT (2.1) CONNECTIONS
P29-NC 2.1 RELAY NORMALLY CLOSED
P29-COM 2.1 RELAY COMMON
P29-NO 2.1 RELAY NORMALLY OPEN

P30 2 AMP RELAY OUPUT (2.2) CONNECTIONS
P30-NC 2.2 RELAY NORMALLY CLOSED
P30-COM 2.2 RELAY COMMON
P30-NO 2.2 RELAY NORMALLY OPEN

P31 2 AMP RELAY OUPUT (2.3) CONNECTIONS
P31-NC 2.3 RELAY NORMALLY CLOSED
P31-COM 2.3 RELAY COMMON
P31-NO 2.3 RELAY NORMALLY OPEN

P32 10 AMP RELAY OUPUT (2.4 & 2.5) CONNECTIONS
P32-NO 2.4 RELAY NORMALLY OPEN
P32-COM 2.4 RELAY COMMON
P32-NC 2.4 RELAY NORMALLY CLOSED

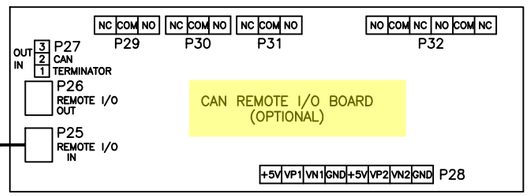
P32-NO 2.5 RELAY NORMALLY OPEN
P32-COM 2.5 RELAY COMMON
P32-NC 2.5 RELAY NORMALLY CLOSED

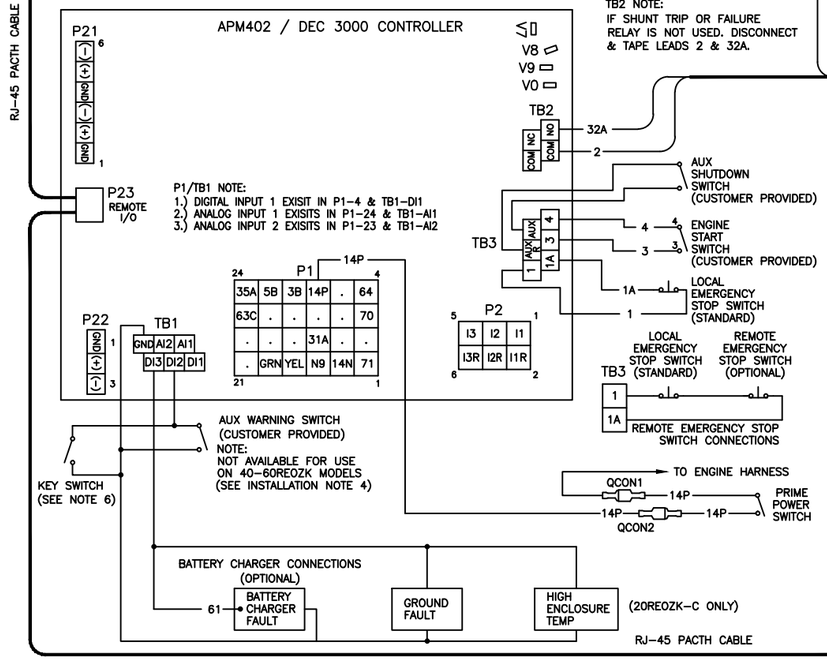
P27 CAN TERMINATOR CONNECTIONS
PLACE THE P27 JUMPER ON THE "IN" PINS

P28 SINGLE-ENDED (0-5V) ANALOG INPUT CONNECTIONS
P28-GND AGND ANALOG RETURN
P28-VN2 NO CONNECTION
P28-VP2 ACH2 SIGNAL
P28-+5V SUPPLY (0.05 AMP MAX)
P28-GND AGND ANALOG RETURN
P28-VN1 NO CONNECTION
P28-VP1 ACH1 SIGNAL
P28-+5V SUPPLY (0.05 AMP MAX)

P28 DIFFERENTIAL (+/-3V) ANALOG INPUT CONNECTIONS
P28-GND AGND ANALOG REFERENCE
P28-VN2 ACH2 NEGATIVE DIFFERENTIAL SIGNAL
P28-VP2 ACH2 POSITIVE DIFFERENTIAL SIGNAL
P28-+5V SUPPLY (0.05 AMP MAX)
P28-GND AGND ANALOG RETURN
P28-VN1 ACH1 NEGATIVE DIFFERENTIAL SIGNAL
P28-VP1 ACH1 POSITIVE DIFFERENTIAL SIGNAL
P28-+5V SUPPLY (0.05 AMP MAX)

NOTE: CONTACT AUTHORIZED DISTRIBUTOR TO DEFINE P28 A/D INPUTS.

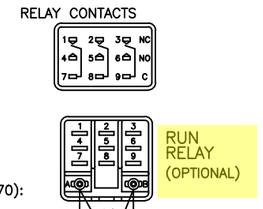


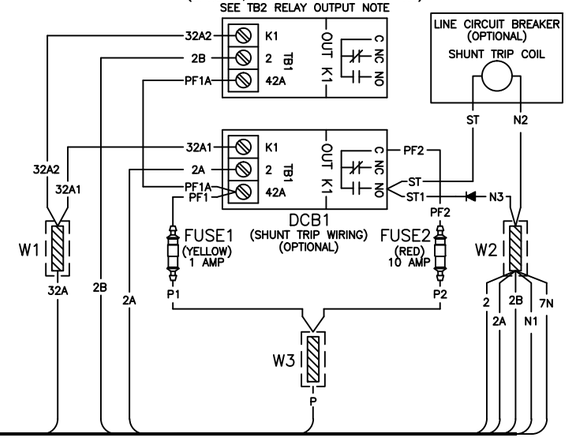


TB2 NOTE:
IF SHUNT TRIP OR FAILURE RELAY IS NOT USED, DISCONNECT & TAPE LEADS 2 & 32A.

TB3 NOTE:
NOTE: TRANSFER SWITCH TERMINAL DESIGNATIONS MAY VARY FROM THOSE SHOWN HERE. VERIFY THE CORRECT DESIGNATIONS USING THE APPROPRIATE TRANSFER SWITCH WIRING DIAGRAM.

(TERMINALS 3 AND 4: REMOTE START SWITCH OR ENGINE START CONTACTS ON TRANSFER SWITCH)





LEGEND
P(#) - PLUG
QCON(#) - QUICK CONNECT
TB(#) - TERMINAL BLOCK
W(#) - SONIC WELD

INSTALLATION NOTES:

1.) FOR FIELD INSTALLATION A MAXIMUM OF TWO WIRE TERMINALS PER TERMINAL STRIP SCREW IS RECOMMENDED UNLESS OTHERWISE NOTED ON THE WIRING DIAGRAM. DO NOT EXTEND ABOVE THE TERMINAL STRIP BARRIER.

2.) GENERATOR SETS WITH FUEL TANKS HAVE THE FUEL IN BASIN SWITCH TIED TO DIGITAL INPUT 1 (TB1-DI1) VIA P1-4 AND FUEL LEVEL SENDER TIED TO ANALOG INPUT 2 (TB1-AI2) VIA P1-23

3.) COOLANT LEVEL SENSOR ON ALL GENSETS IS TIED TO ANALOG INPUT 1 (TB1-AI2) VIA P1-24.

4.) 40-60 REOZK MODELS HAVE COLD START IGNITION RELAY TIED TO DIGITAL INPUT 2 (TB1-DI2)

5.) GROUND FAULT WARNING : CONNECT TO REMOTE I/O BOARD ON 20REOZK-C.

6.) KEYSWITCH AVAILABLE ON SELECT MODELS ONLY.

P21 RS485 NON-ISOLATED CONNECTIONS
P21-1 GND
P21-2 +
P21-3 -
P21-4 GND
P21-5 +
P21-6 -

TB1 ANALOG/DIGITAL INPUT FACTORY SETTINGS
TB1-DI1 DCH1 LOW FUEL PRESSURE
TB1-DI2 DCH2 AUX WARNING
TB1-DI3 DCH3 BATTERY CHARGER FAULT WARNING
TB1-AI1 ACH1 NO FUNCTION
TB1-AI2 ACH2 NO FUNCTION
TB1-GND A/DGND ANALOG/DIGITAL RETURN

NOTE: TB1 A/D INPUTS MAY BE REDEFINED - FACTORY DEFAULTS LISTED. CONTACT AUTHORIZED DISTRIBUTOR FOR DETAILS.

TB2 RELAY OUTPUT
TB2-COM (RELAY COMMON) COMMON FAULT
TB2-COM (RELAY COMMON) COMMON FAULT
TB2-NO (RELAY NORMALLY OPEN) COMMON FAULT
TB2-NC (RELAY NORMALLY CLOSED) COMMON FAULT

NOTE: TB2 RELAY OUTPUT MAY BE REDEFINED - FACTORY DEFAULT LISTED. CONTACT AUTHORIZED DISTRIBUTOR FOR DETAILS. CUSTOMER TO CONNECT TO TB2 UNLESS SHUNT TRIP IS USED. IF SHUNT TRIP IS USED, CUSTOMER TO CONNECT TO DCB2 FOR COMMON FAULT.

APM402 / DEC 3000 ACCESSORIES

UNLESS OTHERWISE SPECIFIED - 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: .XXX ± .010 ANGLES ± 1/2° .XX ± .020 SURFACE FINISH .X ± .060 MAX. FRACTIONS ±

APPROVALS	DATE
DRAWN CRS	9-16-10
CHECKED DFS	9-16-10
APPROVED CRS	9-16-10

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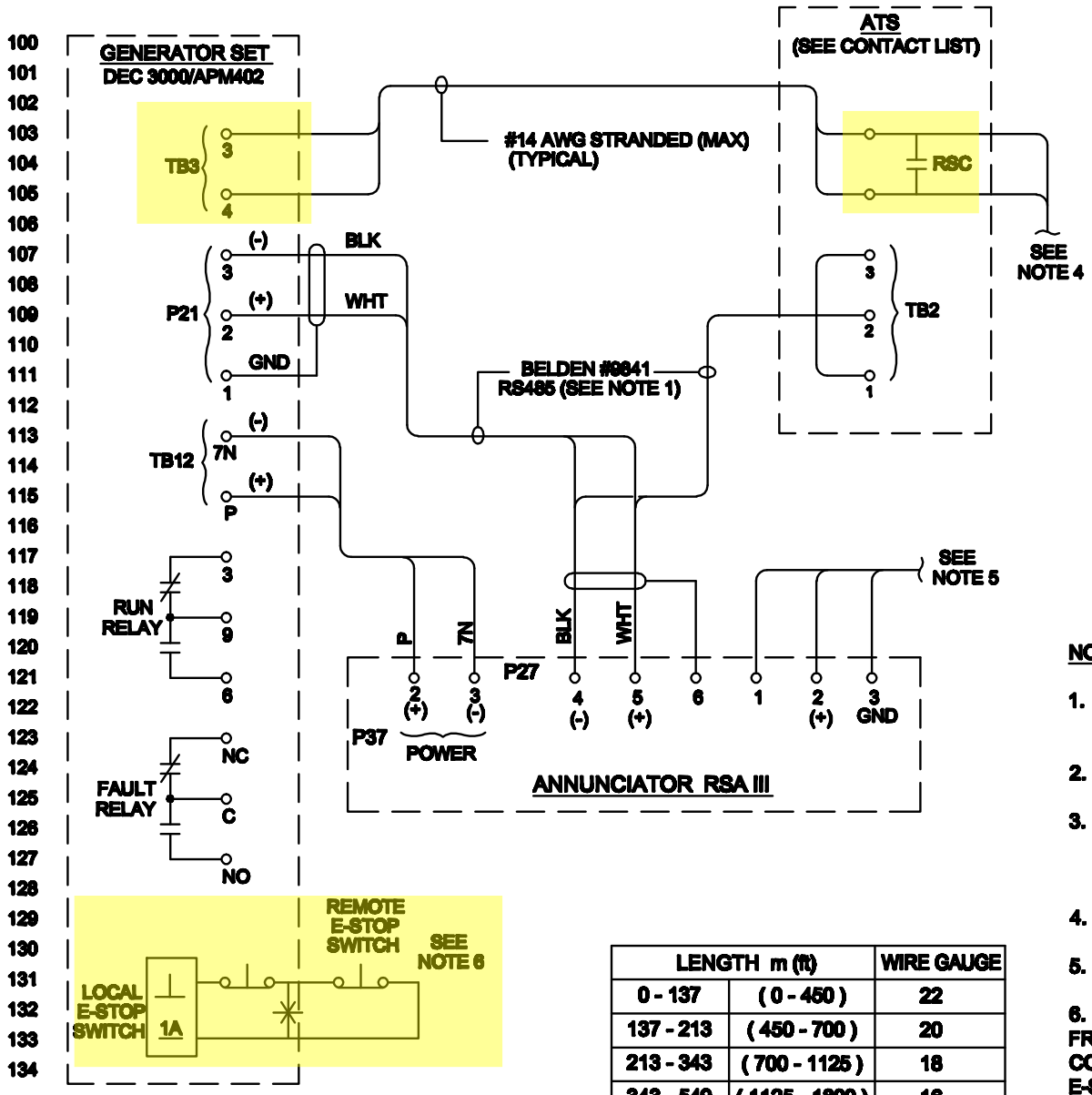
TITLE: DIAGRAM, DEC3000/APM402 ACCY INTERCONNECTION
SCALE: /// DWG NO. SHEET 1-2
PLOTTED: DWG NO. GM78246 D

REVISIONS				
REV	DESCRIPTION	DWN	DATE	APPD
1	INITIAL RELEASE	MAB	05/09/14	P.C.
2	REVISED & UPDATED	MAB	04/03/19	D.B.
3	ADD NOTE 6 & TB3 RELAY	MAB	04/23/19	D.B.



LENGTH m (ft)		WIRE GAUGE
0 - 137	(0 - 450)	22
137 - 213	(450 - 700)	20
213 - 343	(700 - 1125)	18
343 - 549	(1125 - 1800)	16
549 - 853	(1800 - 2800)	14
853 - 1219	(2800 - 4000)	12

WIRE SPECIFICATION FOR THE COMMUNICATION MODULE AND ANNUNCIATOR CONNECTIONS.

KOHLER TRANSFER SWITCH REMOTE START CONTACTS

ATS MODEL	RSC
KCS 30 - 400 (S)	TBF 1 - 2
KCS 600 - 1200	TBF 1 - 2
KCS 1600 - 3000	TBF 1 - 2
KCS 4000	TBF 1 - 2
KCP 150 - 400 (2/3P) (S)	TBF 1 - 2
KCP 150 - 400 (4P) (S)	TBF 1 - 2
KCP 150 - 600 (4P) (B)	TBF 1 - 2
KCP 600 - 1200	TBF 1 - 2
KCP 1600 - 3000	TBF 1 - 2
KCP 4000	TBF 1 - 2
KSS 40 - 260	3 - 4 CONTACTOR ASS'Y
KSS 400 - 600	TB2 3 - 4
KSP 100 - 600 208/240	TB2 3 - 4
KSP 100 - 600 480	TB2 3 - 4

NOTES:

1. RS485 CONNECTORS SUPPLIED. SEE TABLE FOR WIRE SIZE.
2. GENERATOR PHASE ROTATION IS A-B-C.
3. CONTRACTOR TO INSTALL PROPERLY SIZED DUPLEX RECEPTACLE(S) FOR BLOCK HEATER AND BATTERY CHARGER.
4. IF MULTIPLE ATS's CONNECT ALL RSC IN PARALLEL
5. IF MULTIPLE ANNUNCIATORS SEE KOHLER DWG# 62554
6. TO INSTALL REMOTE E-STOP REMOVE THE EXISTING WIRE FROM TB3 1A AND CONNECT IT TO THE REMOTE E-STOP. CONNECT A WIRE FROM THE OTHER SIDE OF THE REMOTE E-STOP TO TB3 1A. ANY ADDITIONAL E-STOPS ARE CONNECTED IN SERIES AS SHOWN.

Kraft Power Corporation
199 WILDWOOD AVENUE
WOBURN, MA 01801

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DWN BY: MAB
DATE: 05/09/14
APPD BY: D.B.
DATE: 04/23/19
DO NOT SCALE DRAWING

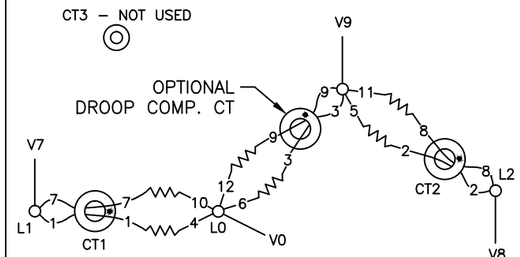
TITLE: TYPICAL FIELD WIRING CONNECTIONS DEC 3000/ATS(1500)/RSA III
SIZE: C | SCALE: NONE | DWG NO.: KPC-1004-FW | REV: 3
COMPUTER FILE NAME: KPC-1004-FW | SHEET 1 OF 1

REV	DATE	REVISION	BY	M F
U	9-14-15	(A-4) DUAL LEADS STATOR NOTE ADDED; SEE SHEET 1, 2, 4,		
		5 & 6 [CT124611]	SVP	
V	3-27-18	SEE SHEET 7 [CT185471]	PAR	
W	7-17-18	SEE SHEETS 6 AND 7 [CT190243]	TLK	
Y	2-13-19	SEE SHEET 8 [CT193706]	RVM	
AA	6-3-19	SEE SHEET 8 [CT196205]	KK	
AB	4-10-19	SEE SHEET 4 [CT199071]	DS	

12 LEAD ALTERNATOR, 3 WIRE, SINGLE PHASE

60 HZ: 100/200V
60 HZ: 120/240V
50 HZ: 100/200V
50 HZ: 110/220V

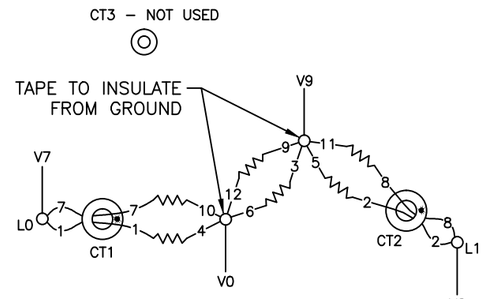
SOME SETS NOT RATED FOR SINGLE PHASE – SEE MANUALS



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 3 WIRE, SINGLE PHASE

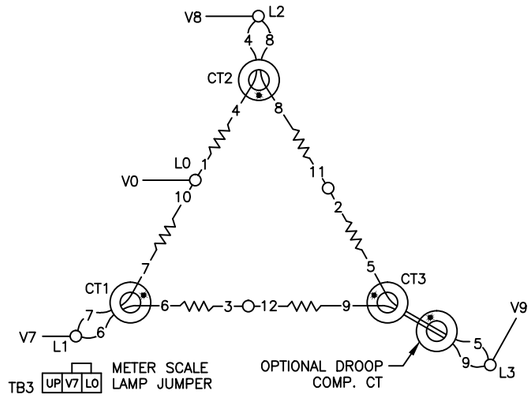
60 HZ: 240V
50 HZ: 220V
(MARINE ONLY)



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, DELTA

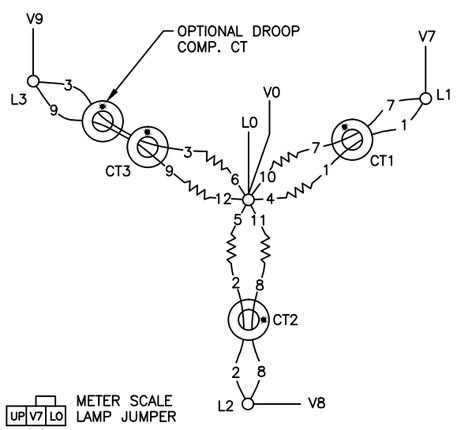
60 HZ: 120/240V
50 HZ: 110/220V



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, LOW WYE

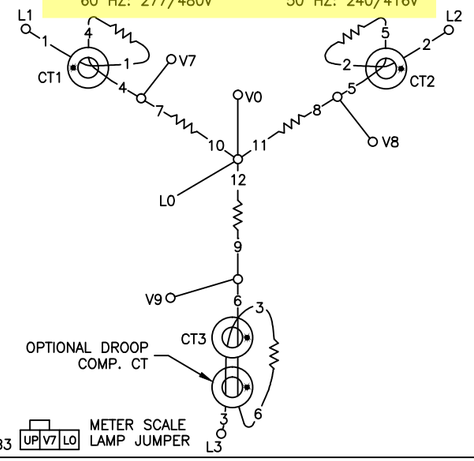
60 HZ: 120/208V
60 HZ: 127/220V
60 HZ: 139/240V
50 HZ: 110/190V
50 HZ: 115/200V
50 HZ: 120/208V



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, HI WYE

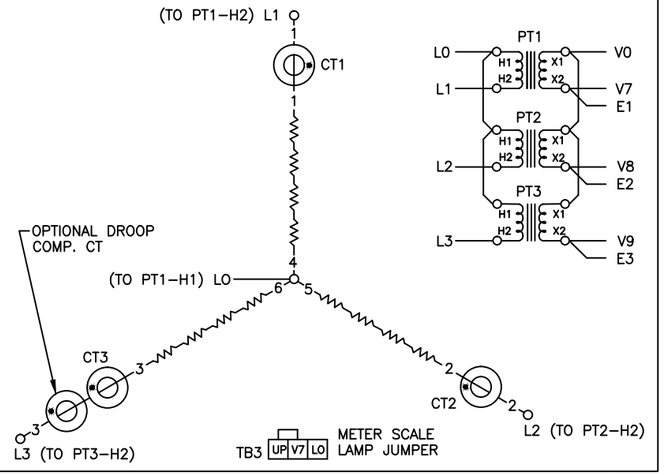
60 HZ: 220/380V
60 HZ: 240/416V
60 HZ: 277/480V
50 HZ: 220/380V
50 HZ: 230/400V
50 HZ: 240/416V



TB3 UP V7 LO METER SCALE LAMP JUMPER

6 LEAD ALTERNATOR, 4 WIRE, WYE

60 HZ: 347/600V



TB3 UP V7 LO METER SCALE LAMP JUMPER

NOTES:
CURRENT TRANSFORMER DOT OR "H1" TOWARD GENERATOR.
CURRENT TRANSFORMERS NOT USED ON ALL SETS.
SOME STATORS HAVE DUAL LEADS. ALWAYS CONNECT LEADS OF THE SAME LABEL TOGETHER.

PHASE ROTATION

A	B	C
L1	L2	L3

3 PHASE
60 (I.M.S.)–300 KW WOUND EXCITER FIELD
600V FRII
ALTERNATORS

UNLESS OTHERWISE SPECIFIED – 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: .XXX± .010 ANGLES± 1/2° .XX ± .030 SURFACE FINISH .X ± .060 FRACTIONS ± MAX.

APPROVALS		DATE
DRAWN	LDS	8-25-98
CHECKED	TLK	6-23-99
APPROVED	JMH	6-23-99

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POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

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TITLE: DIAGRAM, ALTERNATOR CONNECTIONS

SCALE	CAD NO.	SHEET
NONE		3–8
PLOTTED	DWG. NO.	
	ADV–5875	C

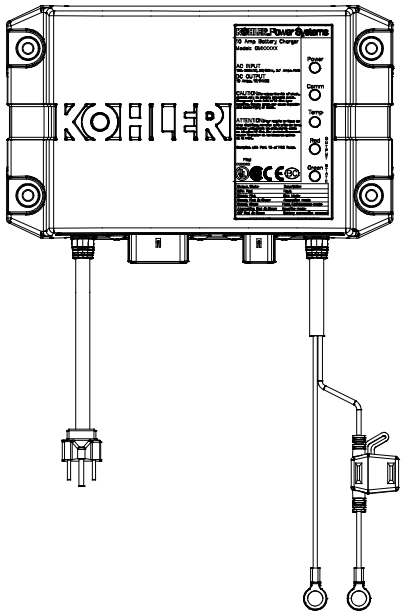
KOHLER®

Generator Accessories

KOHLER

Industrial Generator Set Accessories

12/24 Volt, 10 Amp
Automatic Multi-Stage Battery Charger



The battery charger is a fully-automatic, high efficiency battery charger that charges batteries rapidly and safely. The battery charger is designed for an industrial environment.

The battery charger is designed for operation with an engine cranking battery.

The battery charger is universal voltage input capable, comes with a standard 120 V/60 Hz AC plug, and charges 12 VDC or 24 VDC battery systems.

Five LED lights indicate power, communication status, temperature compensation status, charge curve, and charger status.

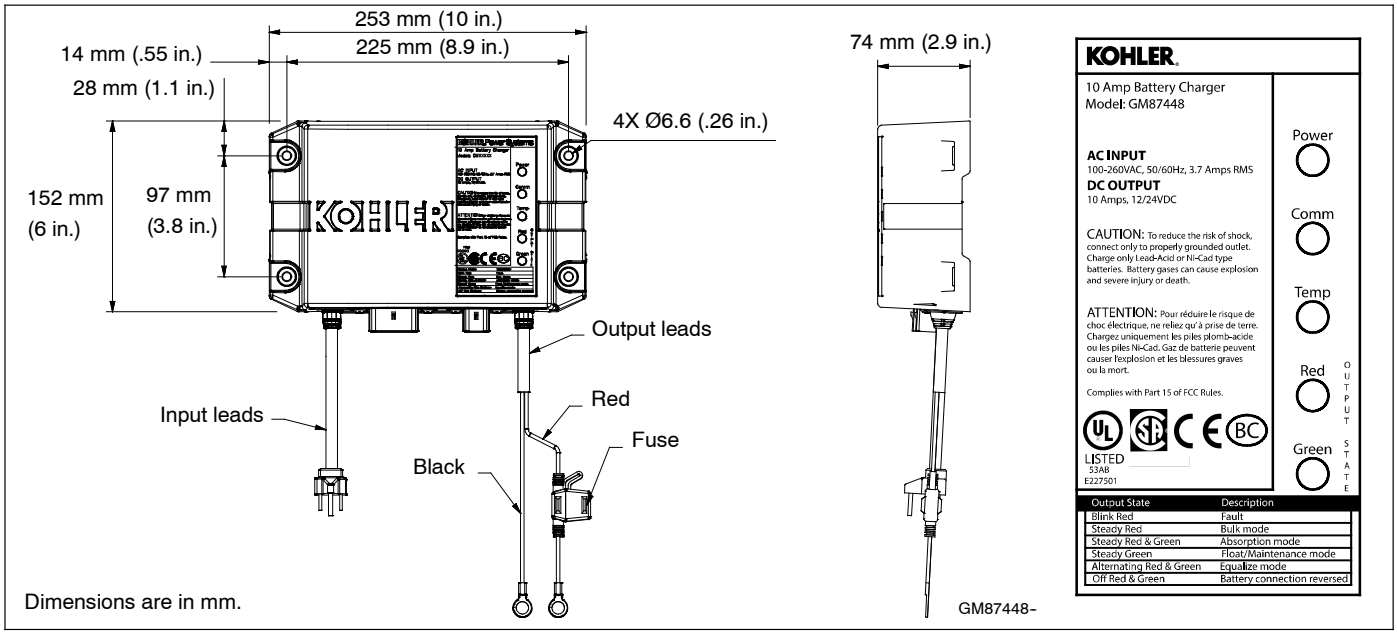
With the optional battery temperature sensor connected, the battery charger can adjust output voltages for optimal charging.

Standard Features

- 12 or 24 VDC output
  - Automatic voltage detection
- Automatic multi-stage charging modes
  - Recovery charge
  - Bulk charge
  - Absorption charge
  - Float charge
  - Equalize charge
- Charges the following type batteries:
  - Flooded lead acid (FLA)
  - AGM
  - Gel cell
  - High performance AGM
  - Nickel-cadmium (NiCad)
- 5 LED status indicators
- Durable potted assembly for waterproofing and vibration resistance
- Reverse-polarity protection
- Short-circuit protection
- Electronically limited output current
- Optional temperature compensation (FLA only)
- User adjustable parameters to support optimal manufacturer recommended charge curve.
- Code compliance:
  - UL 1236 Listed
  - NFPA 110, Level 1 compatible (when used with Kohler controller and connected to engine harness)
  - CSA - C22.2 No. 107.2-01
  - FCC - Title 47, Part 15 Class A
  - CE
  - IBC 2015
  - OSHPD

DC Output		AC Input			Shipping Weight	
Volts (Nominal)	Amps	Volts (Nominal)	Amps	**Overall Dimensions** W x D x H	kgs	lbs
12/24	10	100-260	3.7	253 mm x 152 mm x 74 mm (10.0 in x 6.0 in x 2.9 in)	3.6	7.9

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com



Specifications

AC Input	100–260 VAC
Frequency Input	50/60 Hz
DC Output	10 Amps @ 12 VDC or 10 Amps @ 24 VDC (On battery voltage regulation ±1%; current is electronically limited
Fuse Protection	15 amps ATC
Battery Types	Flooded Lead Acid (FLA) AGM Gel Cell High Performance AGM Nickel–Cadmium (NiCad)
Monitoring	
LED Indications	Power Communication Temperature compensation Output charger curve and charger status: ○ Red ○ Green
Environmental	
Operating	-20° to 70°C (-4° to 158° F)
Storage	-40° to 85°C (-40° to 185° F)
Relative Humidity	5 to 95% (non-condensing)
Salt Spray Testing	ASTM B117
Corrosion Resistant	From battery gases

Enclosure	
Environmental Resistant	From rain, snow, dust, and dripping water
Battery Connections	
Lead Length	1.8 m (6 ft.) red and black leads
Battery Connections	9.5 mm (3/8 in.) ring terminals
AC Power Connections	
Lead Length	1.8 m (6 ft.)
Storage	Standard US style 3-prong AC plug
Available Options	
Temperature compensation	

DISTRIBUTED BY:

Availability is subject to change without notice. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. Contact your local Kohler® generator distributor for availability.

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OVERVIEW:
THE AUTOMATIC MULTI-LEVEL FLOAT/ EQUALIZE CHARGER SPECIFIED BELOW IS INTENDED TO CHARGE ENGINE STARTING BATTERIES EITHER INDEPENDENT OR IN CONJUNCTION WITH AN ENGINE DRIVEN CHARGING SYSTEM.

BATTERY TYPES TO BE CHARGED:
- LEAD ACID
  - AGM
  - GEL CELL
  - HIGH PERFORMANCE AGM
  - FLOODED
- NICKEL CADMIUM (NiCd)

INPUT AC:
- INPUT VOLTAGE: 90-265V SINGLE PHASE
- INPUT FREQUENCY: 47-63 Hz

INPUT LEAD:
APPROXIMATELY 1.8M (72") (REF) TYPE SJTOW -40°C TO 105°C UL RATED WIRE AND INSULATION. TERMINATED IN PRE-MOLDED UL RATED 3 PRONG NEMA 5-15 MALE AC PLUG.

DC OUTPUT:
- 10A @ 12V
- 10A @ 24V
- VOLTAGE REGULATION: +/-1% (VOLTAGE AT EACH STAGE IS TOPOLOGY DEPENDENT)

OUTPUT LEAD:
APPROX. 1.8M (72") (REF) TYPE SJTOOW -40°C TO 105°C UL RATED WIRE WITH RED AND BLACK WIRE INSULATION. TERMINATED IN 9.5 mm (REF) RING STYLE TERMINALS.

FUSES:
THE FUSE MUST BE LOCATED APPROXIMATELY 6" FROM RING TERMINAL ON RED OUTPUT LEAD. 20A ATC

ENVIRONMENTAL:
- STORAGE TEMPERATURE RANGE: -40 TO +85°C (-40 TO +185°F)
- OPERATING TEMPERATURE RANGE: -20 TO +70°C (-4 TO +158°F)
- HUMIDITY: 5 TO 95% (NON-CONDENSING)
- SALT SPRAY TESTING - ASTM B117

CORROSIN RESISTANT FROM GASSING OF BATTERIES

REVERSE POLARITY PROTECTION:
THE CHARGER SHALL SUSTAIN NO DAMAGE WHEN INCORRECTLY CONNECTED TO THE BATTERY IN REVERSE ORIENTATION.

MOUNTING:
4 NON-THREADED THROUGH HOLES FOR M6 FASTENERS TO PASS THOUGH

ENCLOSURE:
SHALL PROTECT THE CHARGER COMPONENTS FROM RAIN, SNOW, DUST AND DRIPPING WATER AND UNINTENTIONAL INPACTS. ALL INTERNAL COMPONENTS PROTECTED FROM WATER DROPLETS.

INDICATORS:
- POWER: INDICATES THE ACCEPTABILITY OF AC INPUT TO THE CHARGER
- COMMUNICATION: INDICATES THE STATE OF THE COMMUNICATION SYSTEM
- TEMPERATURE COMPENSATION: INDICATES THE STATE OF THE TEMPERATUARE COMPENSATION SUBSYSTEM WHEN INSTALLED
- VOLTAGE OUTPUT: INDICATES THE STATE OF THE BATTERY AND CERTAIN FAULT CONDITIONS.

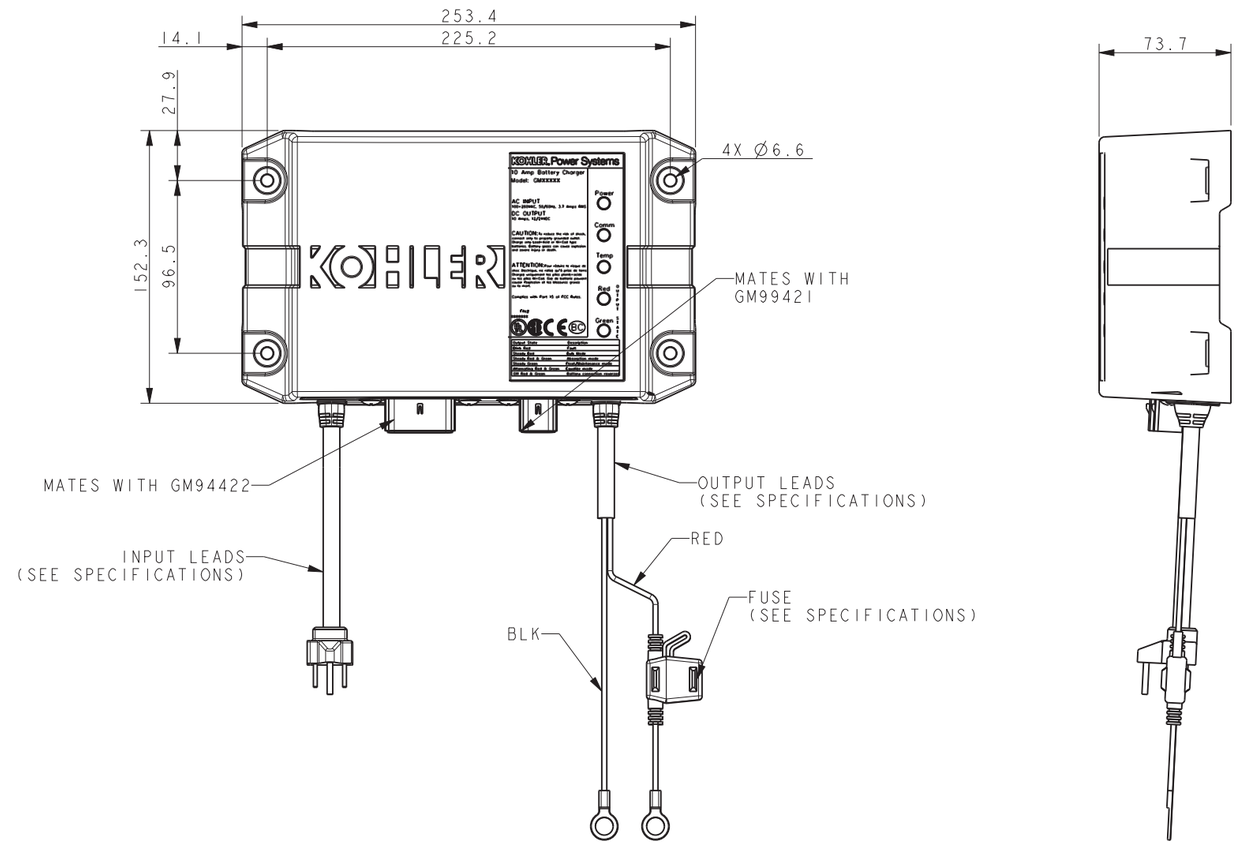
DOCUMENTATION:
THERE SHALL BE AN INSTALLATION / OPERATIONAL MANUAL SUPPLIED WITH EACH CHARGER. PER KOHLER SUPPLIED ARTWORK.

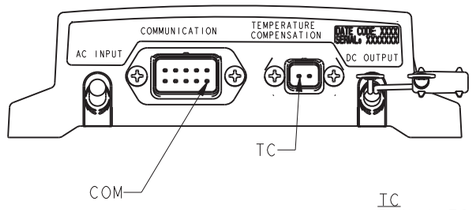
CERTIFICATIONS (US AND CANADA):
- UL1236
- CSA - C22.2 NO 107.2-01
- FCC- TITLE 47, PART 15 CLASS A
- CE
- EN 61000-6-2
- CEC AND DOE
- NFPA-110 LEVEL1 (WHEN SUPPORTED WITH APPLICABLE KOHLER CONTROLLER)
- IBC

PRODUCT LABELING:
THE LABEL ATTACHED TO THE CHARGER SHALL HAVE THE FOLLOWING INFORMATION:
- UL LISTING
- KOHLER PART NUMBER
- DESCRIPTION OF ALL INDICATOR
- OUTPUT CURRENT AND VOLTAGE
- INPUT VOLTAGE AND FREQUENCY

PACKAGING LABEL:
THE PACKAGING LABEL SHALL CONTAIN THE FOLLOWING INFORMATION:
- KOHLER P/N
- DESCRIPTION - BATTERY CHARGER
- MFG. MODEL NO.
- MFG. PART NUMBER
- DATE CODE

WARRANTY:
2 YEAR FROM DATE OF PURCHASE FROM MANUFACTURE.





COM
PIN 1 N/C
2 ID SEL 1
3 ID SEL 2
4 N/C
5 CAN-H
6 N/C
7 ID SEL 1 RTN
8 ID SEL 2 RTN
9 CAN-GND
10 CAN-L

TC
PIN 1 TC SENSOR W1
2 TC SENSOR W2

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	9-22-14	NEW DRAWING [CT91634]	SAM
A	5-9-17	(C-4,2) MATING NOTE ADDED (A-2, 4) PIN CONNECTIONS ADDED [CT174256]	SAM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

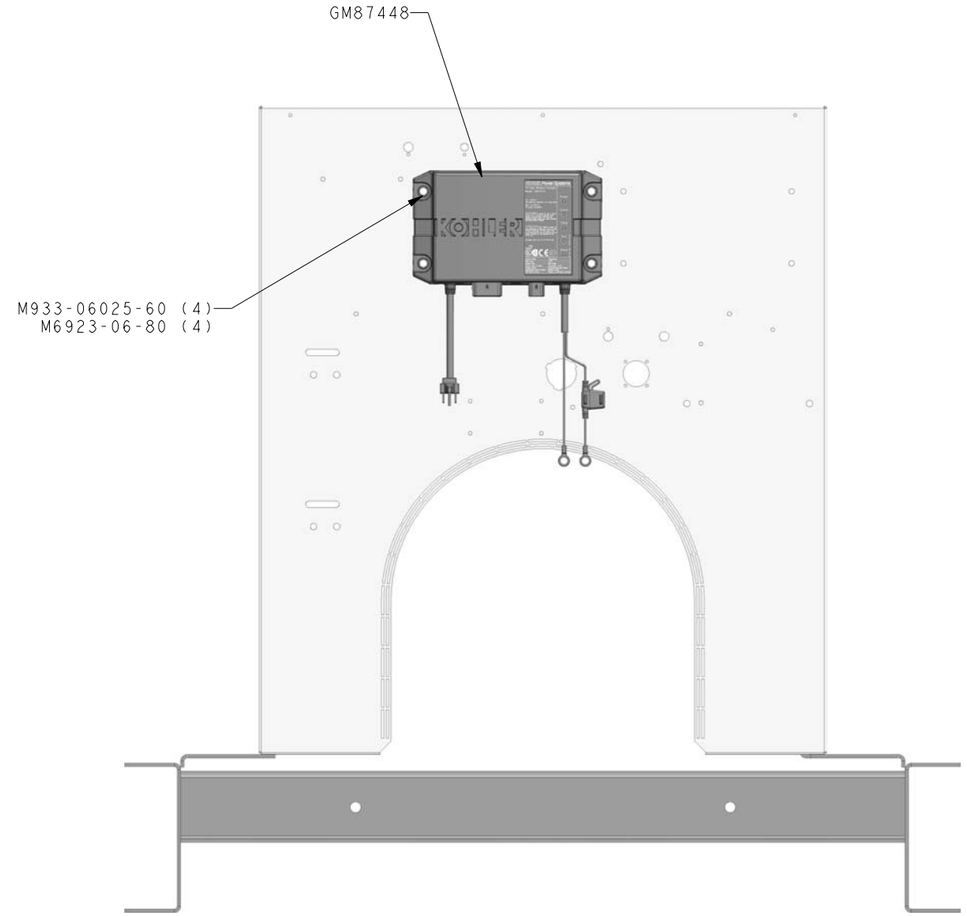
APPROVALS		DATE
DRAWN	SAM	9-22-14
CHECKED	SAM	9-22-14
APPROVED	AGT	9-22-14

KOHLER CO. METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

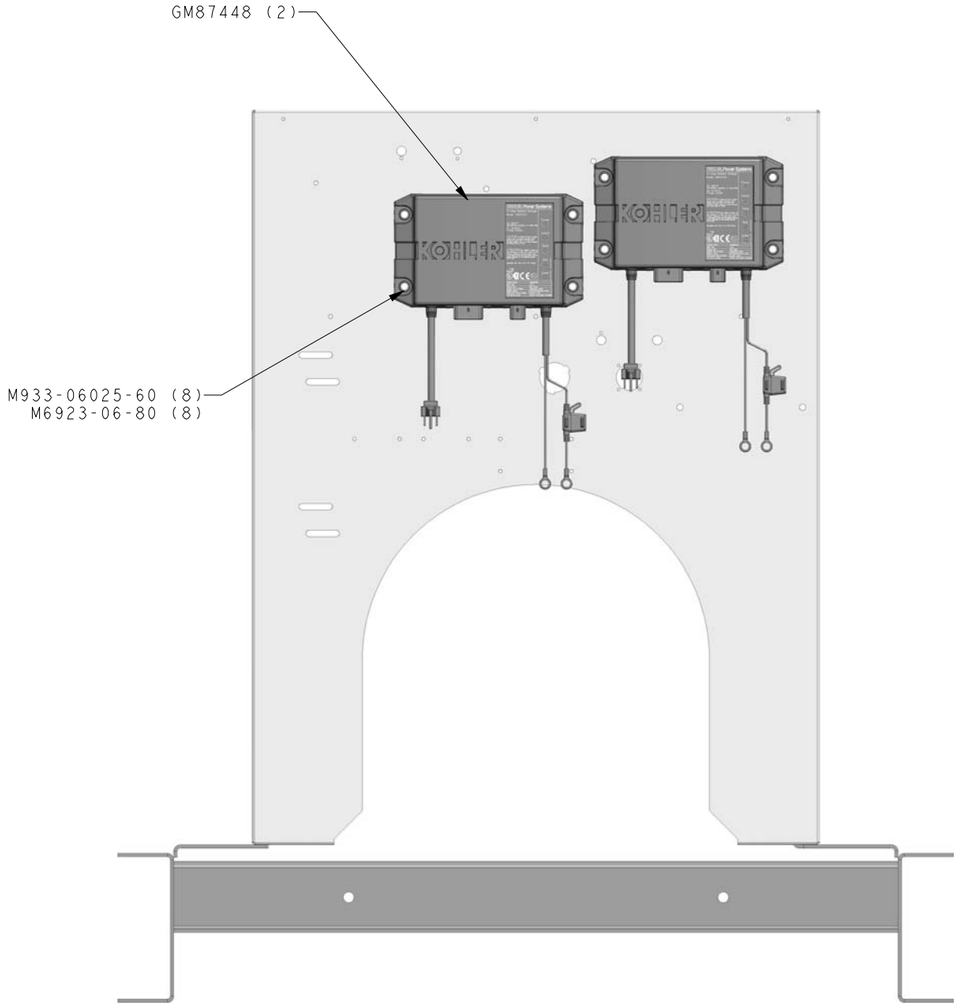
TITLE
CHARGER, BATTERY 10 AMP

SCALE 0.50 | CAD NO. | SHEET 1 of 1
DWG NO. GM87448 | D

KIT NUMBER	VIEW	DESCRIPTION
GM94447-KA1	VIEW 1	BATTERY CHARGER, FLOAT 12V 10A
GM94447-KA2	VIEW 2	BATTERY CHARGER, FLOAT 24V 10A



VIEW 1



VIEW 2

NOTE: FOR PROPER ASSEMBLY METHOD OF HARDWARE, USE G-585 AS A GUIDELINE.

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	9-23-14	NEW DRAWING [CT94502]	SAM

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	SAM	9-23-14
CHECKED	SAM	9-23-14
APPROVED	AGT	9-23-14

KOHLER CO. METRIC PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
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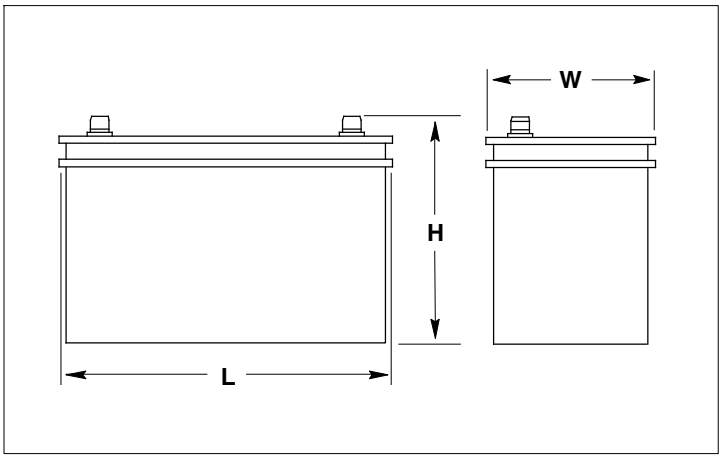
TITLE
DWG, ASSY BATTERY CHARGER

SCALE 0.40 | CAD NO. | SHEET 1 of 1
DWG NO. GM94447 | D

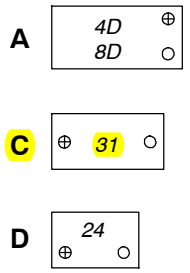
- Kohler Co. selects batteries to meet the engine manufacturer's specifications and to comply with NFPA requirements for engine-cranking cycles.
- Heavy-duty starting batteries are the most cost-effective means of engine cranking and provide excellent reliability in generator set applications.
- Tough polypropylene cases protect against life-shortening vibration and impact damage.
- Batteries are rated according to SAE standard J-537.
- All batteries are 12 volts. Kits that contain two or four 12-volt batteries are available for 24-volt systems and/or systems with redundant starters.
- Wet- and dry-charged batteries have lead-calcium or lead-antimony plates and use sulfuric acid electrolyte. Removable cell covers allow checking of electrolyte specific gravity.
- Absorbent glass mat (AGM) batteries are sealed and maintenance-free.
- Batteries are for applications below and above 0°C (32°F).

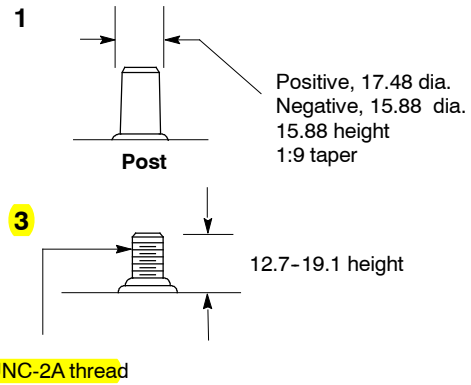
Typical Overall Dimensions



Battery Specifications

Battery Post Layouts (A/C/D) and Styles (1/3)





Notes: Dimensions are in mm; 25.4 mm equals 1 inch. BCI group numbers shown in italics.
Order stud kit 254427 to convert from Style 3 to Style 1.
Battery post layout letters and style numbers match drawing 244578 format.

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

System Battery Specifications

Battery Kit Number	Charge Type*	Battery Part Number	Battery Qty. per Kit	BCI Group Size	Battery SAE Dimensions, mm (in.) L	W	H	Cold Cranking Amps at -18°C (0°F) Minimum	Reserve Capacity Minutes at 27°C (80°F) Minimum	Battery Post Layout and Style
GM22297-KP1	Dry	GM22349	2	8D	527.1 (20.8)	282.4 (11.1)	276.4 (10.9)	1150	400	A/1
GM28546-KP1	Dry	GM22349	4	8D	527.1 (20.8)	282.4 (11.1)	276.4 (10.9)	1150	400	A/1
GM34404-KP1	Wet	GM34399	2	8D	527.1 (20.8)	282.4 (11.1)	276.4 (10.9)	1150	400	A/1
GM34405-KP1	Wet	GM34399	4	8D	527.1 (20.8)	282.4 (11.1)	276.4 (10.9)	1150	400	A/1
PA-225290, 255290	Dry	225289	1	24	273.0 (10.8)	173.0 (6.8)	228.6 (9.0)	650	130	D/1
PA-256985, 256985	Wet	256984	1	24	273.0 (10.8)	173.0 (6.8)	228.6 (9.0)	650	120	D/1
PA-324588, 324588	Wet	324586	2	31	330.2 (13.0)	173.0 (6.8)	239.8 (9.4)	950	185	C/3
PA-324589, 324589	Dry	324587	2	31	330.2 (13.0)	173.0 (6.8)	239.8 (9.4)	950	200	C/3
PA-336071, 336071	Wet	256984	2	24	273.0 (10.8)	173.0 (6.8)	228.6 (9.0)	650	120	D/1
PA-336692, 336692	Wet	324586	1	31	330.2 (13.0)	173.0 (6.8)	239.8 (9.4)	950	185	C/3
PA-354065, 354065	Wet	354147	4	31	330.2 (13.0)	173.0 (6.8)	239.8 (9.4)	700	170	C/3
10702002501-KA1	AGM	10702001800	2	4D	527.1 (20.8)	216.0 (8.5)	258.0 (10.2)	1110	380	A/1
10702002501-KA2	AGM	10702001800	4	4D	527.1 (20.8)	216.0 (8.5)	258.0 (10.2)	1110	380	A/1

* Charge type:
Dry-charged batteries do not contain electrolyte. Supply and add electrolyte per instructions enclosed with each kit.
Wet-charged batteries contain electrolyte and have removable covers.
AGM batteries are sealed and do not require added electrolyte.

NOTE: Battery kit numbers on the Price List may appear with PA- and (loose kit) and/or without PA- (installed kit) for some generator set models. Battery kit numbers with -KP are loose kits. Kit numbers with -KA are factory-installed.

NOTE: 10-20REOD/REODB and 10-20REOZD/REOZDB models: Service kit GM40633 may be required when the original battery is replaced. See Service Bulletin SB-658.

DISTRIBUTED BY:

Availability is subject to change without notice. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. Contact your local Kohler® generator set distributor for availability.

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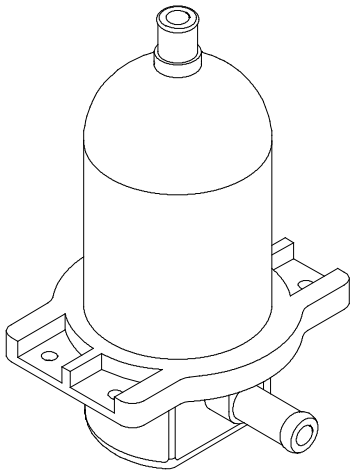
Engine Block Heater Kits



Block Heater Kit, typical

Applicable Models

- KG40- KG125
- KG150- KG200
- KG150R
- 25- 45REZG
- 25- 60REZGB
- 50REZGC/125REZGC/150REZGC
- 50- 60REOZJD
- 50REOZJE
- 80REZGD/100REZGD
- 80RZGD/100RZGD
- 80- 200REOZJF
- 80- 150REOZJG4
- 125RZGC/150RZGC
- 125REOZJG/180REOZJG

Standard Features

- UL- C/US listed
- CE compliant
- Controls for automatic operation
- Compact design
- Easy to install

Description

The engine block heater kit heats the engine coolant in cold ambient, warming the cylinders, oil, and charge air circuit which all help to give a faster starting time. The engine block heater uses thermosiphon action to circulate warm coolant into the engine and supplies constant heating to the engine. The engine block heater kit helps to extend element life and gives a significant reduction in electrical consumption.

The engine block heater kit is recommended for ambient temperatures below 10°C (50°F).

The engine block heater kits are available in 120 V, 240 V, and 277 V versions.

Block Heater Specifications

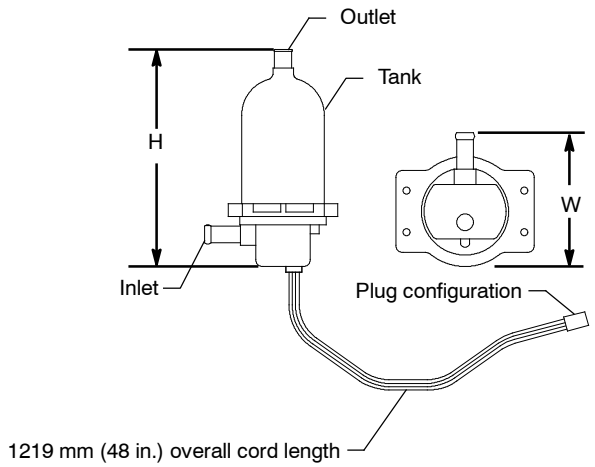
Heating Fluid	Water, Coolant Mix (50% Glycol/50% Water)
Max. Pressure	90 psi (620 kPa)
Heating Element Material	Incoloy 800
Inlet/Outlet Plumbing	0.625 in. hose barb
System Ingress	IP41
Power Connection	NEMA Plug and EURO Plug
Power Chord Length	48 in. (1219 mm)

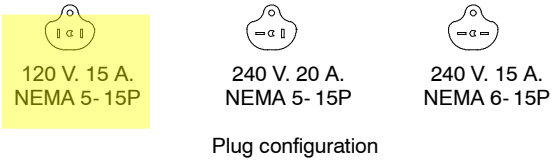
Specifications

Block Heater Kit Number	Component	Watts	Voltage	Phase	Thermostat Temperature	
					ON	OFF
GM58098-KA1	358311	1000	120	1	27°C (80°F)	38°C (100°F)
GM75536-KA1	326228	1500	120	1	49°C (120°F)	60°C (140°F)
GM75555-KA5	GM75552	1800	120	1	27°C (80°F)	38°C (100°F)
GM75555-KA6	GM75553	2000	240	1		
GM75556-KA1	352945	1500	120	1		
GM75557-KA1	352945	1500	120	1		
GM75564-KA1	358311	1000	120	1		
GM75565-KA1	352945	1500	120	1		
GM77944-KA1	352945	1500	120	1		
GM77944-KA2	352946	1500	240	1		
GM85060-KA1	GM75552	1800	120	1		
GM85060-KA2	GM75553	2000	240	1		
GM89427-KA2	GM75552	1800	120	1		
GM91708-KA1	352945	1500	120	1		
GM94248-KA1	352945	1500	120	1		
GM104799-KA1	352945	1500	120	1		
GM105165-KA1	352945	1500	120	1		
GM105165-KA2	352946	1500	240	1		
GM105409-KA1	352945	1500	120	1		
GM105409-KA2	352946	1500	240	1		

Dimensions and Weights

Overall Size, H x W, mm (in): 199 x 122 (7.8 x 4.8)
Weight, kg (lb): 0.77 (1.7)

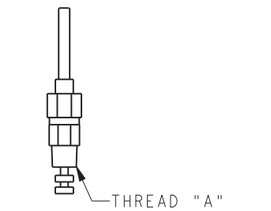




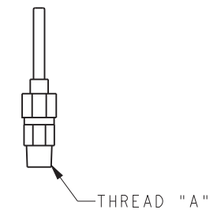
326220- CMP

PART NO.	REV		VOLTS	WATTS	AMPS	THERMOSTAT TYPE/STYLE	REMOTE SENSOR TEMP. RANGE	TANK SENSOR TEMP RANGE	THREAD SIZE "A"	PLUG CONFIG.	LENGTH "B"	CORD TYPE	REMARKS
324930	W		120	1800	15.0	IN BLOCK/B	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	1/2 NPT	FIG-2	1575 [62.0]	1	-
324931	W		240	2000	8.3	IN BLOCK/B	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	1/2 NPT	FIG-3	1575 [62.0]	1	-
326220	W		120	1000	8.3	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	5/8-18 UNF 2A	FIG-1	1372 [54.0]	1	-
326221	W		240	1000	4.2	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	5/8-18 UNF 2A	FIG-3	1372 [54.0]	1	-
326222	W		120	1000	8.3	IN HOSE/C	27°/38°C[80°/100°F]	38°/49°C[100°/120°F]	-	FIG-1	1372 [54.0]	1	-
326224	Z		240	1000	4.2	IN HOSE/C	27°/38°C[80°/100°F]	38°/49°C[100°/120°F]	-	FIG-3	1372 [54.0]	1	-
326228	W		120	1500	12.5	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	1/2 NPT	FIG-1	1372 [54.0]	1	-
326229	W		240	1500	6.3	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	1/2 NPT	FIG-3	1372 [54.0]	1	-
326234	W		120	1800	15.0	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	1/2 NPT	FIG-2	1575 [62.0]	1	-
326235	W		240	2000	8.3	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	1/2 NPT	FIG-3	1575 [62.0]	1	-
326247	W		120	1500	12.5	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	5/8-18 UNF 2A	FIG-1	1372 [54.0]	1	-
326248	W		240	1500	6.3	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	5/8-18 UNF 2A	FIG-3	1372 [54.0]	1	-
336703	W		120	1500	12.5	IN HOSE/C	16°/27°C[60°/80°F]	38°/49°C[100°/120°F]	-	FIG-1	1372 [54.0]	1	-
352945	Y		120	1500	12.5	-	-	27°/38°C[80°/100°F]	-	FIG-1	1524 [60.0]	2	IN-BASE SENSING UNIT ONLY
352946	W		240	1500	6.3	-	-	27°/38°C[80°/100°F]	-	FIG-3	1219 [48.0]	2	IN-BASE SENSING UNIT ONLY
358311	Y		120	1000	8.3	-	-	27°/38°C[80°/100°F]	-	FIG-1	-	2	IN-BASE SENSING UNIT ONLY
358327	W		240	1000	4.2	-	-	27°/38°C[80°/100°F]	-	FIG-3	-	2	IN-BASE SENSING UNIT ONLY
GM23005	W		120	1800	15.0	IN BLOCK/D	27°/38°C[80°/100°F]	49°/60°C[120°/140°F]	28-1.25 6g METRIC	FIG-2	762 [30.0]	1	-
GM23006	W		240	2000	8.3	IN BLOCK/D	27°/38°C[80°/100°F]	49°/60°C[120°/140°F]	28-1.25 6g METRIC	FIG-3	762 [30.0]	1	-
GM24947	W		240	2000	8.3	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	M14-1.5 METRIC	FIG-3	1575 [62.0]	1	-
GM24948	W		120	1800	15.0	IN BLOCK/A	38°/49°C[100°/120°F]	49°/60°C[120°/140°F]	M14-1.5 METRIC	FIG-2	1575 [62.0]	1	-
GM28585	W		120	1000	8.3	-	-	27°/38°C[80°/100°F]	-	FIG-1	-	2	CORD THERMOSTAT [40°/60°F]
GM31942	Y		120	1000	8.3	IN BLOCK/A	27°/38°C[80°/100°F]	49°/60°C[120°/140°F]	1/2 NPT	FIG-1	1372 [54.0]	1	-
GM31943	Y		240	1000	4.2	IN BLOCK/A	27°/38°C[80°/100°F]	49°/60°C[120°/140°F]	1/2 NPT	FIG-3	1372 [54.0]	1	-
GM62682	Y		120	1000	8.3	-	-	27°/38°C[80°/100°F]	-	FIG-4	-	3	-
GM75552	AA		120	1800	15.0	-	-	27°/38°C[80°/100°F]	-	FIG-2	-	2	IN-BASE SENSING UNIT ONLY
GM75553	AA		240	2000	8.3	-	-	27°/38°C[80°/100°F]	-	FIG-3	-	2	IN-BASE SENSING UNIT ONLY
GM83980	AD		120	1000	8.3	-	-	16°/27°C[60°/80°F]	-	FIG-1	1524 [60.0]	2	IN-BASE SENSING UNIT ONLY INCLUDES THERMOSTAT TEMPERATURE DECAL
GM83981	AB		120	1500	12.5	-	-	16°/27°C[60°/80°F]	-	FIG-1	1219 [48.0]	2	IN-BASE SENSING UNIT ONLY INCLUDES THERMOSTAT TEMPERATURE DECAL
GM95436	-		120	500	4.2	-	-	27°/38°C[80°/100°F]	-	FIG-1	-	2	IN-BASE SENSING UNIT ONLY
GM95437	-		240	500	2.1	-	-	27°/38°C[80°/100°F]	-	FIG-3	-	2	IN-BASE SENSING UNIT ONLY
GM103846	-		120	1800	15.0	-	-	16°/27°C[60°/80°F]	-	FIG-2	-	2	IN-BASE SENSING UNIT ONLY

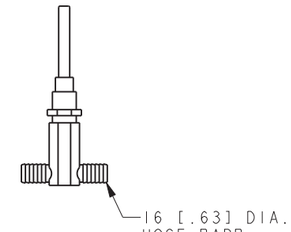
THIS IS AN MANUAL TABLE.



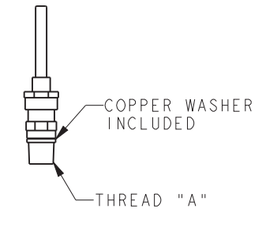
STYLE A IN-BLOCK THERMOSTAT



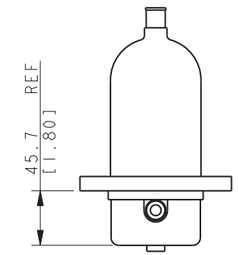
STYLE B IN-BLOCK THERMOSTAT

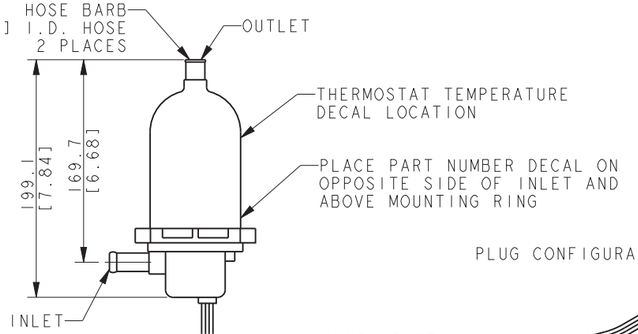


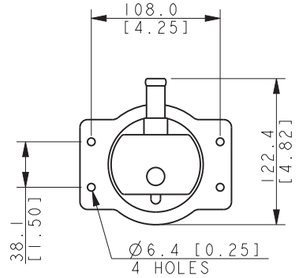
STYLE C IN-HOSE THERMOSTAT

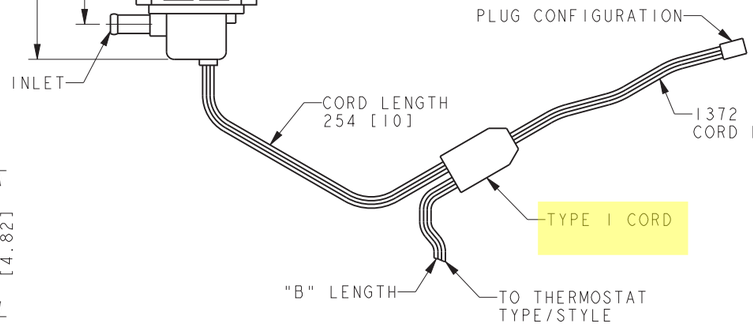


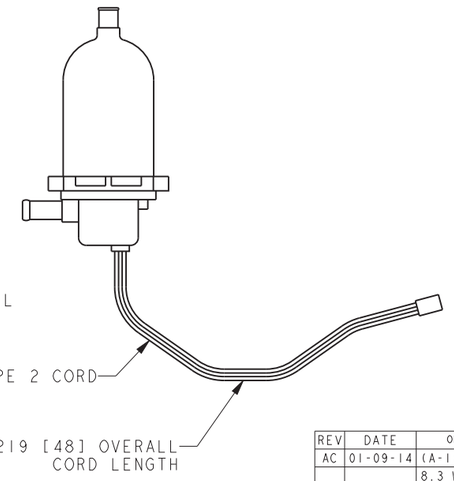
STYLE D IN-BLOCK THERMOSTAT

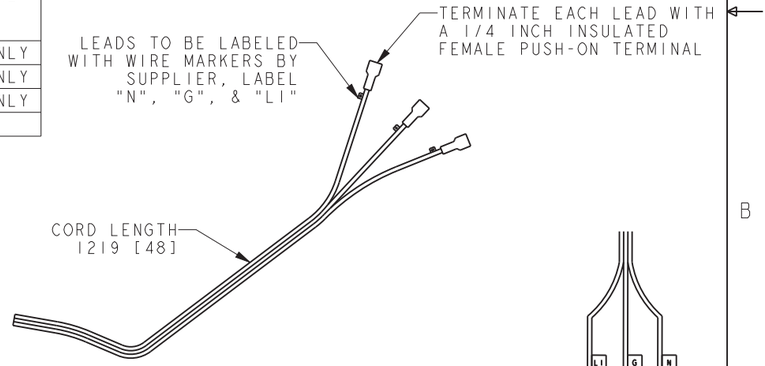












120 V. 15 A. NEMA 5-15P
FIGURE 1

120 V. 20 A. NEMA 5-20P
FIGURE 2

240 V. 15 A. NEMA 6-15P
FIGURE 3

120 V. 15 A.
FIGURE 4

PLUG CONFIGURATION

VALUES IN [ ] ARE ENGLISH EQUIVALENTS.

☐ INDICATES PART NUMBERS AFFECTED BY LATEST REVISION

REVISION BLOCK INDICATES REVISION LEVEL OF DRAWING NOT PART REVISION. SEE PART REVISION LEVEL BEHIND PART NUMBER FOR CURRENT PART REVISION LEVEL.

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
AC	01-09-14	(A-1) 326220-CMP WAS 326220; (C-8) 358311 AMPS	
		8.3 WAS 4.2; GM31942 AMPS 8.3 WAS 12.5; GM31943	
		AMPS 4.2 WAS 6.3; GM62682 AMPS 8.3 WAS 4.2;	
		GM83980 AMPS 8.3 WAS 4.2; (D-4) 352945 "LENGTH	
		1524 WAS 1219" [CT68393]	PAS
AD	3-11-14	(C-4) GM83980 "LENGTH" 1524 WAS 1219 [CT74793]	JMR
AE	11-12-14	(B-8) GM95436 AND GM95437 ADDED [CT99196]	DRA
AF	8-10-17	(B-8) GM103846 ADDED [CT177684]	SAM
AG	4-10-19	(B-4) "CORD TYPE 2" ADDED FOR GM95436 & GM95437 [CT194828]	PAS

UNLESS OTHERWISE SPECIFIED - 1) DIMENSIONS ARE IN MILLIMETERS 2) TOLERANCES ARE: X.XX ± 0.25, X.X ± 1.0, X ± 1.5, ANGLES ± 0° 30' — SURFACE FINISH MAX. — THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	SAM	9-22-11
CHECKED	CF	9-22-11
APPROVED	CF	9-22-11

KOHLER CO. METRIC PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

THIS DRAWING IN DESIGN AND DETAIL IS KOHLER CO. PROPERTY AND MUST NOT BE USED EXCEPT IN CONNECTION WITH KOHLER CO. WORK. ALL RIGHTS OF DESIGN OR INVENTION ARE RESERVED.

TITLE: DWG, HEATER, BLOCK

SCALE 0.40 | CAD NO. | SHEET 1 of 1

DWG NO. 326220-CMP | D

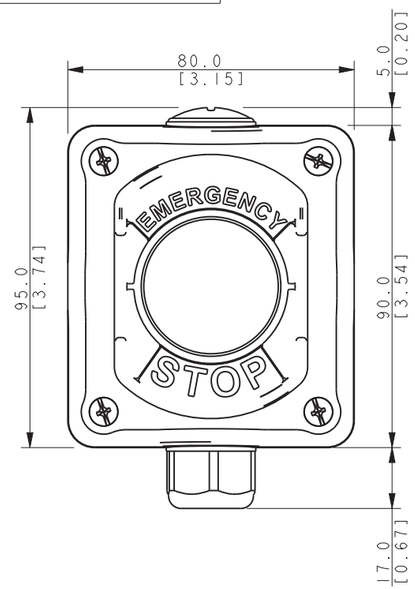
GROUP NO.	ITEM	PART NO	QTY	DESCRIPTION
GM75536-KB				BASE GRP, BLOCK HEATER
	1	25450-00062	1.67FT	HOSE, .63 I.D.
	2	X-312-46 (REF)	1	HOSE, COOLANT
	3	25450-00062	1.83FT	HOSE, .63 I.D.
	4	X-312-5 (REF)	1	HOSE .63 I.D.
	5	227642	1	ELBOW, STREET (45 DEG X 1/2"NPT)
	6	273692	2	ADAPTER, BUSHING
	7	273693	2	O-RING (1.475" ID)
	8	279047	1	TAG, HANG
	9	GM11694	1	O-RING, ISO 6149 (15.3MM ID)
	10	GM22991	1	BUSHING, ADAPTER
	11	GM64285	1	BRACKET, BLOCK HEATER MTG.
	12	M125A-06-80	2	WASHER, PLAIN 6.4 ID X 12.0 OD
	13	M125A-08-80	2	WASHER, PLAIN 8.4 ID X 16.0 OD
	14	M6923-06-80	2	NUT, HEX 6MM
	15	M6923-08-80	2	NUT, HEX 8MM
	16	M933-06020-60	2	SCREW, HEX CAP
	17	M933-08020-60	2	SCREW, HEX CAP
	18	X-211-1	1	ELBOW, STREET(90 DEG X 1/2"NPTF)
	19	X-426-10	4	CLAMP, HOSE, .5/1 IN.
	20	X-582-1	2	CONNECTOR, HOSE 5/8" X 1/2" MIP BRASS
GM75536-KA1				BLOCK HEATER 120V
	21	326228	1	HEATER, BLOCK (120V, 1500W)
GM75536-KA2				BLOCK HEATER 240V
	21	326229	1	HEATER, BLOCK (240V, 1500W)

THIS IS AN AUTOMATED TABLE. ALL UPDATES MUST BE MADE IN THE ASSEMBLY.

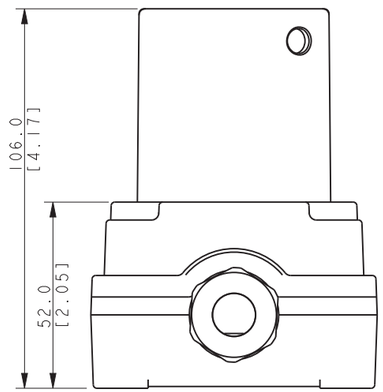
NOTE:
ATTACH
POWER

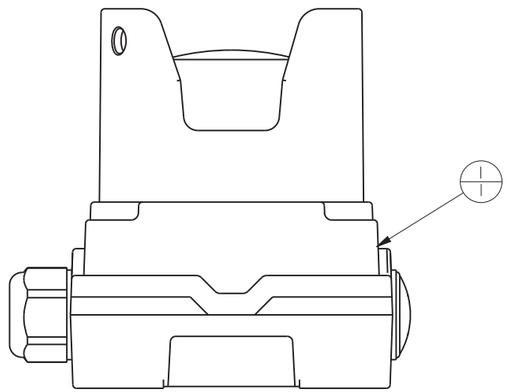
KIT NO.	ITEM	PART NO	QTY	DESCRIPTION
GM103743				E-STOP, NEC REMOTE
	1	GM103743-1	1	E-STOP W/ YELLOW SHROUD, LOTO
	2	GM103743-2	4	#10 X 1.25□ Sheetmetal Screw
	3	GM103743-3	1	TERMINAL, FAST-ON, MALE, 18-22 AWG
	4	GM103743-4	1	TERMINAL, FAST-ON, FEMALE, 18-22 AWG
	5	GM103743-5	2	TERMINAL, SPADE, 22-16 AWG
	6	GM103743-6	1	LITERATURE, TT-1736

THIS IS AN AUTOMATED TABLE. ALL UPDATES MUST BE MADE IN THE ASSEMBLY.



SCALE 1.50





NOTE:

DIMENSIONS IN [ ] ARE IN INCH EQUIVALENTS.

SCREWS AND TERMINALS ARE TO BE BAGGED AND PLACED IN THE BOX

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	2-12-18	NEW DRAWING [CT176728]	CCL

UNLESS OTHERWISE SPECIFIED :-
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX.

THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	CCL	2-12-18
CHECKED	KJB	2-12-18
APPROVED	KJB	2-12-18

KOHLER CO. METRIC | PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

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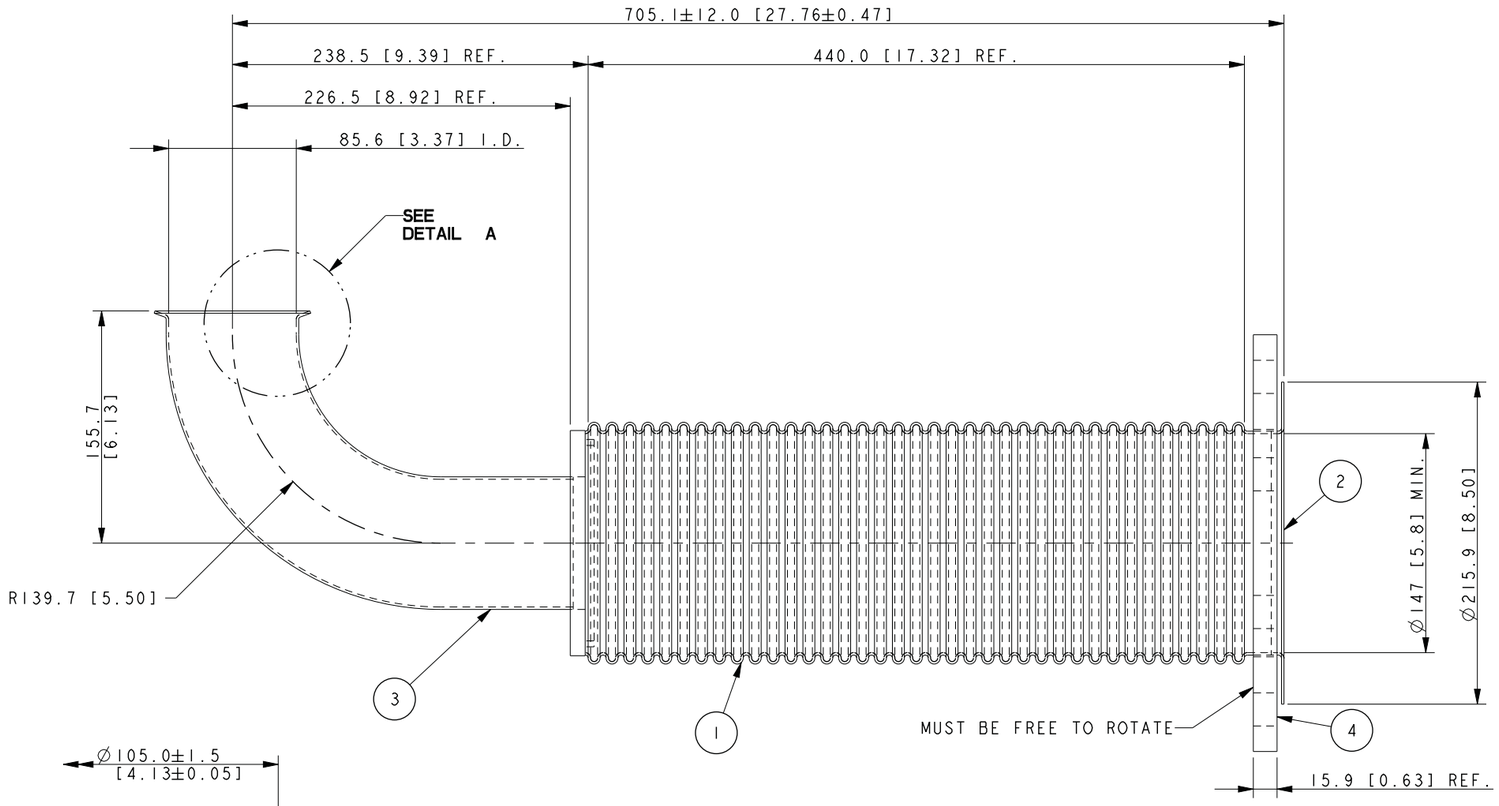
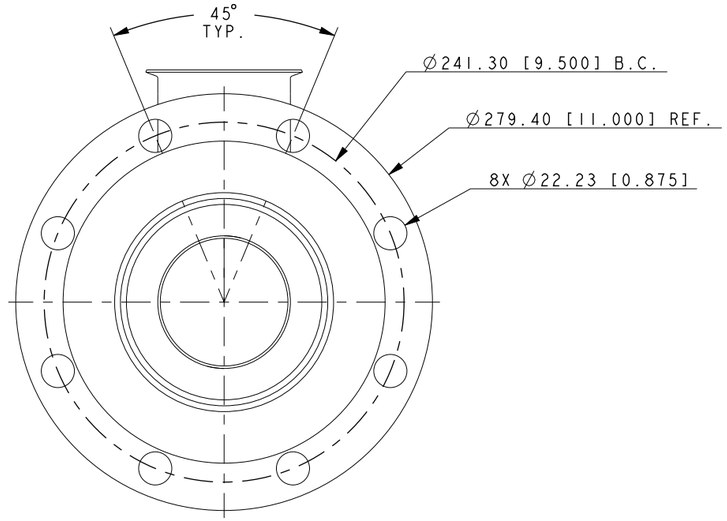
TITLE

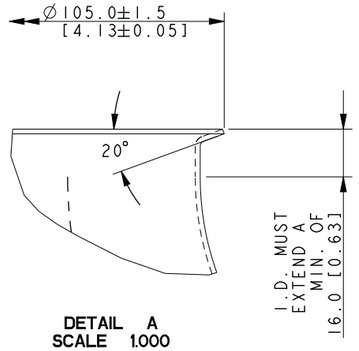
E-STOP, NEC REMOTE

SCALE 1.50 | CAD NO. | SHEET 1 of 1

DWG NO. GM103743 | D







DETAIL A
SCALE 1.000

NOTES:
ALL NON-STAINLESS STEEL COMPONENTS MUST BE COATED TO PREVENT RUST . HIGH TEMP BLACK PAINT COATING MUST BE ABLE TO WITHSTAND 649°C [1200°F]

PIPE AND FLANGE MUST BE SECURED TO EACH OTHER FOR RE-SHIPMENT.

DIMENSIONS IN [ ] ARE ENGLISH UNITS.

MATERIAL: NOTED.

ITEM	QTY	DESCRIPTION
4	1	152.4 [6.0 IN] ANSI FLANGE
3	1	88.9 [3.5 IN] O.D. CARBON STEEL ELBOW
2	1	CARBON STEEL TUBE 1.65 [.065 IN] WALL THICKNESS
1	1	152.4 [6 IN] T-321 STAINLESS STEEL EXHAUST FLEX

125/150 KW MODELS
JOHN DEERE 6068 HF TIER III

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	3-29-10	NEW DRAWING. [89099]	GFR

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH 125 MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	GFR	3-29-10
CHECKED	JMS	3-29-10
APPROVED	ALC	3-29-10

KOHLER CO. METRIC | PRO-E
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.
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TITLE
TUBE, FLEXIBLE EXHAUST

SCALE 0.50 | CAD NO. | SHEET 1 of 1
DWG NO. GM70064 | D

KOHLER®

Warranty

Stationary Standby and Prime Power Industrial Generator Set One-Year or Two Thousand (2000)-Hour Limited Warranty

Your Kohler product has been manufactured and inspected with care by experienced craftsmen. If you are the original end user, Kohler Co. warrants, for the period indicated below, each product to be free from defects in materials and workmanship. In the event of a defect in materials or workmanship, Kohler Co. will repair, replace, or make appropriate adjustment at Kohler Co.'s option if the product, upon Kohler Co.'s inspection, is found to be properly installed, maintained, and operated in accordance with Kohler Co.'s instruction manuals. A Kohler distributor, dealer, or authorized service representative must perform startup.

Kohler Product	**Warranty Coverage**
Stationary Standby Generator Set & Accessories	One (1) year from registered startup or two thousand (2000) hours (whichever occurs first). In any event, the warranty period will expire not later than thirty (30) months from the date of shipment from Kohler Co.'s factory.
Stationary Prime Power Generator Set & Accessories	One (1) year from registered startup or two thousand (2000) hours (whichever occurs first). In any event, the warranty period will expire not later than thirty (30) months from the date of shipment from Kohler Co.'s factory.

The following will **not** be covered by the warranty:

1. Normal wear, routine tuneups, tuneup parts, adjustments, and periodic service.
2. Damage, including but not limited to damage caused by accidents, improper installation or handling, faulty repairs not performed by an authorized Kohler service representative, improper storage, or acts of God.
3. Damage caused by operation at speeds, or with fuel, loads, conditions, modifications or installation contrary to published specifications.
4. Damage caused by negligent maintenance such as:
   a. Failure to provide the specified type and sufficient quantity of lubricating oil.
   b. Failure to keep the air intake and cooling fin areas clean.
   c. Failure to service the air cleaner.
   d. Failure to provide sufficient coolant and/or cooling air.
   e. Failure to perform scheduled maintenance as prescribed in supplied manuals.
   f. Failure to regularly exercise the generator set under load (stationary applications only).
5. Original installation charges and startup costs.
6. Starting batteries and the following related expenses:
   a. Labor charges related to battery service.
   b. Travel expenses related to battery service.
7. Additional expenses for repairs performed after normal business hours, i.e. overtime or holiday labor rates.
8. Rental of equipment during the performance of warranty repairs.
9. Removal and replacement of non-Kohler-supplied options and equipment.
10. Non-Kohler replacement parts. Replacement of a failed Kohler part with a non-Kohler part voids the warranty on that part.
11. Radiators replaced rather than repaired.
12. Fuel injection pumps not repaired by an authorized Kohler service representative.
13. Non-Kohler-authorized repair shop labor without prior approval from Kohler Co. Warranty Department.
14. Engine fluids such as fuel, oil, or coolant/antifreeze.
15. Shop supplies such as adhesives, cleaning solvents, and rags.
16. Expenses incurred investigating performance complaints unless the problem is caused by defective Kohler materials or workmanship.
17. Maintenance items such as fuses, lamps, filters, spark plugs, loose or leaking clamps, and adjustments.
18. Travel time and mileage exceeding 300 miles round trip.

To obtain warranty service, call 1-800-544-2444 for your nearest authorized Kohler service representative or write Kohler Co., Service Department, MS072, Kohler, WI 53044 USA.

KOHLER CO. SHALL NOT BE LIABLE FOR SPECIAL, INCIDENTAL, AND/OR CONSEQUENTIAL DAMAGES OF ANY KIND including, but not limited to, incidental and/or consequential labor costs, installation charges, telephone charges, or transportation charges in connection with the replacement or repair of defective parts.

This is our exclusive written warranty. We make no other express warranty nor is anyone authorized to make any on our behalf.

ANY IMPLIED OR STATUTORY WARRANTY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, IS EXPRESSLY LIMITED TO THE DURATION OF THIS WARRANTY. Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental and/or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

KOHLER®

KOHLER CO., Kohler, Wisconsin 53044
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales/service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

TP-5374 12/15f

KOHLER®

Certification

VMC GROUP
THE POWER OF TOGETHER™

KOHLER®

CERTIFICATE OF COMPLIANCE

SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

Certification No.

VMA-45451-01C (Revision 6)

Expiration Date: 10/31/2022

Certification Parameters:

The nonstructural products (mechanical and/or electrical components) listed on this certificate are CERTIFIED[1] FOR SEISMIC APPLICATIONS in accordance with the following building code[2] releases.

IBC 2009, 2012, 2015, 2018

The following model designations, options, and accessories are included in this certification. Reference report number VMA-45451-01 as issued by The VMC Group for a complete list of certified models, included accessories/options, and certified installation methods.

Kohler; Diesel Gensets
REOZJx; 20kW - 500kW

The above referenced equipment is **APPROVED** for seismic application when properly installed[3], used as intended, and contains a Seismic Certification Label referencing this Certificate of Compliance[4]. As limited by the tabulated values, below grade, grade, and roof-level installations, installations in essential facilities, for life safety applications, and/or of equipment containing hazardous contents are permitted and included in this certification with an Equipment Importance Factor assigned as I_p=1.5. The equipment is qualified by successful seismic shake table testing at the nationally recognized University of California Berkeley Pacific Earthquake Engineering Research Center, Curtis-Wright Flow Control Company Qualtech NP (Formerly Trentec), and Clark Dynamic Test Laboratory under the witness of the ISO Accredited Product Certification Agency, The VMC Group.

Certified Seismic Design Levels			
Certified IBC	**Importance $I_p \leq 1.5$** Soil Classes A-E Risk Categories I-IV Design Categories A-F	z/h ≤ 1.0	z/h = 0.0
		$S_{DS} \leq 1.930$ g	$S_{DS} \leq 1.930$ g

Certified Seismic Installation Methods	
Rigid Mounting From Unit Base To Rigid Structure	Rigid Mounting From Unit Base To Fuel Tank

HEADQUARTERS
113 Main Street
Bloomingdale, NJ 07403
Phone: 973.838.1780
Toll Free: 800.569.8423
Fax: 973.492.8430

CALIFORNIA
180 Promenade Circle
Suite 300
Sacramento, CA 95834
Phone: 916.634.7771

TEXAS
11930 Brittmoore Park Drive
Houston, TX 77041
Phone: 713.466.0003
Fax: 713.466.1355

thevmcgroup.com

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KOHLER®

CERTIFICATE OF COMPLIANCE

SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

Certified Product Table:

Model	Rating Range [kW]	EPA Rating	Configuration	Max L [in.]	Max W [in.]	Max H [in.]	Max Weight [lbs.]
REOZJC	20 - 60	Tier 3	Off Tank	91	42	60	2,566
			On Tank	114		96	4,228
REOZJD	50 - 60		Off Tank	91		60	2,556
			On Tank	114		96	4,228
REOZJE	80 - 275		Off Tank	162	53	85	6,250
			On Tank	210		121	10,330
REOZJF	80 - 200		Off Tank	161		84	5,090
			On Tank	197		120	8,530
REOZJG	125 - 180		Off Tank	161		84	4,250
			On Tank	197		120	7,960
REOZJ	300 - 500	Tier 2, 3	Off Tank	198	70	95	11,525
			On Tank	301	102	138	19,236
REOZJB	350 - 500		Off Tank	233	59	91	11,523
			On Tank	379	102	140	19,420

*Maximum weight and dimensions reflect greatest for open and enclosed. For exact limits please contact the manufacturer.

Group	Type	S_{DS} (z/h=0)	S_{DS} (z/h=1)	A_{Flex-H}	A_{Rig-H}	A_{Flex-V}	A_{Rig-V}	F_p/W_p
Seismic	AC156	1.93	1.93	3.09	2.32	1.29	0.52	1.39

This certification includes the open generator set and the enclosed generator set when installed with or without the sub-base tank. This certification also includes the sub-base tank as a stand-alone accessory. The generator set and included options shall be a catalogue design and factory supplied. The generator set and applicable options shall be installed and attached to the building structure per the manufacturer supplied seismic installation instructions. For a list of certified configurations and options please directly contact the manufacturer. This certification excludes all non-factory supplied accessories, including but not limited to mufflers, isolation/restraint devices, remote control panels, remote radiators, pumps and other electrical/mechanical components.

IBC® CERTIFIED VMC GROUP

VMA-45451-01C (Revision 6)
Issue Date: Tuesday, September 3, 2013
Revision Date: Monday, October 21, 2019
Expiration Date: Monday, October 31, 2022

VMC GROUP
THE POWER OF TOGETHER™

KOHLER®

CERTIFICATE OF COMPLIANCE

SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

Notes & Comments:

1. All equipment listed herein successfully passed the seismic acceptance criteria for shake testing non-structural components and systems as set forth in the ICC AC-156. The Test Response Spectrum (TRS) enveloped the Required Response Spectrum (RRS) for all units tested. The units cited in this certification were representative sample(s) of a contingent of models and all remained captive and structurally sound after the seismic shake simulation. The units also remained functionally operational after the simulation testing as functional testing was completed by the equipment manufacturer before and after the seismic simulations. Although a seismic qualified unit inherently contains some wind resisting capacity, that capacity is undetermined and is excluded from this certification. Snow/Ice loads have been neglected and thus limit the unit to be installed both indoors (covered by an independent protective structure) and out of doors (exposed to accumulating snow/ice) for ground snow loads no greater than 30 psf for all applications.

2. The following building codes are addressed under this certification:
   IBC 2018 referencing ASCE7-16 and ICC-ES AC-156
   IBC 2015 referencing ASCE7-10 and ICC-ES AC-156
   IBC 2012 referencing ASCE7-10 and ICC-ES AC-156
   IBC 2009 referencing ASCE7-05 and ICC-ES AC-156

3. Refer to the manufacturer supplied installation drawings for anchor requirements and mounting considerations for seismic applications. Required anchor locations, size, style, and load capacities (tension and shear) may be specified on the installation drawings or specified by a 3rd party. Mounting requirement details such as anchor brand, type, embedment depth, edge spacing, anchor-to-anchor spacing, concrete strength, special inspection, wall design, and attachment to non-building structures must be outlined and approved by the Engineer of Record for the project or building. Structural walls, structural floors, and housekeeping pads must also be seismically designed and approved by the project or building Structural Engineer of Record to withstand the seismic anchor loads as defined on the installation drawings. The installing contractor is responsible for observing the installation detailed in the seismic installation drawings and the proper installation of all anchors and mounting hardware.

4. For this certificate and certification to remain valid, this certificate must correspond to the "Seismic Certification Label" found affixed to the unit by the factory. The label ensures the manufacturer built the unit in conformance to the IBC seismic design criteria set forth by the Certified Seismic Qualification Agency, The VMC Group, and meets the seismic design levels claimed by this certificate.

5. Mechanical, Electrical, and Plumbing connections to the equipment must be flexibly attached as to not transfer load through the connection. The structural integrity of any conduit, cable trays, piping, ductwork and/or flexible connections is the responsibility of others. This certification does not guarantee the equipment will remain compliant to NEMA, IP, UL, or CSA standards after a seismic event.

6. This certificate applies to units manufactured at:
   Kohler, N7650 Lakeshore Road, Sheboygan, WI 53083

7. This certification follows The VMC Group's ISO-17065 Scheme.

John P. Giuliano, PE
President, The VMC Group

IAS ACCREDITED Product Certification Agency

VMA-45451-01C (Revision 6)
Issue Date: Tuesday, September 3, 2013
Revision Date: Monday, October 21, 2019
Expiration Date: Monday, October 31, 2022

IBC® CERTIFIED VMC GROUP

Certificate of Registration

nqa global assurance

This is to certify that the Quality Management System of:

Kohler Power Systems

N7650 Lakeshore Road
Sheboygan WI 53083
United States of America

Central function listed above. See appendix for additional locations

applicable to:

Design, manufacture, and distributor support for electrical generators, alternators, fuel tanks, automatic transfer switches and switchgear

has been assessed and approved by
National Quality Assurance, U.S.A., against the provisions of:

ISO 9001:2015

Certificate Number:	16852
EAC Code:	19, 17
Certified Since:	February 28, 1995
Valid Until:	November 6, 2021
Reissued:	November 7, 2018
Cycle Issued:	November 7, 2018

For and on behalf of NQA, USA

ANAB ACCREDITED ISO/IEC 17021 MANAGEMENT SYSTEMS CERTIFICATION BODY

G15-152 11/18

This approval is subject to the company maintaining its system to the required standard, which will be monitored by NQA, USA, 289 Great Road, Suite 105, Acton, MA 01720, an accredited organization under the ANSI-ASQ National Accreditation Board.

Certificate of Registration

nqa global assurance

Appendix to Certificate Number: 16852

Includes Facilities Located at:

Kohler Power Systems Certificate Number 16852 N7650 Lakeshore Road Sheboygan WI 53083 United States of America	Design, manufacture, and distributor support for electrical generators, automatic transfer switches and switchgear
Kohler Power Systems Certificate Number 16852 300 N Dekora Woods Blvd. Saukville WI 53080 United States of America	Manufacturer of fuel tanks, skids, fabricated components and generators
Muth Warehouse Certificate Number 16852 2821 Muth Court Sheboygan WI 53083 United States of America	The distribution of generator sets
KWIP Warehouse Certificate Number 16852 4327 County EE Sheboygan WI 53081 United States of America	Receiving, sequencing and warehousing of generator components

Certified Since: February 28, 1995

Valid Until: November 6, 2021

Reissued: November 7, 2018

Cycle Issued: November 7, 2018

This approval is subject to the company maintaining its system to the required standard, which will be monitored by NQA, USA, 289 Great Road, Suite 105, Acton, MA 01720, an accredited organization under the ANSI-ASQ National Accreditation Board.

Kohler Standby/Prime Generator Set Test Program

Testing is an integral part of quality assurance. In keeping with our uncompromising commitment to quality, safety, and reliability, every Kohler Standby/Prime power generator set undergoes an extensive series of prototype and production testing.

Prototype Testing

Prototype testing includes the potentially destructive tests necessary to verify design, proper function of protective devices and safety features, and reliability expectations. Kohler's prototype testing includes the following:

- Alternator temperature rise test per NEMA MG1-32.6. Standby and prime ratings of the alternator are established during this test.
- Maximum power test to assure that the prime mover and alternator have sufficient capacity to operate within specifications.
- Alternator overload test per NEMA MG1-32.8.
- Steady-state load test to ensure voltage regulation meets or exceeds ANSI C84.1, NEMA MG1-32.17 requirements and to verify compliance with steady-state speed control specifications.
- Transient test to verify speed controls meets or exceeds specifications.
- Transient load tests per NEMA MG1-32.18, and ISO 8528 to verify specifications of transient voltage regulation, voltage dip, voltage overshoot, recovery voltage, and recovery time.
- Motor starting tests per NEMA MG1-32.18.5 to evaluate capabilities of generator, exciter, and regulator system.
- Three-phase symmetrical short-circuit test per NEMA MG1-32.13 to demonstrate short circuit performance, mechanical integrity, ability to sustain short-circuit current.
- Harmonic analysis, voltage waveform deviation per NEMA MG1-32.10 to confirm that the generator set is producing clean voltage within acceptable limits.
- Generator set cooling and air flow tests to verify maximum operating ambient temperature.
- Reliability tests to demonstrate product durability, followed by root cause analysis of discovered failures and defects. Corrective action is taken to improve the design, workmanship, or components.
- Acoustical noise intensity and sound attenuation effects tests.

Production Testing

In production, Kohler Standby/Prime generator sets are built to the stringent standards established by the prototype program. Every Kohler generator set is fully tested prior to leaving the factory. Production testing includes the following:

- Stator and exciter winding high-potential test on all generators. Surge transient tests on stators for generators 180 kW or larger. Continuity and balance tests on all rotors.
- One-step, full-load pickup tests to verify that the performance of each generator set, regulator, and governor meets published specifications.
- Regulation and stability of voltage and frequency are tested and verified at no load, 1/4 load, 1/2 load, 3/4 load, and full-rated load.
- Voltage, amperage, frequency and power output ratings verified by full-load test.
- The proper operation of controller logic circuitry, prealarm warnings, and shutdown functions is tested and verified.
- Any defect or variation from specification discovered during testing is corrected and retested prior to approval for shipment to the customer.

Torsional analysis data, to verify torsional effects are not detrimental and that the generator set will provide dependable service as specified, is available upon request.

Kohler offers other testing at the customer's request at an additional charge. These optional tests include power factor testing, customized load testing for specific application, witness testing, and a broad range of MIL-STD-705c testing. A certified test report is also available at an additional charge.

KOHLER®

KOHLER CO. Kohler, Wisconsin 53044
Phone 920-565-3381, Fax 920-459-1646
For the nearest sales/service outlet in the US and Canada, phone 1-800-544-2444
KohlerPowerSystemscom

G18-56 12/05b

KOHLER®

Transfer Switch Spec Sheets

Model KEP-DMTA-0400S-NK

KOHLER®

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

Transfer Switch Standard Features

- Service entrance automatic transfer switches incorporate an isolating mechanism and overcurrent protection on the utility supply, eliminating the need to have a separate, upstream utility source circuit breaker/ disconnect switch
- UL 1008 listed, file #58962
- IBC seismic certification available
- Fully enclosed silver alloy contacts provide high withstand rating
- 3-cycle short circuit current withstand-tested in accordance with UL 1008
- Completely separate utility and generator set power switching units provide redundancy (no common parts) and are easy to service
- Utility disconnect power switching units have overcurrent protection; generator disconnect is available with or without overcurrent protection
  - Molded case circuit breakers (MCCB) include thermal magnetic or electronic trip overcurrent protection (80% rated)
  - Molded case switches (MCSW) do not include overcurrent protection (100% rated) (available on generator disconnect only)
  - Insulated case circuit breakers (ICCB) include elecronic trip overcurrent protection (100% rated)
  - Insulated case switches (ISCW) do not include overcurrent protection (100% rated) (available on generator disconnect only)
- Inherent stored-energy design prevents damage if manually switched while in service
- Heavy duty brushless gear motor and operating mechanism provide mechanical interlocking and extreme long life with minimal maintenance
- Safe manual operation permits easy operation even under adverse conditions
- All mechanical and control devices are visible and readily accessible
- Padlockable service disconnect control switch
- Status indicators
- Two-position control circuit isolation switch disconnects utility power to the transfer switch controller
- Load shed (Forced transfer from Emergency to OFF). (Customer-supplied signal {contact closure} is required for the forced transfer to OFF function.)
- NEMA 1, 3R, 4X and 12 enclosures are availalble

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Service Disconnect Switch

- Service disconnect to OFF position
- Two-position switch with padlockable cover disconnects the normal source and emergency sources
- Controller display show Service Disconnected and the NOT IN AUTO LED flashes
- Lamp illuminates to indicate that the switch is in the DISCONNECT position

Decision-Maker® MPAC 1500 Controller

- LCD display, 4 lines x 20 characters, backlit
- Complete programming and viewing capability at the door using the keypad and LCD display
- LED indicators: Source available, transfer switch position, service required (fault), and "not in auto"
- Modbus communication is standard
- Programmable voltage and frequency pickup and dropout settings
- Programmable time delays
- Programmable generator exerciser
- Time-based load control
- Current-based load control (current-sensing kit required)
- Two programmable inputs and two programmable outputs (one programmable input and one programmable output are used for factory connections on these models are are not available for customer connection)
- Up to four I/O extension modules available
- RS-485 communication standard
- Ethernet communication standard
- Threee-source system
- Prime power

For more information about Decision-Maker® MPAC 1500 features and functions, see specification sheet G11-128.

Codes and Standards

The ATS meets or exceeds the requirements of the following specifications:

- EN6100-4-4 Fast Transient Immunity Severity Level 4
- EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
- EIC Specifications for EMI/EMC Immunity:
  - CISPR 11, Radiated Emissions
  - IEC 1000–4–2, Electrostatic Discharge
  - IEC 1000–4–3, Radiated Electromagnetic Fields
  - IEC 1000–4–4, Electrical Fast Transients (Bursts)
  - IEC 1000–4–5, Surge Voltage
  - IEC 1000–4–6, Conducted RF Disturbances
  - IEC 1000–4–8, Magnetic Fields
  - IEC 1000–4–11, Voltage Dips and Interruptions
- IEC 60947-6-1, Low Voltage Switchgear and Control Gear; Multifunction Equipment; Automatic Transfer Switching Equipment
- IEEE Standard 446, IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- IEEE 472 (ANSI C37.90A) Ring Wave Test
- NEMA Standard ICS 10-2005, Electromechanical AC Transfer Switch Equipment
- NFPA 70, National Electric Code
- NFPA 99, Essential Electrical Systems for Health Care Facilities
- NFPA 110, Emergency and Standby Power Systems
- Underwriters Laboratories UL 1008, Standard for Automatic Transfer Switches for Use in Emergency Standby Systems file #58962

Application Data

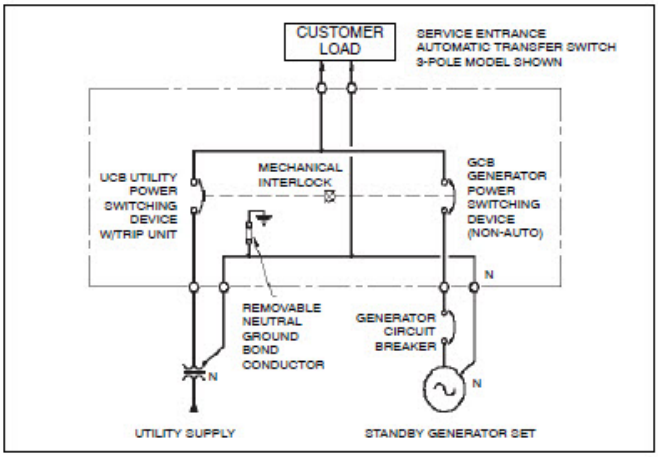
Environmental Specifications	
Operating Temperature	-15°C to 50°C (5°F to 122°F)
Storage Temperature	-20°C to 70°C (-4°F to 158°F)
Humidity	95% noncondensing

Ratings

Interrupting Capacity Current Rating With Integral Overcurrent Protection* (No upstream circuit breaker protection required)				
			Amps RMS	
Power Switching Device	Switch Rating, Amps	Voltage, Max.	Amps RMS @ 240 V	Amps RMS @ 480 V

Molded Case	0400	0600	65,000	50,000
With molded case/insulated case switching devices equipped with integral overcurrent protection.				

Typical Single-Line Diagram



Cable Sizes

Cable Sizes, Al/Cu Wire				
Model	Amps	Circuit Breaker (per phase)	Neutral	Ground
KEP, MCCB	400	(2) 2/0 - 500 KCMIL	(6) 2/0 - 500 KCMIL	(3) #6 - 350 KCMIL

Circuit Breaker Specifications

KEP Molded Case Circuit Breakers (MCCB)								
Breaker			Utility Disconnect			Generator Disconnect (note that units with MCSW selectedwill not have a trip unit)		
Mfr	Model	Amps	Trip Unit	Type	Trip Unit Function	Trip Unit	Type	Trip Unit Function
ABB	Tmax Ts3	100	NI	BM/EL	TM	NI	BM/EL	TM
	Tmax Ts3	150	NI	BM/EL	TM	NI	BM/EL	TM
	Tmax Ts3	200	NI	Electronic	TM	NI	Electronic	TM
	Tmax T5	250 2P/3P	PR221	Electronic	LS/I	PR221	Electronic	LS/I
	Isomax S5	250 4P	PR211	Electronic	LI	PR211	Electronic	LI
	Tmax T6	400	PR221	Electronic	LS/I	PR221	Electronic	LS/I
	Tmax T6	600	PR221	Electronic	LS/I	PR221	Electronic	LS/I
	Tmax T6	800	PR221	Electronic	LS/I	PR221	Electronic	LS/I
	Tmax T7	1000	PR33/P	Electronic	LSIG	PR33/P	Electronic	LSIG
	Tmax T7	1200	PR33/P	Electronic	LSIG	PR33/P	Electronic	LSIG

NI= Non-interchangeable TM = Thermal/Magnetic

BM/EL = Bimetal/Electromagnet MCSW = Molded Case Switch

Circuit Breaker Specifications

KEP Molded Case Circuit Breakers (ICCB)								
Breaker			Utility Disconnect			Generator Disconnect (note that units with MCSW selectedwill not have a trip unit)		
Mfr	Model	Amps	Trip Unit	Type	Trip Unit Function	Trip Unit	Type	Trip Unit Function
Schneider	NW	800	ML5.0A	Electronic	LSI	ML 3.0	Electronic	LI
	NW	1000	ML6.0A	Electronic	LSIG	ML 3.0	Electronic	LI
	NW	1200	ML6.0A	Electronic	LSIG	ML 3.0	Electronic	LI
	NW	1600	ML6.0A	Electronic	LSIG	ML 3.0	Electronic	LI
	NW	2000	ML6.0A	Electronic	LSIG	ML 3.0	Electronic	LI
	NW	2500	ML6.0A	Electronic	LSIG	ML 3.0	Electronic	LI
	NW	3000	ML6.0A	Electronic	LSIG	ML 3.0	Electronic	LI
	NW	4000	ML6.0A	Electronic	LSIG	ML 3.0	Electronic	LI
ICSW= Insulated Case Switch ML= Micrologic								

Weights and Dimensions

See ADV drawings for weights and dimensions. Allow 15% additional weight for packing materials

Accessories

Accessories are available either factory-installed or as loose kits, unless otherwise noted.

IBC Seismic Certification

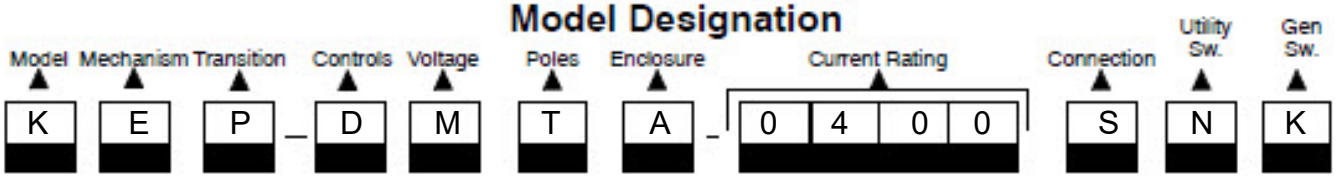
- Certification depends on application and geographic location. Contact your distributor for details.
- Available for the KEP model transfer switches with enclosures shown belo

ATS Type and Size		Enclosure, NEMA Type:			
Type	Amps	1	3R	4X	12
MCCB	100-600			•	
MCCB	100-1200	•	•		•
ICCB	800-400	•	•		

Warranty

Warranty-1-year standard

Model Designation



Record the transfer switch model designation in the boxes. The transfer switch model designation defines characteristics and ratings as explained below.

Sample Model Designation: **KEP-DMTA-0400S-NK**

Model

K: Kohler

Mechanism

E: Service Entrance Rated

Transition

P: Programmed

Controller

D: Decision-Maker® MPAC 1500, Automatic

Voltage/Frequency

C:	208 Volts/60 Hz	M:	480 Volts/60 Hz
F:	240 Volts/60 Hz	R:	220 Volts/60 Hz
K:	440 Volts/60 Hz		

Number of Poles/Wires

N: 2 Poles/3 Wires, Solid Neutral

T: 3 Poles/4 Wires, Solid Neutral

V: 4 Poles/4 Wires, Switched Neutral

Enclosure

A:	NEMA 1	C:	NEMA 3R
B:	NEMA 12	F:	NEMA 4X

Current, Amps

0100	0600	2000
0150	0800	2500
0200	1000	3000
0250	1200	4000
0400	1600	

Connections

S: Standard

Utility Switching Device

M: MCCB w/thermal magnetic trip 100–200 A

N: MCCB w/electronic trip 250–800 A

P: MCCB w/electronic trip and GF 1000-1200 A

R: ICCB w/electronic trip 800 A

T: ICCB w/electronic trip and GF 1000–4000 A

Generator Switching Device

K: MCSW 100–1200 A

M: MCCB w/thermal magnetic trip 100–200 A

N: MCCB w/electronic trip 250–1200 A

Q: ICSW 800–4000 A

R: ICCB w/electronic trip 800–4000 A

Note: Some selections are not available for every model. Contact your Kohler distributor for availability.

KOHLER

Automatic Transfer Switch Controller

Decision-Maker® MPAC 1500

Model KBS with Decision-Maker® MPAC 1500 Controller

Applicable Models

Model	Description
KCS	Standard-Transition Any Breaker ATS ‡
KCP	Programmed-Transition Any Breaker ATS ‡
KCC	Closed-Transition Any Breaker ATS §
KBS	Standard-Transition Bypass/Isolation ATS §
KBP	Programmed-Transition Bypass/Isolation ATS §
KBC	Closed-Transition Bypass/Isolation ATS §
KGS	Standard-Transition Bypass/Isolation ATS §
KGP	Programmed-Transition Bypass/Isolation ATS §
KEP	Service Entrance ATS §

‡ Available with automatic or non-automatic controller
§ Available with automatic controller only

Decision-Maker® MPAC 1500 Controller Standard Features

- Microprocessor-based controller
- Environmentally sealed user interface
- LCD display, 4 lines x 20 characters, backlit
- Dynamic function keypad with tactile feedback pushbuttons allows complete programming and viewing capability at the door
- LED indicators: Source available, transfer switch position, service required (fault), and not in auto
- Broadrange voltage sensing (208–600 VAC) on all phases
- Phase-to-phase sensing and monitoring with 0.5% accuracy on both sources
- Frequency sensing with 0.5% accuracy on both sources
- Anti-single phasing protection
- Phase rotation sensing for three-phase systems
- Real-time clock with automatic adjust for daylight saving time and leap year
- Run time clock and operation counter
- Time-stamped event log
- Fail-safe transfer for loaded test and exercise functions
- DIP switches: password disable and maintenance
- Isolated RS-485 ports for Modbus connections (9.6, 19.2, and 57.6 kbps)
- Standard Ethernet communications with RJ45 connector for 10/100 ethernet connection
- Modbus® RTU and Modbus® TCP/IP protocols (Modbus® register map available)
- USB port. Connect a personal computer and use Kohler® SiteTech™ software to view events and adjust settings *
- Available in automatic and non-automatic versions; see supervised transfer control switch on page 5

Programmable Features

- Programming and monitoring methods:
  - Monitoring and password-protected programming at the door using the keypad and display
  - Program using a PC with Kohler SiteTech software *
- Over/undervoltage and over/underfrequency for all phases of the normal and emergency sources
- Adjustable time delays
- Load/no load/auto-load test and load/no-load exercise functions
- Programmable inputs and outputs
- Load bank control for exercise or test
- Time-based and current-based† load control, nine individual time delays for selected loads
- In-phase monitor (3-phase only)
- Password protection, three security levels

* SiteTech software is available to Kohler-authorized distributors and dealers.
† Requires current sensing kit.

Modbus is a registered trademark of Schneider Electric.

Decision-Maker® MPAC 1500 Controller Features

User Interface LED Indicators

- Contactor position: source N and source E
- Source available: source N and source E
- Service required (fault indication)
- Not in automatic mode

LCD Display

- System status
- Line-to-line voltage
- Line-to-neutral voltage
- Active time delays
- Source frequency
- Preferred source selection
- System settings
- Common alarms
- Load current, each phase (current sensing kit required)
- Inputs and outputs
- Faults
- Time/date
- Address
- Event history
- Maintenance records
- Exerciser schedule
- Exerciser mode
- Time remaining on active exercise

Dynamic Function Tactile Keypad Operations

- Scroll up/down/forward/back
- Increase/decrease/save settings
- End time delay
- Start/end test or exercise
- Reset fault
- Lamp test

DIP Switches

- Maintenance mode
- Password disable

Event History

- View time and date-stamped events on the display or on a personal computer equipped with Kohler® SiteTech™ software. *****
- Download complete event history files using Kohler SiteTech software and a PC connected to the USB port. *****

Main Logic Board Inputs and Outputs

- Two (2) programmable inputs
- Two (2) programmable outputs

Communications

- Ethernet communications with RJ-45 connector for 10/100 ethernet connection
- Isolated RS-485 ports for Modbus communications
- Modbus® RTU and Modbus® TCP/IP protocols (Modbus® register map available)
- USB Port. Use SiteTech software to upload or download files and adjust transfer switch settings *****
  - Application software
  - Event history files
  - Language files
  - Parameter settings
  - Usage reports
  - Feature configuration

Programmable Features

- System voltage, 208–600 VAC †
- System frequency, 50/60 Hz †
- Single/three-phase operation †
- Standard/programmed/closed-transition operation †
- Bypass/isolation enable/disable †
- Service entrance enable/disable †
- Preferred source selection allows the normal or emergency source to be used when both sources are available (alarm module required)
- Phase rotation: ABC/BAC/none selection with error detection
- Voltage and frequency pickup and dropout settings
- Voltage unbalance, enable/disable
- In-phase monitor: enable/disable and phase angle
- Transfer commit/no commit
- Source/source mode: utility/gen, gen/gen, utility/utility, or utility/gen/gen for 3-source systems
- Passwords, system and test
- Three-source system setup allows the use of one utility source and two generator sets
- Time, date, automatic daylight saving time enable/disable
- Time delays (see table)
- Exerciser: calendar mode, loaded/unloaded up to 21 events
- Test: loaded/unloaded/auto load (1–60 minutes)
- Remote test: loaded/unloaded
- Automatic override on generator failure (loaded test and exercise)
- Peak shave delay enable/disable
- Current monitoring (current sensing kit required)
- Load control pre/post-transfer delays, 9 individual time delays for selected loads
- Current-based load control settings: high/low current levels and load add/remove priority for 9 separate loads (current sensing kit required)
- Prime power sequence alternates between two generator sets with adjustable generator set runtimes
- Resettable historical data

***** SiteTech software is available to Kohler-authorized distributors and dealers.

† System parameters are factory-set per order.

Modbus is a registered trademark of Schneider Electric.

Decision-Maker® MPAC 1500 Controller Features, Continued

Programmable Inputs

- Bypass contactor disable (for bypass/isolation switches)
- Forced transfer to OFF (programmed-transition models only; requires load shed accessory)
- Inhibit transfer
- Low battery voltage (external battery supply module required)
- Peak shave/area protection input
- Remote common fault
- Remote test
- Remote end time delay
- Remotely monitored inputs, four (4) available
- Service disconnect (for service entrance models)
- Three-source system disable

Programmable Outputs

- Alarm silenced
- Audible alarm
- Chicago alarm control
- Common alarm events
- Contactor position
- Exercise active
- Fail to open, source 1/source 2 (service entrance models)
- Fail to close, source 1/source 2 (service entrance models)
- Failure to acquire preferred source
- Failure to acquire standby source
- Failure to transfer
- Generator engine start, source N and E
- I/O module faults
- In-phase monitor synch
- Load bank control
- Load control active (pre/post transfer delay, up to 9 outputs)
- Loss of phase fault, source N and E
- Low battery fault (external battery supply module required)
- Maintenance mode
- Non-emergency transfer
- Not in automatic mode
- Over/underfrequency faults, source N and E (generator)
- Over/undervoltage faults, source N and E
- Peak shave/area protection active
- Phase rotation error, source N and E
- Preferred source supplying load
- Software-controlled relay outputs (four maximum)
- Source available, preferred and standby
- Standby source supplying load
- Test active
- Three-source system disable
- Transfer switch auxiliary contact fault
- Transfer switch auxiliary contact open
- Voltage unbalance, source N and E

Voltage and Frequency Sensing

Parameter	Default	Adjustment Range
Undervoltage dropout	90% of pickup	75%–98%
Undervoltage pickup	90% of nominal	85%–100%
Overvoltage dropout *	115% of nominal*	106%–135%
Overvoltage pickup	95% of dropout	95%–100%
Unbalance enable	Disable	Enable/Disable
Unbalance dropout	20%	5%–20%
Unbalance pickup	10%	3%–18%
Voltage dropout time	0.5 sec.	0.1–9.9 sec.
Underfrequency dropout	99% of pickup	95%–99%
Underfrequency pickup	90% of nominal	80%–95%
Overfrequency dropout	101% of pickup	101%–115%
Overfrequency pickup	110% of nominal	105%–120%
Frequency dropout time	3 sec.	0.1–15 sec.

* 690 volts, maximum. Default = 110% for 600 volt applications.

Adjustable Time Delays

Time Delay	Default	Adjustment Range
Engine start, Source S2	3 sec.	0–6 sec. †
Engine start, Source S1 (gen/gen)	3 sec.	
Engine cooldown, Source S2	5 min.	0–60 min.
Engine cooldown, S1 (gen/gen)	5 min.	
Fail to acquire standby source	1 min.	
Fail to acquire preferred source	1 min.	
Transfer, preferred to standby	3 sec.	
Transfer, standby to preferred	15 min.	
Transfer, off to standby	1 sec.	1 sec. – 60 min.
Transfer, off to preferred	1 sec.	
Fail to synchronize	60 sec.	10 sec – 15 min.
Auto load test termination after transfer	1 sec.	1 sec.–60 min.
Prime power run duration	6 min.	6 min. – 100 days (6 min. increments)
Load Control Time Delays:		
Pretransfer to preferred	0 sec.	0–60 min.
Post-transfer to preferred	0 sec.	
Pretransfer to standby	0 sec.	
Post-transfer to standby	0 sec.	
Load add Source1/Source2	0 sec.	
Load remove Source1/Source2	0 sec.	

Note: Time delays are adjustable in 1 second increments, except as noted.

† Engine start time delay can be extended to 60 minutes with an External Battery Supply Module Kit.

Accessory Modules

The mounting kit holds up to five optional modules.

Module Current Draw Specifications, mA	
Alarm Module	75
Standard I/O Module	75
High Power I/O Module	100
Maximum Total Current *	300

* If an External Battery Module is installed, there is no current restriction.

❑ Standard Input/Output Module

Inputs	
Available Inputs	2
Input Definition	Contact closure
Current	5 mA Max
Connection Type	Terminal Strip
Wire Size	#14-24 AWG
Max Distance	700 feet
Outputs	
Outputs Available	6
Contact Type	Form C (SPDT)
Contact Voltage Rating	2 A @ 30 VDC 500 mA @ 125 VAC
Connection Type	Terminal Strip
Wire Size	#14-24 AWG

❑ High-Power Input/Output Module

Inputs	
Available Inputs	2
Input Definition	Contact closure
Current	5 mA Max
Connection Type	Terminal Strip
Wire Size	#14-24 AWG
Max Distance	700 feet
Outputs	
Outputs Available	3
Contact Type	Form C (SPDT)
Contact Voltage Rating	12 A @ 24 VDC 12 A @ 250 VAC 10 A @ 277 VAC 2 A @ 480 VAC
Connection Type	Terminal Strip
Wire Size	#14-24 AWG
Environmental Specifications	
Temperature	-40°C to 85°C (-40°F to 185°F)
Humidity	35% to 85% noncondensing

❑ Alarm Module

- 90 dB Audible alarm
- Any alarm function can be programmed to trigger the audible alarm
- Chicago alarm function
- Preferred source selection
- Supervised transfer control (supervised transfer control switch required)
- Connection for external alarm

External Alarm Connection Specifications	
Wire Size	#12-22 AWG Cu
Contact Voltage Rating	500 mA @ 120 VAC
	250 mA @ 240 VAC

❑ External Battery Supply Module

- Energizes the ATS controls using an external battery when no source power is available
- Allows extended engine start time delays
- Allows the use of any combination of accessory modules (no current draw restriction, maximum of five modules total)
- Connects to one or two batteries, 12 VDC or 24 VDC system
- Current draw, 140 mA @ 12 VDC, 86 mA @ 24 VDC
- Provides low external battery voltage indication to the transfer switch controller
- Reverse-polarity protected

Other Controller Accessories

Accessories are available either factory-installed or as loose kits, unless otherwise noted.

❑ Controller Disconnect Switch

- Disconnects power to controller without disconnecting load
- Mounts inside the enclosure

❑ Current Sensing Kit

- Monitor current on all phases with 1% accuracy

❑ Digital Meter

- Measure and display voltage, current, frequency, and power for both sources
- Programmable visual alarms for high voltage, low voltage, and high current
- Three digital outputs
- Serial port for optional network connections
- Password-protected programming menus
- Joystick operation
- Factory-installed
- Joystick operation
- Available factory-installed
- For more information, see TT-1506, Digital Power Meters.

❑ Line-to-Neutral Voltage Monitoring

- Monitors all line-to-neutral voltages

❑ Load Shed Kit

- Forced transfer from Emergency to OFF for programmed-transition models
- Customer-supplied signal (contact closure) is required for the forced transfer to OFF function
- Factory-installed only

❑ Padlockable User Interface Cover

- Provides additional protection against unauthorized access
- Standard on NEMA 3R enclosures

❑ RSA III Remote Serial Annunciator

- Monitors the generator set
- Monitors Normal and Emergency source status and connection
- Monitors ATS common alarm
- Allows remote testing of the ATS
- For more information about RSA III features and functions, see specification sheet G6-139.

❑ Supervised Transfer Control Switch

- Standard on models with non-automatic controls
- Optional for models with automatic controls
- Auto, manual, and transfer positions
- Automatic and non-automatic modes
- Alarm module required

Supervised Transfer Control Switch Operation for Automatic and Non-Automatic Transfer Switches		
Switch Position	**Automatic Switches**	**Non-Automatic Switches**
AUTO	• Automatically transfers to the standby source, when available, if the preferred source is lost. • Transfers back to the preferred source when it becomes available.	
MANUAL	• Automatically transfers to an available source if the connected source is lost. • Test, peak shave, and loaded exercise commands will transfer to the standby source. • Does not automatically transfer back to preferred when both sources are available.	• Does not automatically transfer to an available source when the connected source is lost. • Test, peak shave, and loaded exercise commands are ignored. • Does not automatically transfer back to preferred when both sources are available. • Transfers only when the switch is manually moved to the TRANSFER position as described below.
TRANSFER (momentary switch position)	• Does not initiate an engine start sequence. Generator set engine must be signalled to start by an event such as a loss of utility, loaded test, loaded exercise, etc. • Allows transfer to the other source, if available. An event such as a loss of utility, loaded exercise, or loaded test must first initiate the transfer sequence. • Time delays will operate. Wait for time delays to expire, or press the End Time Delay button. • Operates pre- and post-transfer load control time delays if both sources are available. • MANUAL TRANSFER is displayed when the ATS is ready to transfer.	

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Environmental Specifications	
Operating Temperature	-20°C to 70°C (-4°F to 158°F)
Storage Temperature	-40°C to 85°C (-40°F to 185°F)
Humidity	5% to 95% noncondensing

Main Board I/O Specifications	
Output contact type	Isolated form C (SPDT)
Output contact rating	1 amp @ 30 VDC, 500 mA @120 VAC
I/O terminals wire size	#12-24 AWG

DISTRIBUTED BY:

Availability is subject to change without notice. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. Contact your local Kohler® Power Systems distributor for availability.

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KOHLER®

Dimensional Drawings

** FOR ATS INSTALLATION ONLY **

GENERAL SEISMIC INSTALLATION NOTES:

1. ANCHORS MUST BE DESIGNED IN ACCORDANCE WITH ACI 355.2-04. SUGGESTED MANUFACTURERS INCLUDE SIMPSON, RAMSET AND HILTI.
2. ANCHORS MUST BE INSTALLED TO A MINIMUM EMBEDMENT OF 8X THE ANCHOR DIAMETER.
3. ANCHORS MUST BE INSTALLED IN MINIMUM 4000 PSI COMPRESSIVE STRENGTH NORMAL WEIGHT CONCRETE. CONCRETE AGGREGATE MUST COMPLY WITH ASTM C33. INSTALLATION IN STRUCTURAL LIGHTWEIGHT CONCRETE IS NOT PERMITTED UNLESS OTHERWISE APPROVED BY THE STRUCTURAL ENGINEER OF RECORD.
4. ANCHORS MUST BE INSTALLED TO THE REQUIRED TORQUE SPECIFIED BY THE ANCHOR MANUFACTURER TO OBTAIN MAXIMUM LOADING.
5. ANCHORS MUST BE INSTALLED TO THE ANCHOR SPACING REQUIRED TO OBTAIN MAXIMUM LOAD AND EDGE DISTANCE REQUIRED TO OBTAIN MAXIMUM LOAD UNLESS OTHERWISE APPROVED BY THE STRUCTURAL ENGINEER OF RECORD.
6. ANCHORS USED FOR SEISMIC INSTALLATION MUST BE DESIGNED AND RATED TO RESIST SEISMIC LOADING IN ACCORDANCE WITH ACI 355.2-04 AND DOCUMENTED IN A REPORT BY A REPUTABLE TESTING AGENCY. (EX. THE EVALUATION SERVICE REPORT ISSUED BY THE INTERNATIONAL CODE COUNCIL)
7. WIDE WASHERS MUST BE INSTALLED AT EACH ANCHOR LOCATION BETWEEN THE ANCHOR HEAD AND EQUIPMENT FOR TENSION LOAD DISTRIBUTION.
8. EQUIPMENT INSTALLED ON A HOUSEKEEPING PAD REQUIRES THE HOUSEKEEPING PAD THICKNESS TO BE AT LEAST 1.5X THE ANCHOR EMBEDMENT DEPTH.
9. ALL HOUSEKEEPING PADS MUST BE SEISMICALLY DESIGNED AND DOWELLED OR CAST INTO THE BUILDING STRUCTURE AS APPROVED BY THE STRUCTURAL ENGINEER OF RECORD.
10. REBAR REINFORCING IN THE HOUSEKEEPING PAD IS REQUIRED FOR ALL INSTALLATIONS.
11. CONCRETE AND REBAR REINFORCING MUST BE DESIGNED IN ACCORDANCE ACI 318-05.
12. WALL MOUNTED EQUIPMENT MUST BE INSTALLED TO A REBAR REINFORCED STRUCTURAL CONCRETE WALL THAT IS SEISMICALLY DESIGNED AND APPROVED BY THE ENGINEER OF RECORD TO RESIST THE ADDED SEISMIC LOADS FROM COMPONENTS BEING ANCHORED TO THE WALL.
13. FLOOR MOUNTED EQUIPMENT (WITH OR WITHOUT A HOUSEKEEPING PAD) MUST BE INSTALLED TO A REBAR REINFORCED STRUCTURAL CONCRETE FLOOR THAT IS SEISMICALLY DESIGNED AND APPROVED BY THE ENGINEER OF RECORD TO RESIST THE ADDED SEISMIC LOADS FROM COMPONENTS BEING ANCHORED TO THE FLOOR.
14. WHEN INSTALLING TO A FLOOR OR WALL, REBAR INTERFERENCE MUST BE CONSIDERED.
15. EQUIPMENT ATTACHED TO ANY STRUCTURAL FLOOR OR WALL OTHER THAN THOSE CONSTRUCTED OF STRUCTURAL CONCRETE AND DESIGNED TO ACCEPT THE SEISMIC LOADS FROM THE MOUNTED EQUIPMENT ARE BEYOND THE SCOPE OF THIS SPECIFICATION.
16. INSTALLATION TO LIGHT WEIGHT CONCRETE OVER STEEL DECKING IS BEYOND THE SCOPE OF THIS SPECIFICATION.
17. INSTALLATION TO CONCRETE BLOCK OR CINDER BLOCK WALLS IS BEYOND THE SCOPE OF THIS SPECIFICATION.

IBC 2000, IBC 2003, IBC 2006, IBC 2009, IBC 2012
CERTIFIED SEISMIC DESIGN LEVELS

$S_{DS} \leq 2.0$	$S_{DS} \leq 2.0$
$z/h \leq 0.0$	$z/h \leq 1.0$
(EQUIPMENT AT GRADE)	(EQUIPMENT ON ROOF)

SOIL CLASSES A, B, C, D, SEISMIC RISK CATEGORY I, II, III, IV, AND SEISMIC DESIGN CATEGORIES A, B, C, D, E, AND F ARE ALL COVERED UNDER THIS CERTIFICATION, LIMITED BY THE S_{DS} VALUE STATED ABOVE.

THE FOLLOWING BUILDING CODES ARE ADDRESSED UNDER THIS CERTIFICATION:
- IBC 2012 - REFERENCING ASCE7-10 AND ICC AC-156
- IBC 2009 - REFERENCING ASCE7-05 AND ICC AC-156
- IBC 2006 - REFERENCING ASCE7-05 AND ICC AC-156
- IBC 2003 - REFERENCING ASCE7-02 AND ICC AC-156
- IBC 2000 - REFERENCING ASCE7-98 AND ICC AC-156

NOTE:
SEE CERTIFICATE OF COMPLIANCE (GI8-211) FOR COMPLETE CERTIFICATION INFORMATION AND ATS MODELS COVERED.

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	1-16-08	NEW DRAWING [83609]	WSD
A	5-20-10	(D-3) SDS WAS 5SDS; [89539]	BTW
B	10-8-10	(D-4) FOR ATS INSTALLATION ONLY ADDED. (A-1) ATS ADDED TO TITLE. [90542]	GFR
C	4-7-14	(B-1-4) NOTES ADDED, DRAWING UPDATED;[CT77129]	BTW

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30′
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	WSD	1-16-08
CHECKED	WSD	1-16-08
APPROVED	MTL	1-16-08

KOHLER CO. | METRIC | PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

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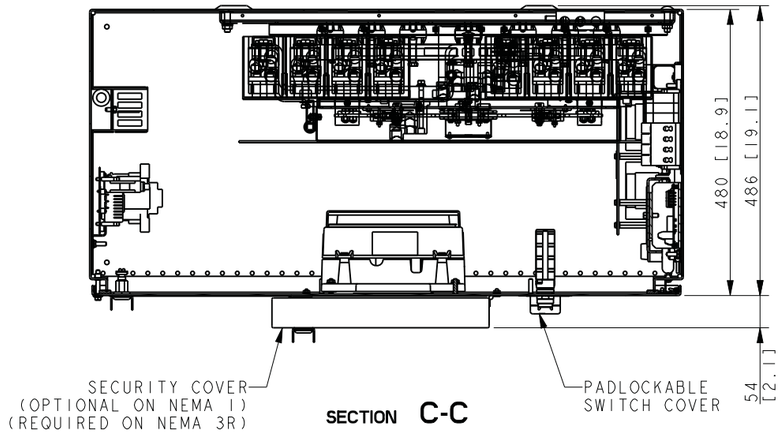
TITLE: SPECIFICATION PRINT (SEISMIC INSTALL)

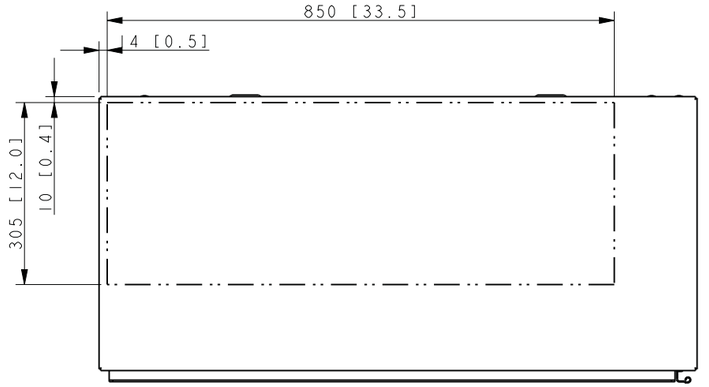
SCALE | CAD NO. | SHEET 1 of 1

DWG NO. ADV-7456 | B

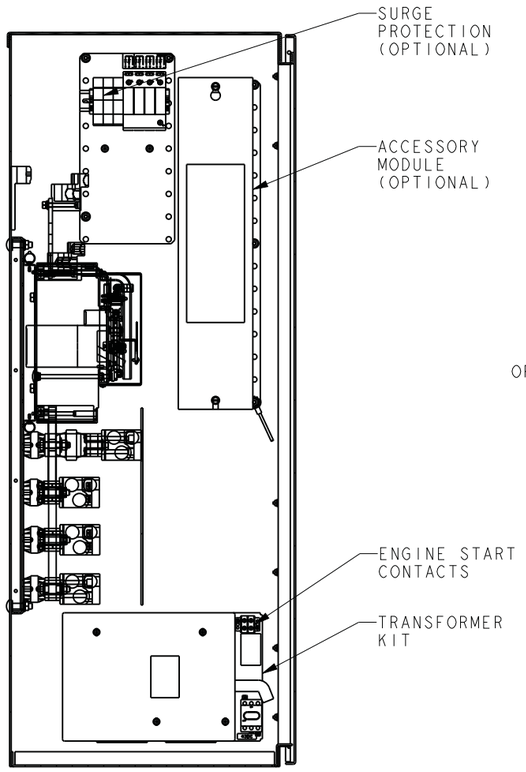
NOTES:
1. DIMENSION IN [ ] ARE INCHES.
2. FINISH:
   NEMA 1 & 3R: ANSI 49 GRAY
3. REFER TO OPERATOR'S MANUAL PRIOR TO INSTALLING SWITCH & OPERATION OF SWITCH.
4. OMIT CENTER POLE ON 2 POLE SWITCHES.
5. FOR SEISMIC CERTIFIED UNITS, REFER TO ADV-7456 AND INSTALLATION INSTRUCTIONS.



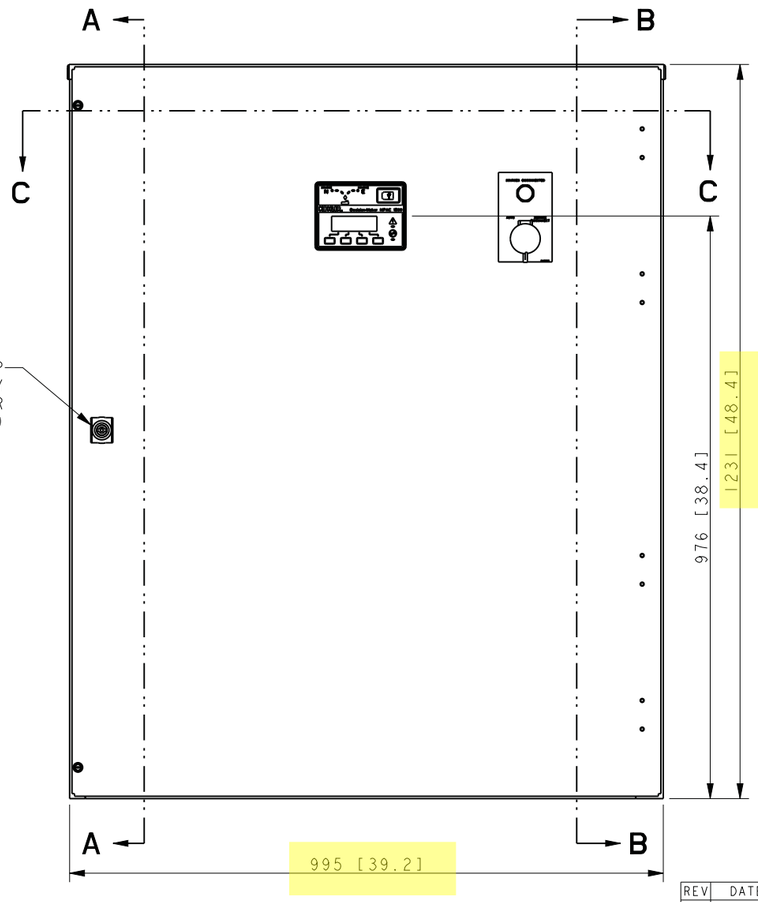
SECTION C-C



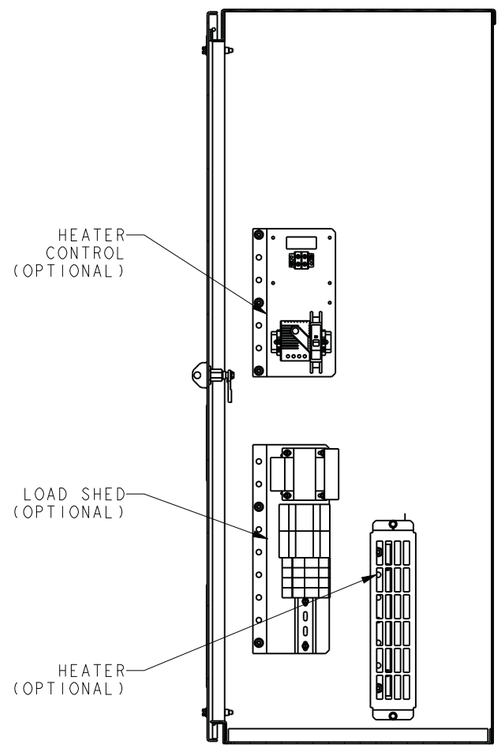
RECOMMENDED ENTRANCE AREA
TOP & BOTTOM



SECTION B-B



NOTE:
ALLOW FOR MINIMUM DOOR SWING CLEARANCE OF 1032 [40.7] IN FRONT OF CABINET.



SECTION A-A

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	8-27-13	NEW DRAWING [CT54441]	BTW
A	1-14-15	VIEWS UPDATED; [CT112665]	BTW

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	BTW	8-27-13
CHECKED	BTW	8-27-13
APPROVED	MTL	8-27-13

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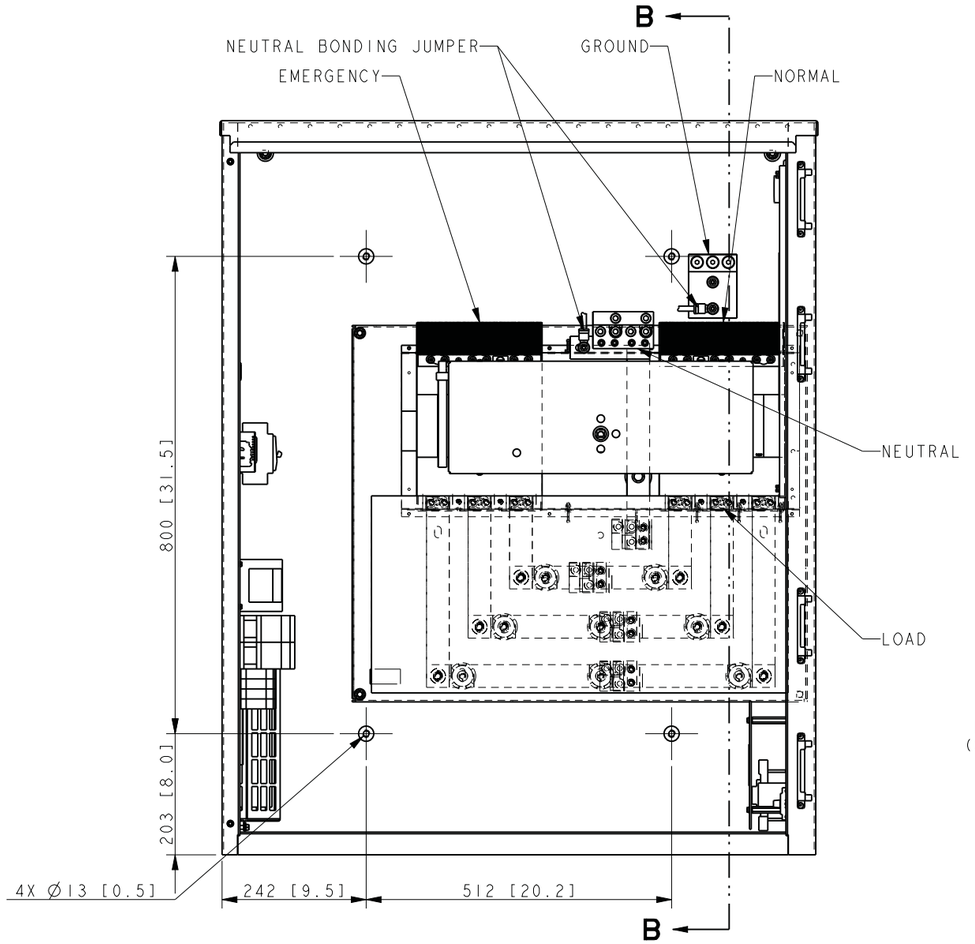
TITLE: DIMENSION PRINT

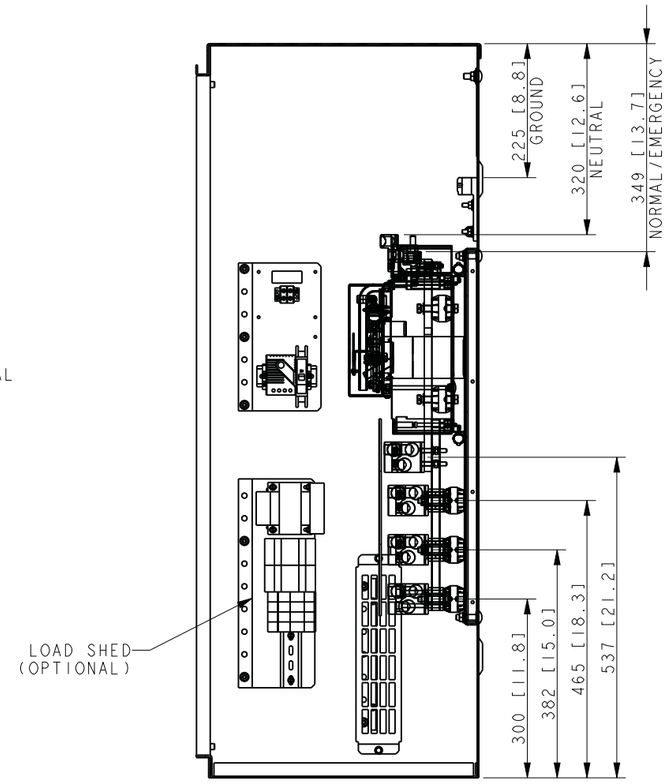
SCALE 0.20 | CAD NO. | SHEET 1 of 2

DWG NO. ADV-8614 | D

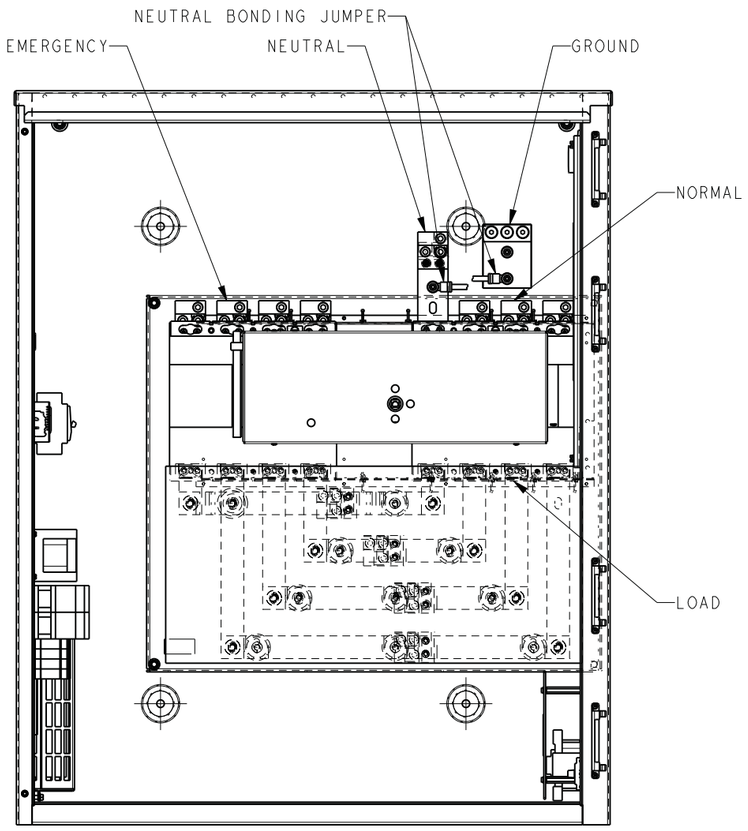
SEE ADV-8565 FOR FULL MODEL CODE DEFINITION								
STYLE	MECHANISM	TRANSITION	MPAC LOGIC	VOLTS	POLES	NEUTRAL	ENCLOSURE	AMPS	CONNECTION
KEP MCCB	SERVICE ENT	PROGRAMMED	1500	208-480	2,3,4	SOLID,SW	1,3R	400,600,800	STANDARD



800 AMP 3 POLE SHOWN
(DOOR REMOVED TO SHOW INTERNAL COMPONENTS)
NOTE: OMIT CENTER POLE ON 2 POLES SWITCHES.



SECTION **B-B**



800 AMP 4 POLE SHOWN
(DOOR REMOVED TO SHOW INTERNAL COMPONENTS)

SEISMIC MOUNTING NOTE:
FOR SEISMIC CERTIFIED UNITS,
MOUNT WITH THE FOLLOWING HARDWARE:
WALL MOUNTED (STEEL)
Ø9.53 [.375] Dia. SAE GRADE 1/ ASTM A307 BOLTS.
WALL MOUNTED (CONCRETE)
Ø9.53 [.375] Dia. HILTI KWIK BOLT TZ-CS WITH MIN. EMBEDMENT 50.8 [2.00]; EDGE DISTANCE OF 101.6 [4.00] ON A 101.6 [4.00] THICK 4000 PSI CONDRETE WALL. HARDWARE TO COMPLY WITH SPECIFICATIONS ON ADV-7456.

SERVICE DISCONNECT BREAKERS ARE 80% RATED. CONTINUOUS LOAD CURRENT IS NOT TO EXCEED 80% OF BREAKER RATING.

SCREW TYPE TERMINALS FOR EXTERNAL POWER CONNECTIONS

SWITCH RATING (AMPS)	RANGE OF AL/CU WIRE SIZE		
	CIRCUIT BREAKER PER PHASE	NEUTRAL	GROUND
400	(2) 2/0-500 KCMIL	(6) 2/0-500 KCMIL	(3) #6-350 KCMIL
600	(2) 2/0-500 KCMIL	(6) 2/0-500 KCMIL	(3) #6-350 KCMIL
800	(3) 2/0-500 KCMIL	(9) 2/0-500 KCMIL	(3) #6-350 KCMIL

APPROX. WEIGHTS KG (LBS)			
AMPS	2 POLE	3 POLE	4 POLE
400	195 [430]	195 [430]	195 [430]
600	200 [441]	200 [441]	200 [441]
800	200 [441]	200 [441]	200 [441]

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	8-27-13	NEW DRAWING [CT54441]	BTW
A	1-14-15	SEE SHEET 1 [CT112665]	BTW

UNLESS OTHERWISE SPECIFIED -
1) DIMENSIONS ARE IN MILLIMETERS
2) TOLERANCES ARE:
X.XX ± 0.25
X.X ± 1.0
X ± 1.5
ANGLES ± 0° 30'
SURFACE FINISH ✓ MAX.
THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	BTW	8-27-13
CHECKED	BTW	8-27-13
APPROVED	MTL	8-27-13

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TITLE
DIMENSION PRINT

SCALE 0.20 | CAD NO. | SHEET 2 of 2
DWG NO. ADV-8614 | D

KOHLER®

Wiring Schematics

REV	DATE	REVISION	BY	M E
–	10-28-15	NEW DRAWING [CT129471]	DFS	
A	2-9-16	(C-5) F7A WAS F5A; (C-3) F6A WAS F4A, F7A WAS F5A &		
		F8A WAS F6A; [CT138762]	BTW	

LEGEND

43SD – SERVICE DISCONNECT SWITCH
43DC – CONTROL CIRCUIT DISCONNECT SWITCH
F(#) – FUSE
GSD – GENERATOR BREAKER AUX CONTACT
GSL – GENERATOR SIDE LIMIT SWITCH
L1 – SERVICE DISCONNECT LIGHT
LCD – LIQUID CRYSTAL DISPLAY
M – MOTOR
MUS – LIMIT SWITCH
NRSR – NON REVERSING SOURCE SELECTION RELAY
P(#) – PLUG
PT(#) – POWER TRANSFORMER
SW(#) – DIP SWITCH
SDL – SERVICE DISCONNECT LIGHT
TB(#) – TERMINAL BLOCK
TB1 – MPAC PROGRAMMABLE INPUT/OUTPUT TERMINAL BLOCK
TB2 – MPAC MODBUS TERMINAL BLOCK
TS – TRANSFER SWITCH
TR – SOURCE RELAY
USD – UTILITY BREAKER AUX CONTACT
ULS – UTILITY SIDE LIMIT SWITCH

MEMBRANE SWITCH
LCD DISPLAY
ETHERNET INTERFACE
ETHERNET INTERFACE STANDARD ON MPAC1500 OPTIONAL ON MPAC750 AND MPAC1200
MPAC POWER/ CONTROL BOARD
P14 (MEMBRANE SW.)
P17 (LCD DISPLAY)
P9 (ETHERNET)
TB2 (MODBUS)
P12 USB PORT (ON BACK OF BOARD)
P16 (OPTION BOARDS)
(GROUND) P1-10
(POSITION_SOURCE2) P1-13
(POSITION_SOURCE1) P1-14
(GEN_START_1) P1-8
(GEN_START_2) P1-9
ENGINE START/STOP
43SD (SDSW)
NRSR
D3A
CONNECT TO APPROPRIATE VOLTAGE TAP TERMINAL
CONTROL CIRCUIT ISOLATION PLUG
UTILITY (SOURCE 1)
UA UB UC UN G
GRD
43SD (SDSW)
SW1
PASSWORD
MAINTENANCE
POWER DISABLE
SPARE
SOURCE 1 AC VOLTAGE SENSING
* POWER SUPPLY
(SOURCE1_A) P1-12
(SOURCE1_B) P1-11
(SOURCE1_C) P1-4
(SOURCE1_N) P1-22
OUT 1 NC C NO
OUT 2 NC C NO
IN1
IN2
TB1 (PROGRAMMABLE INPUTS/OUTPUTS)
UTILITY
OPTIONAL 4 POLE UNIT
CN
CE
MECHANICAL INTERLOCK
TO LOAD
LA LB LC N G
P3-1 (1A)
P3-2 (1AR)
P3-3 (1B)
P3-4 (1BR)
P3-5 (1C)
P3-6 (1CR)
CURRENT SENSING
(SOURCE2_C1) P1-1
(SOURCE1_NO1) P1-3
(SOURCE2_A) P1-7
(SOURCE2_B) P1-18
(SOURCE2_C) P1-6
(SOURCE2_N) P1-23
SOURCE 2 AC VOLTAGE SENSING
* POWER SUPPLY
PT1 PT2
H4(460) H3(230) H2(208) H1(COM1)
120
CONNECT TO APPROPRIATE VOLTAGE TAP TERMINAL
GENERATOR
GA GB GC N G
GENERATOR (SOURCE 2)
GND
(SOURCE2_C2) P1-16
(SOURCE1_NO2) P1-15
(SOURCE1_C1) P1-2
(SOURCE1_C2) P1-5
P2 (PROGRAMMED TRANSITION.)
SDL (SERVICE DISCONNECTED)
MOTOR DISCONNECT PLUG
TRA TR TRB
GSD
USD
QCON1
ULS (RIGHT)
GLS (LEFT)
COMM
BK BE
T/S MOTOR
POWER CHASSIS

FOR WIRING DIAGRAM SEE GM95677

43SD
CONTACTS | AUTO | SERVICE DISCONNECT
1–2 | | X
3–4 | X |
5–6 | X |
UTILITY DISCONNECTED
AUTO SERVICE DISCONNECT
SERVICE DISCONNECT SELECTOR SWITCH (PADLOCKABLE)

43CD
CONTACTS | ON | OFF
2T1–1L1 | X |
4T2–3L2 | X |
6T3–5L3 | X |
CONTROL CIRCUIT DISCONNECT
ON OFF
CONTROL CIRCUIT DISCONNECT SWITCH

RELAY/MUS	EMERGENCY BREAKER POSITION OPEN	>	AFTER TDC *	<	EMER
K1		X		X	
K2		X		X	
GLS–NC	X		X		X
GSD 14–11				X	X
GSD 24–21				X	X

RELAY/MUS	NORMAL BREAKER POSITION NORM	>	AFTER TDC *	<	OPEN
K1	X		X		X
K2	X		X		X
ULS–NC	X		X		X
USD 14–11		X		X	
USD 24–21		X		X	

* TDC – TOP DEAD CENTER POSITION

NOTE:
DIAGRAM SHOWN WITH "NORMAL" ENERGIZED AND MECHANISM IN THE NORMAL POSITION.

MODEL KEP
100–1200A
SERVICE DISCONNECT, MCCB
TRANSFER TO OFF
PROGRAMMED TRANSITION

UNLESS OTHERWISE SPECIFIED – 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: .XXX ± .010 ANGLES ± 1/2° .XX ± .030 SURFACE FINISH .X ± .060 MAX. FRACTIONS ±

APPROVALS	DATE
DRAWN DFS	10-28-15
CHECKED HCC	10-28-15
APPROVED HCC	10-28-15

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TITLE: DIAGRAM, SCHEMATIC
SCALE: /// CAD NO. SHEET 1–1
PLOTTED PRM. NO. GM95676 D

REV	DATE	REVISION	BY	N F
–	10-28-15	NEW DRAWING [CT129471]	DFS	
A	2-9-16	SEE SHEET 2 [CT138762]	BTW	

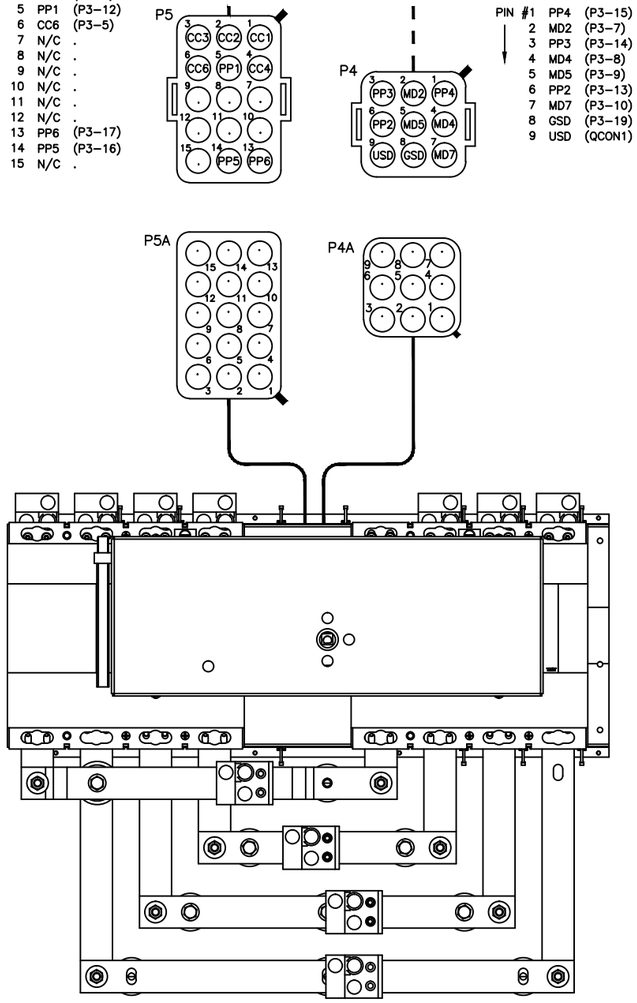
ENCLOSURE BACK PANEL

P5 CONNECTIONS

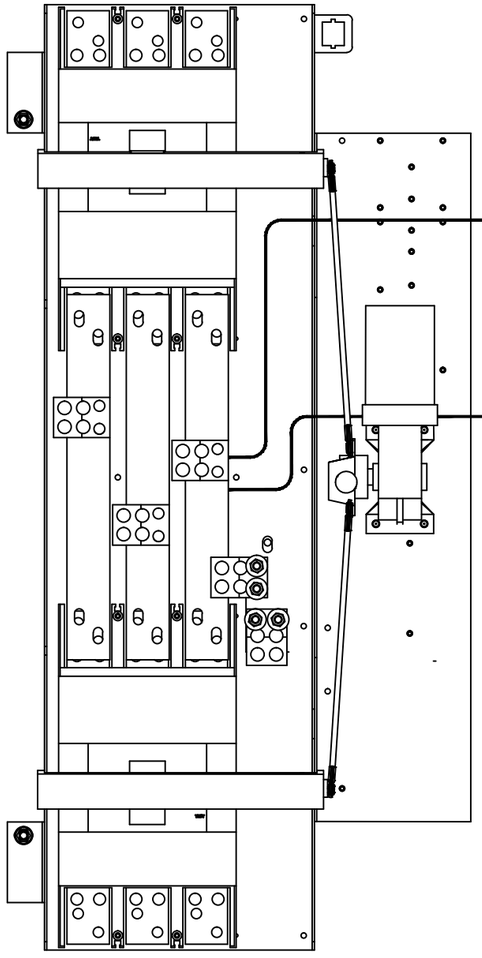
PIN			
#1	CC1	(P3–1)
2	CC2	(P3–2)
3	CC3	(P3–3)
4	CC4	(P3–4)
5	PP1	(P3–12)
6	CC6	(P3–5)
7	N/C	.
8	N/C	.
9	N/C	.
10	N/C	.
11	N/C	.
12	N/C	.
13	PP6	(P3–17)
14	PP5	(P3–16)
15	N/C	.

P4 CONNECTIONS

PIN			
#1	PP4	(P3–15)
2	MD2	(P3–7)
3	PP3	(P3–14)
4	MD4	(P3–8)
5	MD5	(P3–9)
6	PP2	(P3–13)
7	MD7	(P3–10)
8	GSD	(P3–19)
9	USD	(QCON1)



100–800 AMP MECHANISM
(4P, 800A UNIT SHOWN)



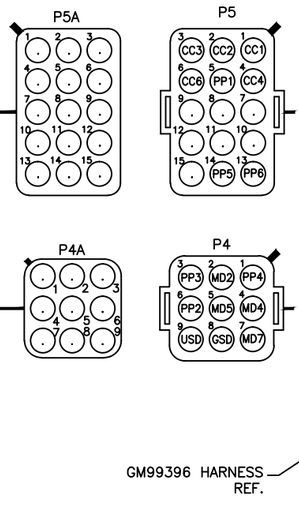
1000–1200 AMP MECHANISM

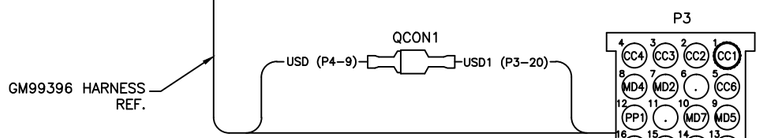
P4 CONNECTIONS

PIN			
#1	PP4	(P3–15)
2	MD2	(P3–7)
3	PP3	(P3–14)
4	MD4	(P3–8)
5	MD5	(P3–9)
6	PP2	(P3–13)
7	MD7	(P3–10)
8	GSD	(P3–19)
9	USD	(QCON1)

P5 CONNECTIONS

PIN			
#1	CC1	(P3–1)
2	CC2	(P3–2)
3	CC3	(P3–3)
4	CC4	(P3–4)
5	PP1	(P3–12)
6	CC6	(P3–5)
7	N/C	.
8	N/C	.
9	N/C	.
10	N/C	.
11	N/C	.
12	N/C	.
13	PP6	(P3–17)
14	PP5	(P3–16)
15	N/C	.





(TO TRANSFORMER PANEL SHEET 2)

P3 CONNECTIONS

PIN			
#1	CC1	(P5–1)
2	CC2	(P5–2)
3	CC3	(P5–3)
4	CC4	(P5–4)
5	CC6	(P5–6)
6	N/C	.
7	MD2	(P4–2)
8	MD4	(P4–4)
9	MD5	(P4–5)
10	MD7	(P4–7)
11	N/C	.
12	PP1	(P5–5)
13	PP2	(P4–6)
14	PP3	(P4–3)
15	PP4	(P4–1)
16	PP5	(P5–14)
17	PP6	(P5–13)
18	N/C	.
19	GSD	(P4–8)
20	USD1	(QCON1)
21	N/C	.
22	N/C	.
23	N/C	.
24	N/C	.

FOR SCHEMATIC DIAGRAM SEE GM95676

MODEL KEP
100–1200A
SERVICE DISCONNECT, MCCB
TRANSFER TO OFF
PROGRAMMED TRANSITION

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX ± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 √ MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	DFS	10-28-15
CHECKED	HCC	10-28-15
APPROVED	HCC	10-28-15

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TITLE: DIAGRAM, WIRING

SCALE: / / / CAD NO. SHEET 1–3
PLOTTED DWG. NO. GM95677 D

REV	DATE	REVISION	BY	N F
–	10-28-15	NEW DRAWING [CT129471]	DFS	
A	2-9-16	(D-8) PIN#: 4: (F6-1) WAS (F4-1), 5: (F8-1) WAS (F6-1)		
		& 12: (F7-1) WAS (F5-1); (C-4-5) F6 WAS F4, F7 WAS F5		
		F8 WAS F6, F8A WAS F4A, F7A WAS F5A & F8A WAS F8A;		
		(D-4) F8A (F8-2) WAS F6A (F6-2), F6A (F6-2) WAS F4A		
		(F4-2); (C-1) PIN#: 14: F7A (F7-2) WAS F5A (F5-2); (B-1)		
		(B-1) F7A WAS F5A; [CT138762]	BTW	

ENCLOSURE SIDE PANEL

TRANSFORMER PANEL

P3A CONNECTIONS

PIN #1	CC1	(43DC–1L1)
2	CC2	(43DC–3L2)
3	CC3	(43DC–5L3)
4	CC4	(F6–1)
5	CC6	(F8–1)
6	N/C	.
7	MD2	(P2A–9)
8	MD4	(P2A–7)
9	MD5	(W4)
10	MD7A	(W6)
11	N/C	.
12	PP1	(F7–1)
13	PP2	(P2A–15)
14	PP3	(P2A–16)
15	PP4	(P2A–17)
16	PP5	(P2A–18)
17	PP6	(P2A–19)
18	N/C	.
19	GSD	(W8)
20	USD	(W8)
21	N/C	.
22	N/C	.
23	N/C	.
24	N/C	.

P2A CONNECTIONS

PIN #1	D3	(W5)
2	D6	(W2)
3	D7	(W3)
4	D16	(W5)
5	DL1	(W4)
6	D16B	(W5)
7	MD4	(P3A–8)
8	N/C	.
9	MD2	(P3A–7)
10	N/C	.
11	DL2	(TR–3)
12	MD7	(W6)
13	N/C	.
14	F7A	(F7–2)
15	PP2	(P3A–13)
16	PP3	(P3A–14)
17	PP4	(P3A–15)
18	PP5	(P3A–16)
19	PP6	(P3A–17)
20	3	(TB–1)
21	F1A	(F1–2)
22	F2A	(F2–2)
23	F3A	(F3–2)
24	4	(TB–2)

P3A

(TO CONTACTOR SHEET 1)

P2A

(TO DOOR SHEET 3)

TR

TRB (W8)

TRA (W4)

MD7B (W6)

DL2 (P2A–11)

F1B (43DC–2T1)

F2B (43DC–4T2)

F3B (43DC–6T3)

CC4 (P3A–4)

PP1 (P3A–12)

CC6 (P3A–5)

F1 F2 F3 F6 F7 F8

TB

3 (P2A–20)

4 (P2A–24)

2H1 (PT2–H1) — W2 — D6 (P2A–2)

F8A (F8–2)

2HV (PT2) — W3 — D7 (P2A–3)

F6A (F6–2)

MD5 (P3A–9) — W4 — TRA (TR–A)

1X1 (PT1–X1) — 2X1 (PT2–X1)

RA2 (NRSR–A2) — DL1 (P2A–5)

D16 (P2A–4) — W5

D3A (NRSR–R2) — D16B (P2A–6)

D16A (NRSR–4) — D3 (P2A–1)

MD7A (P3A–10) — W6 — MD7 (P2A–12)

MD7B (TR–9)

NRSR3 (NRSR–3) — W7 — 2X2 (PT2–X2)

RA1 (NRSR–A1)

GSD (P3A–19) — W8 — TRB (TR–B)

USD (P3A–20)

F1A (P2A–21)

1HV (PT1)

F2A (P2A–22)

F3A (P2A–23)

1H1 (PT1–H1)

F6A (W3)

F7A (P2A–14)

F8A (W2)

GM95685 HARNESS REF.

NRSR

1X2 (PT1–X2)

NRSR3 (W7)

RA1 (W7)

13(NO) 21(NC) A1

14(NO) 22(NC) A2

D3A (W5)

D16A (W5)

RA2 (W4)

1X1 (W4)

1X2 (NRSR–R1)

PT1

H4 H3 H2 H1

1H1 (F3–2)

1HV (F1–2)

SEE NOTE 1

2X1 (W4)

2X2 (W7)

PT2

2H1 (W2)

2HV (W3)

SEE NOTE 2

43DC

CC1 (P3A–1)

CC2 (P3A–2)

CC3 (P3A–3)

1L1 3L2 5L3

2T1 4T2 6T3

F1B (F1–1)

F2B (F2–1)

F3B (F3–1)

NOTE 1

208V MODELS: CONNECT THE "1HV" LEAD TO THE H2 TERMINAL ON THE PT1 TRANSFORMER

220–240V MODELS: CONNECT THE "1HV" LEAD TO THE H3 TERMINAL ON THE PT1 TRANSFORMER

440–480V MODELS: CONNECT THE "1HV" LEAD TO THE H4 TERMINAL ON THE PT1 TRANSFORMER

NOTE 2

208V MODELS: CONNECT THE "2HV" LEAD TO THE H2 TERMINAL ON THE PT2 TRANSFORMER

220–240V MODELS: CONNECT THE "2HV" LEAD TO THE H3 TERMINAL ON THE PT2 TRANSFORMER

440–480V MODELS: CONNECT THE "2HV" LEAD TO THE H4 TERMINAL ON THE PT2 TRANSFORMER

FOR SCHEMATIC DIAGRAM SEE GM95676

MODEL KEP
100–1200A
SERVICE DISCONNECT, MCCB
TRANSFER TO OFF
PROGRAMMED TRANSITION

UNLESS OTHERWISE SPECIFIED — 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: .XXX ± .010 ANGLES ± 1/2° .XX ± .030 SURFACE FINISH .X ± .060 FRACTIONS ± MAX.

APPROVALS	DATE
DRAWN DFS	10-28-15
CHECKED HCC	10-28-15
APPROVED HCC	10-28-15

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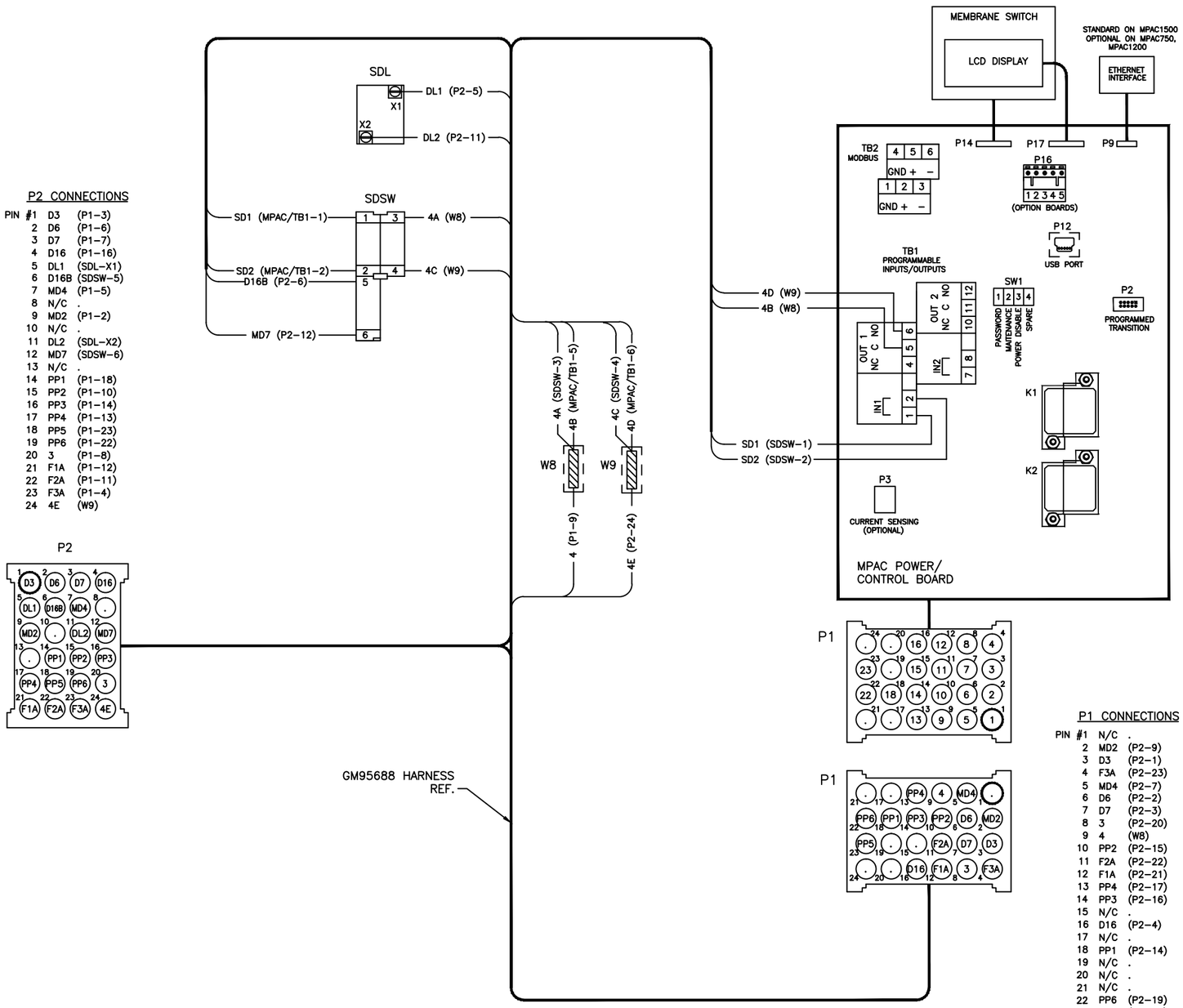
SCALE: / / / CAD NO. SHEET 2–3

PLOTTED DWG. NO. GM95677 D

REV	DATE	REVISION	BY	N F
–	10-28-15	NEW DRAWING [CT129471]	DFS	
A	2-9-16	SEE SHEET 2 [CT138762]	BTW	

ENCLOSURE DOOR (REAR VIEW)



P2 CONNECTIONS

PIN			
#1	D3	(P1–3)
2	D6	(P1–6)
3	D7	(P1–7)
4	D16	(P1–16)
5	DL1	(SDL–X1)
6	D16B	(SDSW–5)
7	MD4	(P1–5)
8	N/C	.
9	MD2	(P1–2)
10	N/C	.
11	DL2	(SDL–X2)
12	MD7	(SDSW–6)
13	N/C	.
14	PP1	(P1–18)
15	PP2	(P1–10)
16	PP3	(P1–14)
17	PP4	(P1–13)
18	PP5	(P1–23)
19	PP6	(P1–22)
20	3	(P1–8)
21	F1A	(P1–12)
22	F2A	(P1–11)
23	F3A	(P1–4)
24	4E	(W9)

P1 CONNECTIONS

PIN			
#1	N/C	.
2	MD2	(P2–9)
3	D3	(P2–1)
4	F3A	(P2–23)
5	MD4	(P2–7)
6	D6	(P2–2)
7	D7	(P2–3)
8	3	(P2–20)
9	4	(W8)
10	PP2	(P2–15)
11	F2A	(P2–22)
12	F1A	(P2–21)
13	PP4	(P2–17)
14	PP3	(P2–16)
15	N/C	.
16	D16	(P2–4)
17	N/C	.
18	PP1	(P2–14)
19	N/C	.
20	N/C	.
21	N/C	.
22	PP6	(P2–19)
23	PP5	(P2–18)
24	N/C	.

FOR SCHEMATIC DIAGRAM SEE GM95676

MODEL KEP
100–1200A
SERVICE DISCONNECT, MCCB
TRANSFER TO OFF
PROGRAMMED TRANSITION

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.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS	DATE
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TITLE: DIAGRAM, WIRING

SCALE: / / / | SHEET 3-3
CAD NO.
PLOTTED
DWG. NO. GM95677 | D

KOHLER®

Breaker Data

For use in alternating current the Tmax T2, T4, T5, T6 and T7 circuit breakers can be equipped with trip units constructed using electronic technology. This allows protection functions to be obtained which provide high reliability, tripping precision and insensitivity to temperature and to the electromagnetic components.
The power supply needed for correct operation is supplied directly by the current sensors of the trip unit, and tripping is always guaranteed, even under single-phase load conditions.

Characteristics of the Tmax electronic trip units

Operating temperature	-13 °F…+158 °F (-25 °C…+70 °C)
Relative humidity	98%
Self-supply	0.2 x In (single phase)
Auxiliary power supply (where applicable)	24 V DC
Operating frequency	45…66 Hz
Electromagnetic compatibility (LF and HF)	IEC 60947-2 Annex F

For Tmax T2, T4, T5 and T6 the protection trip unit consists of:
– 3 or 4 current sensors (current transformers)
– external current sensors (e.g. for the external neutral), when available
– a trip unit
– a trip coil (for T2 housed in the right slot, for T4, T5 and T6 integrated in the electronic trip unit).
For Tmax T7 the protection trip unit consists of:
– 3 or 4 current sensors (Rogowski coils and current transformers)
– external current sensors (e.g. for the external neutral)
– interchangeable rating plug
– a trip unit
– a trip coil housed in the body of the circuit breaker.

Rating plugs

Circuit breaker	CS Rated current I_u	In [A]				
		400	600	800	1000	1200
T7	1000	■	■	■	■	
	1200	■	■	■	■	■

The current sensors supply the electronic trip unit with the energy needed for correct operation of the trip unit and the signal needed to detect the current.
The current sensors are available with rated primary current as shown in the table.

Current sensors

	In [A]	25	60	100	150	250	300	400	600	800	1000	1200
PR221DS	T2	■	■	■	■							
	T4			■	■	■	■					
	T5						■	■	■			
	T6								■	■		
PR222DS/P, PR222DS/PD-A	T4			■	■	■	■					
	T5						■	■	■			
	T6								■	■		
PR231/P, PR232/P, PR331/P, PR332/P	T7							■	■	■	■	■

When a protection function trips, the circuit breaker opens by means of the trip coil, which changes the contact AUX-SA (supplied on request, see chapter “Accessories” at page 3/21 and following) to tripping. Mechanical signalling reset takes place with resetting of the circuit breaker.

Basic protection functions

(L) Protection against overload
This protection function trips when there is an overload with inverse long-time delay trip according to an inverse time curve ($I^2t=k$). The protection cannot be excluded.

(S) Protection against short-circuit with time delay
This protection function trips when there is a short-circuit, with long inverse time-delay trip ($I^2t=k$ ON) or a constant trip time ($I^2t=k$ OFF). The protection can be excluded.

(I) Instantaneous protection against short-circuit
This protection function trips instantaneously in case of a short-circuit. The protection can be excluded.

(G) Protection against ground fault
The protection against ground fault trips when the vectorial sum of the currents passing through the current sensors exceeds the set threshold value, with long inverse time-delay trip ($I^2t=k$ ON) or a constant trip time ($I^2t=k$ OFF). The protection can be excluded.

2

Advanced protection functions

The PR332/P trip unit makes it possible to carry out highly developed protection against the most varied types of fault. It adds the following advanced protection functions to the basic protection functions.

(U) Protection against unbalanced phase
The protection function against unbalanced phase U can be used in those cases where a particularly precise control is needed regarding missing and/or unbalance of the phase currents. The trip time is instantaneous. The protection can be excluded.

(OT) Protection against overtemperature
The protection against overtemperature trips instantaneously when the temperature inside the trip unit exceeds 85 °C, in order to prevent any temporary or continual malfunction of the microprocessor. The protection cannot be excluded.

(ZS) Zone selectivity
ZS zone selectivity is an advanced method for carrying out coordination of the protections in order to reduce the trip times of the protection closest to the fault in relation to the time foreseen by time selectivity. Zone selectivity can be applied to the protection functions S and G, with constant time-delay trip. The protection can be excluded.

(UV, OV, RV) Protections against voltage
The three protections trip with a constant time-delay in the case of undervoltage, overvoltage and residual voltage respectively. The latter allows to detect interruptions of the neutral (or of the ground conductor in systems with grounded neutral). The protections can be excluded.

(RP) Protection against reversal of power
The protection against reversal power causes tripping of the breaker, with constant time-delay trip, when the flow of power reverses sign and exceeds, as an absolute value, the set threshold. It is particularly suitable for protection of large machines such as generators. The protection can be excluded.

(UF, OF) Protections of frequency
The two protections detect the variation in network frequency above or below the adjustable thresholds, opening the circuit breaker, with constant time-delay trip. The protection can be excluded.

Electronic trip units for power distribution

SACE PR221DS		
	PR221DS	**PR221DS**
Protection functions	L S / I	I

SACE PR222DS/P		
	PR222DS/P	**PR222DS/P**
Protection functions	L S I	L S I G

SACE PR222DS/PD-A		
	PR222DS/PD-A	**PR222DS/PD-A**
Protection functions	L S I	L S I G

SACE PR231/P

	PR231/P	PR231/P
Protection functions	L S / I	I

SACE PR232/P

	PR232/P
Protection functions	L S I

SACE PR331/P

	PR331/P
Protection functions	L S I G

SACE PR332/P

	PR332/P	PR332/P	PR332/P
Protection functions	L I	L S I	L S I G[1]
Advanced protection function[*]	L[***] U OT	L[***] U OT	L[***] U OT
Opt.[**]	UV OV RV RP UF OF	UV OV RV RP UF OF	UV OV RV RP UF OF

[1] In alternative to Rc (with external toroid).
[*] For all versions.
[**] Available with PR330/V. Measurement module.
[***] According to IEC 60255-3.

PR221DS − Tmax T2, T4, T5 and T6

The PR221DS trip unit, available for T2,T4, T5 and T6, provides protection functions against overload L and short-circuit S/I (version PR221DS-LS/I): with this version you can choose whether to have inverse time-delay S or instantaneous I protection against short-circuit by moving the dedicated dip-switch. Alternatively, the version with only the protection function against instantaneous short-circuit I is available (version PR221DS-I, also see page 2/33 and following).
There is a single adjustment for the phases and the neutral. The neutral is adjustable from 50 - 100% of the phases for Tmax T2 In = 160 A (T2 In<160 A, N = 100%), whereas for T4, T5 and T6 it is possible to select the protection threshold OFF, 50% or 100% directly from the front of the trip unit by means of the specific dip switch.
The trip coil is always supplied with the PR221DS trip unit for Tmax T2 and is housed in the right-hand slot of the circuit breaker. Dedicated auxiliary contacts are available for T2 with electronic trip units (see page 3/21).
For Tmax T4, T5 and T6, the opening solenoid is housed internally and therefore, by not using the right-hand slot of the circuit breaker, all the auxiliary contacts available can be used.

PR221DS-LS/I

Protection S
Against short-circuit with delayed trip

Protection L
Against overload

Dip-switch for neutral setting (only for T4, T5 and T6)

Socket for TT1 test unit

Protection I
Against short-circuit with instantaneous trip

1SDC210B05F0001

PR221DS - Protection functions and settings

Protection functions		Trip threshold	Trip curves[1]
L **CANNOT BE EXCLUDED**	Against overload with long inverse time delay trip and trip characteristic according to an inverse time curve (I^2t=constant)	I_1 = 0.40 - 0.44 - 0.48 - 0.52 - 0.56 - 0.60 - 0.64 - 0.68 - 0.72 - 0.76 - 0.80 - 0.84 - 0.88 - 0.92 - 0.96 - 1 x In Release between 1.1...1.3 x I_1 (IEC 60947-2 and UL 489)	at 6 x I_1, t_1 = 3s at 6 x I_1, t_1 = 6s **only for T2** at 6 x I_1, t_1 = 12s **only for T4, T5** Tolerance: ± 10% up to 6 x In, ± 20% above 6 x In
S **CAN BE EXCLUDED**	Against short-circuit with inverse short time delay trip and trip characteristic with inverse time (I^2t=constant) (selectable as an alternative to protection function I)	I_2 = 1 - 1.5 - 2 - 2.5 - 3 - 3.5 - 4.5 - 5.5 - 6.5 - 7 - 7.5 - 8 - 8.5 - 9 - 10 x In[2] Tolerance: ± 10% (T4-T5), ± 10% up to 2 x In (T2), ± 20% above 2 x In (T2)	a 8 x In, t_2 = 0,1s a 8 x In, t_2 = 0,25s Tolerance: ± 10% up to 6 x In (T4-T5), ± 20% above 6 x In (T4-T5), ± 20% (T2)
I **CAN BE EXCLUDED**	Against short-circuit with instantaneous trip (selectable as an alternative to protection function S)	I_3 = 1 - 1,5 - 2 - 2,5 - 3 - 3,5 - 4,5 - 5,5 - 6,5 - 7 - 7,5 - 8 - 8,5 - 9 - 10 x In[3] Tolerance: ± 10% (T4-T5), ± 20% (T2)	instantaneous

[1] These tolerances hold in the following conditions:
– self-powered relay at full power and/or auxiliary supply;
– two or three-phase power supply.

In conditions other than those considered, the following tollerances hold:

	Trip time
S	± 20%
I	≤ 40ms

[2] For T5 In = 600 A ⇒ I_2 max = 9.5 x In
[3] For T5 In = 600 A ⇒ I_3 max = 9.5 x In

PR222DS/P − Tmax T4, T5 and T6

The PR222DS/P trip unit, available for T4, T5 and T6, has protection functions against overload L, delayed S and instantaneous I short-circuit (version PR222DS/P-LSI). Alternatively, in addition to the functions L, S, I, it also has protection against ground fault G (version PR222DS/P-LSIG).
Setting of the PR222DS trip unit can be carried out either by means of dip switches on the front of the circuit breaker or electronically, using the PR010/T programming and control unit (see page 3/48) or the BT030 wireless communication unit (see page 3/45).
There is a single setting for the phases and neutral for which one can decide whether to set the threshold of the protection functions to OFF, to 50% or to 100% of the phases by means of two dedicated dip switches.
Furthermore, on the front of the PR222DS/P (or PR222DS/PD-A) trip units, signalling of pre-alarm and alarm of protection L is available. The pre-alarm threshold value, signalled by the red LED fixed, is equal to 0.9 x I1. It is also possible to remotely transmit the alarm of protection L by simply connecting connector X3 to the dedicated contact.

PR222DS/PD-A − Tmax T4, T5 and T6

Apart from the protection functions available for the PR222DS/P trip unit (for the settings see page 2/18), the PR222DS/PD-A trip unit, available for T4, T5 and T6 also has the communication unit integrated with Modbus® RTU protocol.
The Modbus® RTU protocol has been known and used worldwide for many years and is now a market standard thanks to its simplicity of installation, configuration and to its integration in the various different supervision, control and automation systems, as well as good level performances.
The PR222DS/PD-A trip units allow the Tmax T4, T5 and T6 circuit breakers to be integrated in a communication network based on the Modbus® RTU protocol. Modbus® RTU provides a Master-Slave system architecture where a Master (PLC, PC…) cyclically interrogates several Slaves (field devices). The devices use the EIA RS485 standard as the physical means for data transmission at a maximum transmission speed of 19.2 kbps.
Again for this trip unit, the power supply needed for correct operation of the protection functions is supplied directly by the current transformers of the trip unit and tripping is always guaranteed, even under conditions of single-phase load down. Nevertheless, communication is only possible with an auxiliary power supply of 24 V DC.

PR222DS/PD-A − Electrical characteristics

Auxiliary power supply (galvanically insulated)	24 V DC ± 20%
Maximum ripple	± 5%
Inrush current @ 24 V	1 A for 30 ms
Rated current @ 24 V	100 mA
Rated power @ 24 V	2.5 W

The PR222DS/PD-A trip unit, with integrated communication and control functions, allows a wide range of information to be acquired and transmitted remotely, opening and closing commands to be carried out by means of the electronic version motor operator, the configuration and programming parameters of the unit to be stored, such as the current thresholds of the protection functions and the protection curves.
All the information can be consulted both locally, directly on the front of the circuit breaker with the front display unit FDU, or on the HMI030 switchgear multi-meter and remotely by means of supervision and control systems.
Moreover, by connecting of the BT030 external module to the test connector of the PR222DS/PD-A trip unit, wireless communication to a PDA or Notebook is possible through a Bluetooth port.
The PR222DS/PD-A trip units can be associated with the AUX-E auxiliary contacts to know the state of the circuit breaker (open/closed), and with MOE-E motor operator (the AUX-E are obligatory when MOE-E is to be used) to remotely control circuit- breaker opening and closing as well.
If the circuit breaker fitted with the PR222DS/PD-A trip unit is inserted in a supervision system, during the test phases with the PR010/T unit, communication is automatically abandoned and starts again on completion of this operation.

Communication functions	PR222DS/P	PR222DS/PD-A
Protocol		Modbus RTU standard
Physical medium		EIA RS485
Speed (maximum)		19.2 kbps
Measurement functions		
Phase currents	■(1)	■
Neutral current	■(1)	■
Ground current	■(1)	■
Voltages (phase to phase, phase to ground)		
Powers (active, reactive, apparent)		
Power factors		
Energies		
Peak factor		
Frequency		
Signalling functions		
L pre-alarm and alarm LED	■(5)	■(5)
L alarm output contact(2)	■	■
Available data		
Circuit breaker status (open, closed)(3)		■
Mode (local, remote)		■
Protection parameters set	■(1)	■
Alarms		
Protections: L, S, I, G	■(1)	■
Failed tripping under fault conditions	■(1)	■
Maintenance		
Total number of operations		■
Total number of trips		■
Number of trip tests		■
Number of manual operations		■
Number of trips for each individual protection function		■
Record of last trip data	■(1)	■
Commands		
Circuit breaker opening/closing (with motor operator)		■
Alarm reset	■(1)	■
Circuit breaker reset (with motor operator)		■
Setting the curves and protection thresholds	■(1)	■
Safety function		
Automatic opening in the case of failed Trip command fail (with motor operator)(4)		■
Events		
Changes in circuit breaker state, in the protections and all the alarms		■

(1) With PR010/T unit or BT030 unit
(2) Typical contact: MOS photo Vmax: 48 V DC/30 V AC
Imax: 50 mA DC/35 mA AC
(3) Available with AUX-E electronic auxiliary contacts
(4) The motor operator must be in electronic version (MOE-E) and electronic auxiliary contacts (AUX-E) have to be used
(5) Signals: – Pre-alarm L - permanently lit
– Alarm L - flashing (0.5 s ON / 0.5 s OFF)
– Incongruent manual setting (L > S / S > I) - flashing (1 s ON / 2 s OFF)
– WINK (remote control to identify the relay) - flashing (0.125 s ON / 0.125 s OFF)

PR222DS/P

Protection S
Against short-circuit
with delayed trip

Protection L
Against overload

Socket for TT1
test unit

Socket for connection
of PR010/T test unit
and BT030 wireless
communication unit

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Protection I
Against short-circuit
with instantaneous trip

Dip-switch for
neutral setting

Selection for electronic
or manual setting

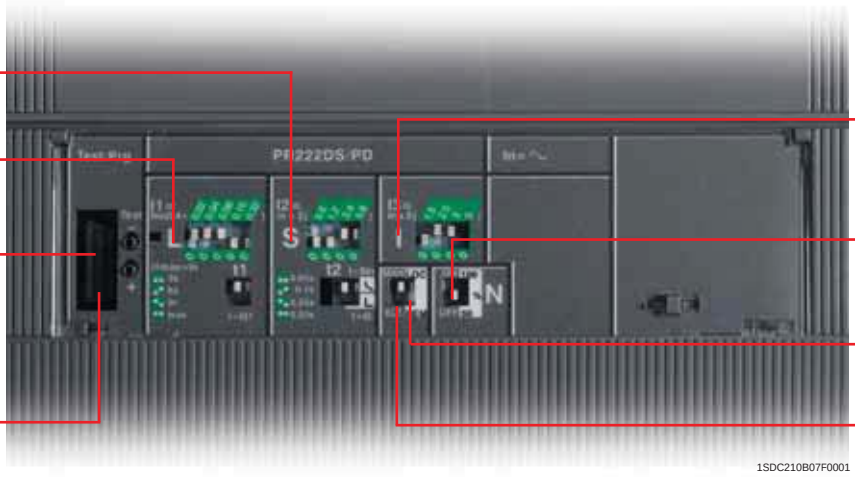
PR222DS/PD-A

Protection S
Against short-circuit
with delayed trip

Protection L
Against overload

Socket for TT1
test unit

Socket for connection
of PR010/T test unit
and BT030 wireless
communication unit



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Protection I
Against short-circuit
with instantaneous trip

Dip-switch for
neutral setting

Selection for electronic
or manual setting

Selection for local
or remote setting

PR222DS/P, PR222DS/PD-A − Protection functions and settings

Protection functions		Trip threshold	Trip curves[1]
L **CANNOT BE EXCLUDED**	Against overload with long inverse time delay trip and trip characteristic according to an inverse time curve (I^2t=constant)	**Manual setting** I_1 = 0.40 - 0.42 - 0.44 - 0.46 - 0.48 - 0.50 - 0.52 - 0.54 - 0.56 - 0.58 - 0.60 - 0.62 - 0.64 - 0.66 - 0.68 - 0.70 - 0.72 - 0.74 - 0.76 - 0.78 - 0.80 - 0.82 - 0.84 - 0.86 - 0.88 - 0.90 - 0.92 - 0.94 - 0.96 - 0.98 - 1 x In	**Manual setting** at 6 x I_1 t_1 = 3s; at 6 x I_1 t_1 = 6s; at 6 x I_1 t_1 = 9s; at 6 x I_1 t_1 = 18s[2]
		Electronic setting I_1= 0.40…1 x In (step 0.01 x In) Release between 1.1...1.3 x I_1 (IEC 60947-2 and UL 489)	**Electronic setting** at 6 x I_1 t_1 = 3…18s (step 0.5s)[2] Tolerance: ± 10%
S **CAN BE EXCLUDED**	Against short-circuit with inverse short time delay trip and trip characteristic with inverse time (I^2t=constant) or definite time	**Manual setting** I_2 = 0.6 - 1.2 - 1.8 - 2.4 - 3.0 - 3.6 - 4.2 - 5.8 - 6.4 - 7.0 - 7.6 - 8.2 - 8.8 - 9.4 - 10 x In[3]	**Manual setting** at 8 x In t_2 = 0.05s; at 8 x In t_2 = 0.1s; at 8 x In t_2 = 0.25s; at 8 x In t_2 = 0.5s
	I^2t=const ON	**Electronic setting** I_2 = 0.60…10 x In (step 0.1 x In) [3] Tolerance: ± 10%	**Electronic setting** at 8 x In t_2 = 0.05…0.5s (step 0.01s) Tolerance: ± 10%[4]
		Manual setting I_2 = 0.6 - 1.2 - 1.8 - 2.4 - 3.0 - 3.6 - 4.2 - 5.8 - 6.4 - 7.0 - 7.6 - 8.2 - 8.8 - 9.4 - 10 x In[3]	**Manual setting** t_2 = 0.05s; t_2 = 0.1s; t_2 = 0.25s; t_2 = 0.5s
	I^2t=const OFF	**Electronic setting** I_2 = 0.60…10 x In (step 0.1 x In)[3] Tolerance: ± 10%	**Electronic setting** t_2 =0.05…0.5s (step 0.01s) Tolerance: ± 10%[4]
I **CAN BE EXCLUDED**	Against short-circuit with instantaneous trip	**Manual setting** I_3 = 1.5 - 2.5 - 3 - 4 - 4.5 - 5 - 5.5 - 6.5 - 7 - 7.5 - 8 - 9 - 9.5 - 10.5 - 12 x In[3]	instantaneous
		Electronic setting I_3 = 1.5…12 x In (step 0.1 x In) [3] Tolerance: ± 10%	
G **CAN BE EXCLUDED**	Against ground fault with inverse short time delay trip and trip characteristic according to an inverse time curve (I^2t= constant)	**Manual setting** I_4 = 0.2 - 0.25 - 0.45 - 0.55 - 0.75 - 0.8 - 1 x In	**Manual setting** up to 3.15 x I_4 t_4 = 0.1s; up to 2.25 x I_4 t_4 = 0.2s; up to 1.6 x I_4 t_4 = 0.4s; up to 1.10 x I_4 t_4 = 0.8s
		Electronic setting I_4 = 0.2…1 x In (step 0.01 x In) Tolerance: ± 10%	**Electronic setting** t_4 = 0.1...0.8 x In (step 0.01s) Tolerance: ± 20%

[1] These tolerances hold in the following conditions:
– self-powered relay at full power and/or auxiliary supply;
– two or three-phase power supply.
In conditions other than those considered, the following tolerances hold:

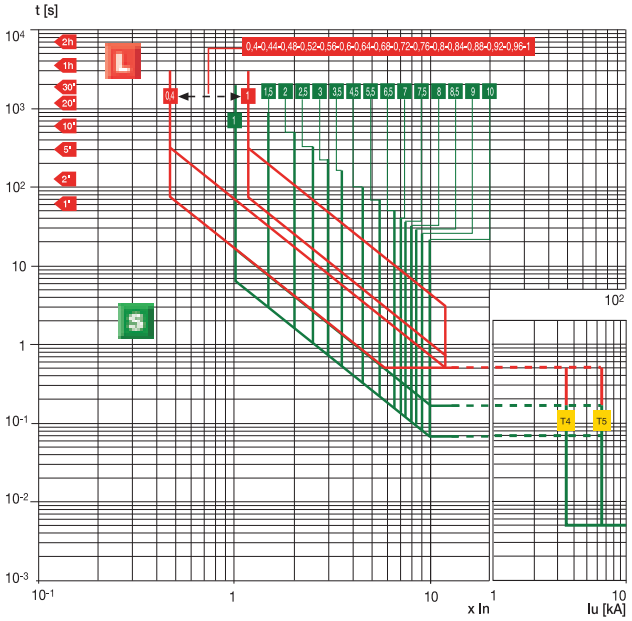
	Trip time
S	± 20%
G	± 20%

[2] For T5 In = 600 A ⇒ t_1 = 10.5s
[3] For T5 In = 600 A ⇒ I_3max = 9.5 x In
I_2max = 9.5 x In
[4] Tolerance: ± 10 ms up to t_2 = 0.1s

T4 250 / T5 400/600 – PR221DS

L-S Functions

Note: For T5 In = 600 A ⇒ I_2max = 9.5 x In



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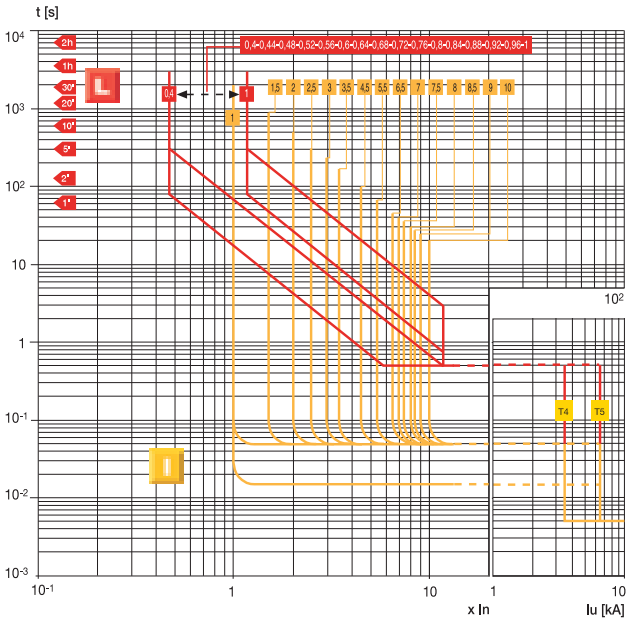
T4 250 / T5 400/600 – PR221DS

L-I Functions

Note: For T5 In = 600 A ⇒ I_3max = 9.5 x In



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For use in alternating current the Tmax T2, T4, T5, T6 and T7 circuit breakers can be equipped with trip units constructed using electronic technology. This allows protection functions to be obtained which provide high reliability, tripping precision and insensitivity to temperature and to the electromagnetic components.
The power supply needed for correct operation is supplied directly by the current sensors of the trip unit, and tripping is always guaranteed, even under single-phase load conditions.

Characteristics of the Tmax electronic trip units

Operating temperature	-13 °F…+158 °F (-25 °C…+70 °C)
Relative humidity	98%
Self-supply	0.2 x In (single phase)
Auxiliary power supply (where applicable)	24 V DC
Operating frequency	45…66 Hz
Electromagnetic compatibility (LF and HF)	IEC 60947-2 Annex F

For Tmax T2, T4, T5 and T6 the protection trip unit consists of:
– 3 or 4 current sensors (current transformers)
– external current sensors (e.g. for the external neutral), when available
– a trip unit
– a trip coil (for T2 housed in the right slot, for T4, T5 and T6 integrated in the electronic trip unit).
For Tmax T7 the protection trip unit consists of:
– 3 or 4 current sensors (Rogowski coils and current transformers)
– external current sensors (e.g. for the external neutral)
– interchangeable rating plug
– a trip unit
– a trip coil housed in the body of the circuit breaker.

Rating plugs

Circuit breaker	CS Rated current I_u	In [A]				
		400	600	800	1000	1200
T7	1000	■	■	■	■	
	1200	■	■	■	■	■

The current sensors supply the electronic trip unit with the energy needed for correct operation of the trip unit and the signal needed to detect the current.
The current sensors are available with rated primary current as shown in the table.

Current sensors

	In [A]	25	60	100	150	250	300	400	600	800	1000	1200
PR221DS	T2	■	■	■	■							
	T4			■	■	■	■					
	T5						■	■	■			
	T6								■	■		
PR222DS/P, PR222DS/PD-A	T4			■	■	■	■					
	T5						■	■	■			
	T6								■	■		
PR231/P, PR232/P, PR331/P, PR332/P	T7							■	■	■	■	■

When a protection function trips, the circuit breaker opens by means of the trip coil, which changes the contact AUX-SA (supplied on request, see chapter “Accessories” at page 3/21 and following) to tripping. Mechanical signalling reset takes place with resetting of the circuit breaker.

Basic protection functions

(L) Protection against overload
This protection function trips when there is an overload with inverse long-time delay trip according to an inverse time curve ($I^2t=k$). The protection cannot be excluded.

(S) Protection against short-circuit with time delay
This protection function trips when there is a short-circuit, with long inverse time-delay trip ($I^2t=k$ ON) or a constant trip time ($I^2t=k$ OFF). The protection can be excluded.

(I) Instantaneous protection against short-circuit
This protection function trips instantaneously in case of a short-circuit. The protection can be excluded.

(G) Protection against ground fault
The protection against ground fault trips when the vectorial sum of the currents passing through the current sensors exceeds the set threshold value, with long inverse time-delay trip ($I^2t=k$ ON) or a constant trip time ($I^2t=k$ OFF). The protection can be excluded.

2

Advanced protection functions

The PR332/P trip unit makes it possible to carry out highly developed protection against the most varied types of fault. It adds the following advanced protection functions to the basic protection functions.

(U) Protection against unbalanced phase
The protection function against unbalanced phase U can be used in those cases where a particularly precise control is needed regarding missing and/or unbalance of the phase currents. The trip time is instantaneous. The protection can be excluded.

(OT) Protection against overtemperature
The protection against overtemperature trips instantaneously when the temperature inside the trip unit exceeds 85 °C, in order to prevent any temporary or continual malfunction of the microprocessor. The protection cannot be excluded.

(ZS) Zone selectivity
ZS zone selectivity is an advanced method for carrying out coordination of the protections in order to reduce the trip times of the protection closest to the fault in relation to the time foreseen by time selectivity. Zone selectivity can be applied to the protection functions S and G, with constant time-delay trip. The protection can be excluded.

(UV, OV, RV) Protections against voltage
The three protections trip with a constant time-delay in the case of undervoltage, overvoltage and residual voltage respectively. The latter allows to detect interruptions of the neutral (or of the ground conductor in systems with grounded neutral). The protections can be excluded.

(RP) Protection against reversal of power
The protection against reversal power causes tripping of the breaker, with constant time-delay trip, when the flow of power reverses sign and exceeds, as an absolute value, the set threshold. It is particularly suitable for protection of large machines such as generators. The protection can be excluded.

(UF, OF) Protections of frequency
The two protections detect the variation in network frequency above or below the adjustable thresholds, opening the circuit breaker, with constant time-delay trip. The protection can be excluded.

Electronic trip units for power distribution

SACE PR221DS		
	PR221DS	**PR221DS**
Protection functions	L S / I	I

SACE PR222DS/P		
	PR222DS/P	**PR222DS/P**
Protection functions	L S I	L S I G

SACE PR222DS/PD-A		
	PR222DS/PD-A	**PR222DS/PD-A**
Protection functions	L S I	L S I G

SACE PR231/P

	PR231/P	PR231/P
Protection functions	L S / I	I

SACE PR232/P

	PR232/P
Protection functions	L S I

SACE PR331/P

	PR331/P
Protection functions	L S I G

SACE PR332/P

	PR332/P	PR332/P	PR332/P
Protection functions	L I	L S I	L S I G[1]
Advanced protection function[*]	L[***] U OT	L[***] U OT	L[***] U OT
Opt.[**]	UV OV RV RP UF OF	UV OV RV RP UF OF	UV OV RV RP UF OF

[1] In alternative to Rc (with external toroid).
[*] For all versions.
[**] Available with PR330/V. Measurement module.
[***] According to IEC 60255-3.

PR221DS − Tmax T2, T4, T5 and T6

The PR221DS trip unit, available for T2,T4, T5 and T6, provides protection functions against overload L and short-circuit S/I (version PR221DS-LS/I): with this version you can choose whether to have inverse time-delay S or instantaneous I protection against short-circuit by moving the dedicated dip-switch. Alternatively, the version with only the protection function against instantaneous short-circuit I is available (version PR221DS-I, also see page 2/33 and following).
There is a single adjustment for the phases and the neutral. The neutral is adjustable from 50 - 100% of the phases for Tmax T2 In = 160 A (T2 In<160 A, N = 100%), whereas for T4, T5 and T6 it is possible to select the protection threshold OFF, 50% or 100% directly from the front of the trip unit by means of the specific dip switch.
The trip coil is always supplied with the PR221DS trip unit for Tmax T2 and is housed in the right-hand slot of the circuit breaker. Dedicated auxiliary contacts are available for T2 with electronic trip units (see page 3/21).
For Tmax T4, T5 and T6, the opening solenoid is housed internally and therefore, by not using the right-hand slot of the circuit breaker, all the auxiliary contacts available can be used.

PR221DS-LS/I

Protection S
Against short-circuit with delayed trip

Protection L
Against overload

Dip-switch for neutral setting (only for T4, T5 and T6)

Socket for TT1 test unit

Protection I
Against short-circuit with instantaneous trip

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PR221DS - Protection functions and settings

Protection functions		Trip threshold	Trip curves[1]
L **CANNOT BE EXCLUDED**	Against overload with long inverse time delay trip and trip characteristic according to an inverse time curve (I^2t=constant)	I_1 = 0.40 - 0.44 - 0.48 - 0.52 - 0.56 - 0.60 - 0.64 - 0.68 - 0.72 - 0.76 - 0.80 - 0.84 - 0.88 - 0.92 - 0.96 - 1 x In Release between 1.1...1.3 x I_1 (IEC 60947-2 and UL 489)	at 6 x I_1, t_1 = 3s at 6 x I_1, t_1 = 6s **only for T2** at 6 x I_1, t_1 = 12s **only for T4, T5** Tolerance: ± 10% up to 6 x In, ± 20% above 6 x In
S **CAN BE EXCLUDED**	Against short-circuit with inverse short time delay trip and trip characteristic with inverse time (I^2t=constant) (selectable as an alternative to protection function I)	I_2 = 1 - 1.5 - 2 - 2.5 - 3 - 3.5 - 4.5 - 5.5 - 6.5 - 7 - 7.5 - 8 - 8.5 - 9 - 10 x In[2] Tolerance: ± 10% (T4-T5), ± 10% up to 2 x In (T2), ± 20% above 2 x In (T2)	a 8 x In, t_2 = 0,1s a 8 x In, t_2 = 0,25s Tolerance: ± 10% up to 6 x In (T4-T5), ± 20% above 6 x In (T4-T5), ± 20% (T2)
I **CAN BE EXCLUDED**	Against short-circuit with instantaneous trip (selectable as an alternative to protection function S)	I_3 = 1 - 1,5 - 2 - 2,5 - 3 - 3,5 - 4,5 - 5,5 - 6,5 - 7 - 7,5 - 8 - 8,5 - 9 - 10 x In[3] Tolerance: ± 10% (T4-T5), ± 20% (T2)	instantaneous

[1] These tolerances hold in the following conditions:
– self-powered relay at full power and/or auxiliary supply;
– two or three-phase power supply.

In conditions other than those considered, the following tollerances hold:

	Trip time
S	± 20%
I	≤ 40ms

[2] For T5 In = 600 A ⇒ I_2 max = 9.5 x In
[3] For T5 In = 600 A ⇒ I_3 max = 9.5 x In

PR222DS/P − Tmax T4, T5 and T6

The PR222DS/P trip unit, available for T4, T5 and T6, has protection functions against overload L, delayed S and instantaneous I short-circuit (version PR222DS/P-LSI). Alternatively, in addition to the functions L, S, I, it also has protection against ground fault G (version PR222DS/P-LSIG).
Setting of the PR222DS trip unit can be carried out either by means of dip switches on the front of the circuit breaker or electronically, using the PR010/T programming and control unit (see page 3/48) or the BT030 wireless communication unit (see page 3/45).
There is a single setting for the phases and neutral for which one can decide whether to set the threshold of the protection functions to OFF, to 50% or to 100% of the phases by means of two dedicated dip switches.
Furthermore, on the front of the PR222DS/P (or PR222DS/PD-A) trip units, signalling of pre-alarm and alarm of protection L is available. The pre-alarm threshold value, signalled by the red LED fixed, is equal to 0.9 x I1. It is also possible to remotely transmit the alarm of protection L by simply connecting connector X3 to the dedicated contact.

PR222DS/PD-A − Tmax T4, T5 and T6

Apart from the protection functions available for the PR222DS/P trip unit (for the settings see page 2/18), the PR222DS/PD-A trip unit, available for T4, T5 and T6 also has the communication unit integrated with Modbus® RTU protocol.
The Modbus® RTU protocol has been known and used worldwide for many years and is now a market standard thanks to its simplicity of installation, configuration and to its integration in the various different supervision, control and automation systems, as well as good level performances.
The PR222DS/PD-A trip units allow the Tmax T4, T5 and T6 circuit breakers to be integrated in a communication network based on the Modbus® RTU protocol. Modbus® RTU provides a Master-Slave system architecture where a Master (PLC, PC…) cyclically interrogates several Slaves (field devices). The devices use the EIA RS485 standard as the physical means for data transmission at a maximum transmission speed of 19.2 kbps.
Again for this trip unit, the power supply needed for correct operation of the protection functions is supplied directly by the current transformers of the trip unit and tripping is always guaranteed, even under conditions of single-phase load down. Nevertheless, communication is only possible with an auxiliary power supply of 24 V DC.

PR222DS/PD-A − Electrical characteristics

Auxiliary power supply (galvanically insulated)	24 V DC ± 20%
Maximum ripple	± 5%
Inrush current @ 24 V	1 A for 30 ms
Rated current @ 24 V	100 mA
Rated power @ 24 V	2.5 W

The PR222DS/PD-A trip unit, with integrated communication and control functions, allows a wide range of information to be acquired and transmitted remotely, opening and closing commands to be carried out by means of the electronic version motor operator, the configuration and programming parameters of the unit to be stored, such as the current thresholds of the protection functions and the protection curves.
All the information can be consulted both locally, directly on the front of the circuit breaker with the front display unit FDU, or on the HMI030 switchgear multi-meter and remotely by means of supervision and control systems.
Moreover, by connecting of the BT030 external module to the test connector of the PR222DS/PD-A trip unit, wireless communication to a PDA or Notebook is possible through a Bluetooth port.
The PR222DS/PD-A trip units can be associated with the AUX-E auxiliary contacts to know the state of the circuit breaker (open/closed), and with MOE-E motor operator (the AUX-E are obligatory when MOE-E is to be used) to remotely control circuit- breaker opening and closing as well.
If the circuit breaker fitted with the PR222DS/PD-A trip unit is inserted in a supervision system, during the test phases with the PR010/T unit, communication is automatically abandoned and starts again on completion of this operation.

Communication functions	PR222DS/P	PR222DS/PD-A
Protocol		Modbus RTU standard
Physical medium		EIA RS485
Speed (maximum)		19.2 kbps
Measurement functions		
Phase currents	■(1)	■
Neutral current	■(1)	■
Ground current	■(1)	■
Voltages (phase to phase, phase to ground)		
Powers (active, reactive, apparent)		
Power factors		
Energies		
Peak factor		
Frequency		
Signalling functions		
L pre-alarm and alarm LED	■(5)	■(5)
L alarm output contact(2)	■	■
Available data		
Circuit breaker status (open, closed)(3)		■
Mode (local, remote)		■
Protection parameters set	■(1)	■
Alarms		
Protections: L, S, I, G	■(1)	■
Failed tripping under fault conditions	■(1)	■
Maintenance		
Total number of operations		■
Total number of trips		■
Number of trip tests		■
Number of manual operations		■
Number of trips for each individual protection function		■
Record of last trip data	■(1)	■
Commands		
Circuit breaker opening/closing (with motor operator)		■
Alarm reset	■(1)	■
Circuit breaker reset (with motor operator)		■
Setting the curves and protection thresholds	■(1)	■
Safety function		
Automatic opening in the case of failed Trip command fail (with motor operator)(4)		■
Events		
Changes in circuit breaker state, in the protections and all the alarms		■

(1) With PR010/T unit or BT030 unit
(2) Typical contact: MOS photo Vmax: 48 V DC/30 V AC
Imax: 50 mA DC/35 mA AC
(3) Available with AUX-E electronic auxiliary contacts
(4) The motor operator must be in electronic version (MOE-E) and electronic auxiliary contacts (AUX-E) have to be used
(5) Signals: – Pre-alarm L - permanently lit
– Alarm L - flashing (0.5 s ON / 0.5 s OFF)
– Incongruent manual setting (L > S / S > I) - flashing (1 s ON / 2 s OFF)
– WINK (remote control to identify the relay) - flashing (0.125 s ON / 0.125 s OFF)

PR222DS/P

Protection S
Against short-circuit
with delayed trip

Protection L
Against overload

Socket for TT1
test unit

Socket for connection
of PR010/T test unit
and BT030 wireless
communication unit

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Protection I
Against short-circuit
with instantaneous trip

Dip-switch for
neutral setting

Selection for electronic
or manual setting

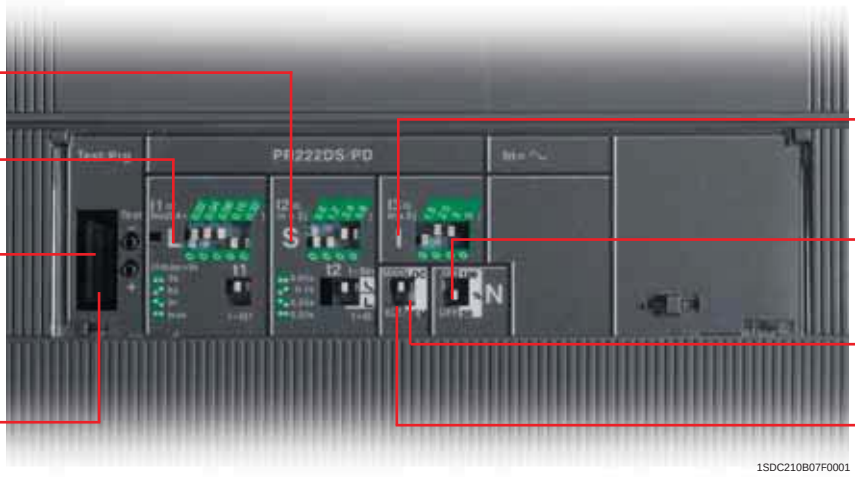
PR222DS/PD-A

Protection S
Against short-circuit
with delayed trip

Protection L
Against overload

Socket for TT1
test unit

Socket for connection
of PR010/T test unit
and BT030 wireless
communication unit



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Protection I
Against short-circuit
with instantaneous trip

Dip-switch for
neutral setting

Selection for electronic
or manual setting

Selection for local
or remote setting

PR222DS/P, PR222DS/PD-A − Protection functions and settings

Protection functions		Trip threshold	Trip curves[1]
L **CANNOT BE EXCLUDED**	Against overload with long inverse time delay trip and trip characteristic according to an inverse time curve (I^2t=constant)	**Manual setting** I_1 = 0.40 - 0.42 - 0.44 - 0.46 - 0.48 - 0.50 - 0.52 - 0.54 - 0.56 - 0.58 - 0.60 - 0.62 - 0.64 - 0.66 - 0.68 - 0.70 - 0.72 - 0.74 - 0.76 - 0.78 - 0.80 - 0.82 - 0.84 - 0.86 - 0.88 - 0.90 - 0.92 - 0.94 - 0.96 - 0.98 - 1 x In	**Manual setting** at 6 x I_1 t_1 = 3s; at 6 x I_1 t_1 = 6s; at 6 x I_1 t_1 = 9s; at 6 x I_1 t_1 = 18s[2]
		Electronic setting I_1= 0.40…1 x In (step 0.01 x In) Release between 1.1...1.3 x I_1 (IEC 60947-2 and UL 489)	**Electronic setting** at 6 x I_1 t_1 = 3…18s (step 0.5s)[2] Tolerance: ± 10%
S **CAN BE EXCLUDED**	Against short-circuit with inverse short time delay trip and trip characteristic with inverse time (I^2t=constant) or definite time	**Manual setting** I_2 = 0.6 - 1.2 - 1.8 - 2.4 - 3.0 - 3.6 - 4.2 - 5.8 - 6.4 - 7.0 - 7.6 - 8.2 - 8.8 - 9.4 - 10 x In[3]	**Manual setting** at 8 x In t_2 = 0.05s; at 8 x In t_2 = 0.1s; at 8 x In t_2 = 0.25s; at 8 x In t_2 = 0.5s
	I^2t=const ON	**Electronic setting** I_2 = 0.60…10 x In (step 0.1 x In) [3] Tolerance: ± 10%	**Electronic setting** at 8 x In t_2 = 0.05…0.5s (step 0.01s) Tolerance: ± 10%[4]
		Manual setting I_2 = 0.6 - 1.2 - 1.8 - 2.4 - 3.0 - 3.6 - 4.2 - 5.8 - 6.4 - 7.0 - 7.6 - 8.2 - 8.8 - 9.4 - 10 x In[3]	**Manual setting** t_2 = 0.05s; t_2 = 0.1s; t_2 = 0.25s; t_2 = 0.5s
	I^2t=const OFF	**Electronic setting** I_2 = 0.60…10 x In (step 0.1 x In)[3] Tolerance: ± 10%	**Electronic setting** t_2 =0.05…0.5s (step 0.01s) Tolerance: ± 10%[4]
I **CAN BE EXCLUDED**	Against short-circuit with instantaneous trip	**Manual setting** I_3 = 1.5 - 2.5 - 3 - 4 - 4.5 - 5 - 5.5 - 6.5 - 7 - 7.5 - 8 - 9 - 9.5 - 10.5 - 12 x In[3]	instantaneous
		Electronic setting I_3 = 1.5…12 x In (step 0.1 x In) [3] Tolerance: ± 10%	
G **CAN BE EXCLUDED**	Against ground fault with inverse short time delay trip and trip characteristic according to an inverse time curve (I^2t= constant)	**Manual setting** I_4 = 0.2 - 0.25 - 0.45 - 0.55 - 0.75 - 0.8 - 1 x In	**Manual setting** up to 3.15 x I_4 t_4 = 0.1s; up to 2.25 x I_4 t_4 = 0.2s; up to 1.6 x I_4 t_4 = 0.4s; up to 1.10 x I_4 t_4 = 0.8s
		Electronic setting I_4 = 0.2…1 x In (step 0.01 x In) Tolerance: ± 10%	**Electronic setting** t_4 = 0.1...0.8 x In (step 0.01s) Tolerance: ± 20%

[1] These tolerances hold in the following conditions:
– self-powered relay at full power and/or auxiliary supply;
– two or three-phase power supply.
In conditions other than those considered, the following tolerances hold:

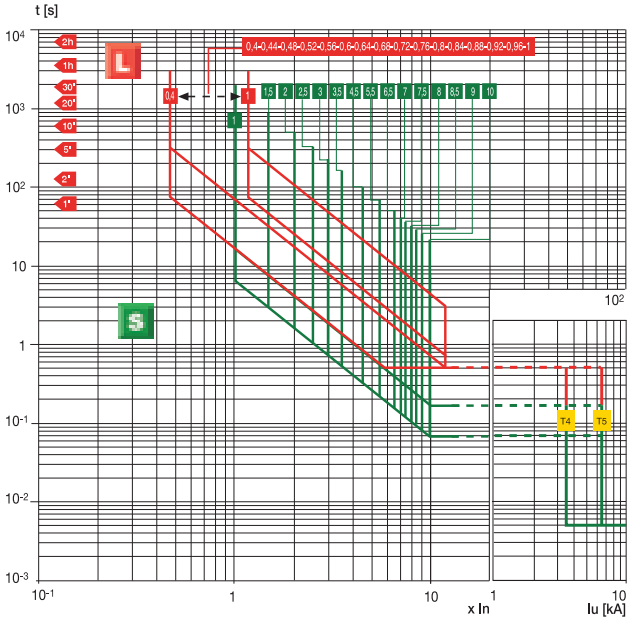
	Trip time
S	± 20%
G	± 20%

[2] For T5 In = 600 A ⇒ t_1 = 10.5s
[3] For T5 In = 600 A ⇒ I_3max = 9.5 x In
I_2max = 9.5 x In
[4] Tolerance: ± 10 ms up to t_2 = 0.1s

T4 250 / T5 400/600 – PR221DS

L-S Functions

Note: For T5 In = 600 A ⇒ I_2max = 9.5 x In



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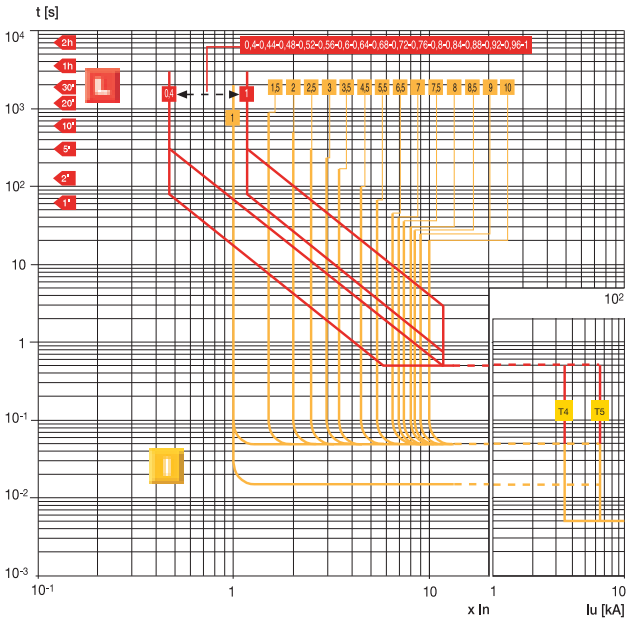
T4 250 / T5 400/600 – PR221DS

L-I Functions

Note: For T5 In = 600 A ⇒ I_3max = 9.5 x In



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KOHLER®

Warranty

Transfer Switch One-Year Limited Warranty

Your Kohler product has been manufactured and inspected with care by experienced craftsmen. If you are the original end user, Kohler Co. warrants, for the period indicated below, each product to be free from defects in materials and workmanship. In the event of a defect in materials or workmanship, Kohler Co. will repair, replace, or make appropriate adjustment at Kohler Co.'s option if the product, upon Kohler Co.'s inspection, is found to be properly installed, maintained, and operated in accordance with Kohler Co.'s instruction manuals. A Kohler distributor, dealer, or authorized service representative must perform startup.

Kohler Product	**Warranty Coverage**
Transfer switch and factory-supplied transfer switch accessories	One (1) year from the registered startup date. In any event, the warranty period will expire not later than thirty (30) months from the date of shipment from Kohler Co.'s factory.
Transfer switch main contacts	Ten (10) years from the registered startup date. In any event, the warranty period will expire not later than eleven (11) years and six (6) months from the date of shipment from Kohler Co.'s factory.

The following will **not** be covered by the warranty:

1. Normal wear, periodic service, and routine adjustments.
2. Damage, including but not limited to damage caused by accidents, improper installation or handling, faulty repairs not performed by an authorized Kohler service representative, improper storage, or acts of God.
3. Damage caused by:
   a. Operation above or below rated capacity, voltage, or frequency.
   b. Modifications.
   c. Installation contrary to published specifications and codes.
4. Damage caused by negligent maintenance such as:
   a. Failure to provide a clean, dry environment.
   b. Failure to perform recommended exercising.
   c. Failure to perform scheduled maintenance as prescribed in supplied manuals.
   d. Use of parts and/or procedures other than factory-supplied or -approved replacement parts and/or procedures.
5. Non-Kohler replacement parts. Replacement of a failed Kohler part with a non-Kohler part voids the warranty on that part.
6. Original installation charges and startup costs.
7. Additional expenses for repair after normal business hours, i.e. overtime or holiday labor rates.
8. Rental of equipment during performance of warranty repairs.
9. Removal and replacement of non-Kohler-supplied options and equipment.
10. Non-Kohler-authorized repair shop labor without prior approval from Kohler Co. Warranty Department.
11. Expenses incurred investigating performance complaints unless the problem is caused by defective Kohler materials or workmanship.
12. Maintenance items such as fuses, lamps, and adjustments.
13. Labor and travel charges after the first year of the transfer switch main contacts warranty period.
14. Travel time and mileage exceeding 300 miles round trip.

To obtain warranty service, call 1-800-544-2444 for your nearest authorized Kohler service representative or write Kohler Co., Kohler Power Systems Service Department, MS072, Kohler, WI 53044 USA.

KOHLER CO. SHALL NOT BE LIABLE FOR SPECIAL, INCIDENTAL, AND/OR CONSEQUENTIAL DAMAGES OF ANY KIND including, but not limited to, incidental and/or consequential labor costs, installation charges, telephone charges, or transportation charges in connection with the replacement or repair of defective parts.

This is our exclusive written warranty. We make no other express warranty nor is anyone authorized to make any on our behalf.

ANY IMPLIED OR STATUTORY WARRANTY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, IS EXPRESSLY LIMITED TO THE DURATION OF THIS WARRANTY. Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental and/or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

KOHLER®

KOHLER CO. Kohler, Wisconsin 53044
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales/service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

TP-5373 4/15f

KOHLER®

Certification

VMC GROUP
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CERTIFICATE OF COMPLIANCE
SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

Certification No.

VMA-46550-01C (Revision 9)

Expiration Date: 10/31/2022

Certification Parameters:

The nonstructural products (mechanical and/or electrical components) listed on this certificate are CERTIFIED[1] FOR SEISMIC APPLICATIONS in accordance with the following building code[2] releases.

IBC 2018, 2015, 2012, 2009

The following model designations, options, and accessories are included in this certification. Reference report number VMA-46550-01 as issued by The VMC Group for a complete list of certified models, included accessories/options, and certified installation methods.

Kohler; Automatic Transfer Switches

KCx, KBx, KGx, KEP ICCB, KSx, KEP MCCB; 30 - 4000 Amps

The above referenced equipment is **APPROVED** for seismic application when properly installed[3], used as intended, and contains a Seismic Certification Label referencing this Certificate of Compliance[4]. As limited by the tabulated values, below grade, grade, and roof-level installations, installations in essential facilities, for life safety applications, and/or of equipment containing hazardous contents are permitted and included in this certification with an Equipment Importance Factor assigned as I_p=1.5. The equipment is qualified by successful seismic shake table testing at the nationally recognized University of California Berkeley Pacific Earthquake Engineering Research Center, National Technical Solutions Longmont (formerly Sun APT), and National Technical Solutions Huntsville (formerly Wyle Labs) under the witness of the ISO Accredited Product Certification Agency, the VMC Group.

Certified Seismic Design Levels[8]			
Certified **IBC**	**Importance $I_p \leq 1.5$** Soil Classes A-E Risk Categories I-IV Design Categories A-F	z/h ≤ 1.0	z/h = 0.0
		$S_{DS} \leq 2.000$ g	$S_{DS} \leq 2.000$ g

The qualified seismic design level stated is the lowest for all series this certificate covers. For more information, see the certified product tables on page 2.

Certified Seismic Installation Methods	
Rigid Mounting From Unit Base To Rigid Structure	Directly To Structural Wall

HEADQUARTERS
113 Main Street
Bloomingdale, NJ 07403
Phone: 973.838.1780
Toll Free: 800.569.8423
Fax: 973.492.8430

CALIFORNIA
180 Promenade Circle
Suite 300
Sacramento, CA 95834
Phone: 916.634.7771

TEXAS
11930 Brittmoore Park Drive
Houston, TX 77041
Phone: 713.466.0003
Fax: 713.466.1355

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CERTIFICATE OF COMPLIANCE

SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

Certified Product Table:

Model	Amp Range	NEMA 1	NEMA 3R	NEMA 4	NEMA 4X	NEMA 12	Certified S_{DS} Level	Configuration
KCS	30 - 1200	X	X	X	X	X	2.00g at Roof 2.50g at Grade	Non-Bypass (Standard Configuration)
	1600 - 4000			N/A	N/A	N/A		
KCP / KCC	150 - 1200			X	X	X		
	1600 - 4000			N/A	N/A	N/A		
KCS / KCP / KCC	1600 - 2000							Non-Bypass (Front Connected)
KBS / KBP / KBC	150 - 4000						2.00g at Roof and Grade	Bypass
KGS / KGP	150 - 3000		N/A					
KEP ICCB	800 - 4000		X					Service Entrance (Insulated Case Circuit Breaker)
KSS	40 - 1000			X	X	X		Standard Transistion
KSP	100 - 600							Programmed Transistion
KEP MCCB	100 - 1200			N/A	N/A			Service Entrance (Molded Case Circuit Breaker)
	100 - 600	N/A	N/A		X	N/A		

An "X" denotes that the given NEMA enclosure is available as a certified option, whereas the "N/A" denotes the given NEMA enclosure is not available as a certified option.

Group	Type	S_{DS} (z/h=0)	S_{DS} (z/h=1)	A_{Flex-H}	A_{Rig-H}	A_{Flex-V}	A_{Rig-V}	F_p/W_p
Seismic	AC156	2.00	2.00	3.20	2.40	1.33	0.53	1.50

This certification includes the product and factory supplied accessories and options. The product and included accessories and options shall be a catalogue design and factory supplied. The product shall be installed and attached to the building structure per the manufacturer supplied seismic installation instructions. For a list of certified configurations and options please directly contact the manufacturer. This certification excludes all non-factory supplied accessories, including but not limited to enclosures, isolation/restraint devices, remote control panels, mounting brackets, and other electrical/mechanical components.

IBC CERTIFIED VMC GROUP

VMA-46550-01C (Revision 9)
Issue Date: Sunday, November 3, 2013
Revision Date: Thursday, October 1, 2020
Expiration Date: Monday, October 31, 2022

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CERTIFICATE OF COMPLIANCE

SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

Notes & Comments:

1. All equipment listed herein successfully passed the seismic acceptance criteria for shake testing non-structural components and systems as set forth in the ICC AC-156. The Test Response Spectrum (TRS) enveloped the Required Response Spectrum (RRS) for all units tested. The units cited in this certification were representative sample(s) of a contingent of models and all remained captive and structurally sound after the seismic shake simulation. The units also remained functionally operational after the simulation testing as functional testing was completed by the equipment manufacturer before and after the seismic simulations. Although a seismic qualified unit inherently contains some wind resisting capacity, that capacity is undetermined and is excluded from this certification. Snow/Ice loads have been neglected and thus limit the unit to be installed both indoors (covered by an independent protective structure) and out of doors (exposed to accumulating snow/ice) for ground snow loads no greater than 30 psf for all applications.

2. The following building codes are addressed under this certification:
   IBC 2018 referencing ASCE7-16 and ICC-ES AC-156
   IBC 2015 referencing ASCE7-10 and ICC-ES AC-156
   IBC 2012 referencing ASCE7-10 and ICC-ES AC-156
   IBC 2009 referencing ASCE7-05 and ICC-ES AC-156

3. Refer to the manufacturer supplied installation drawings for anchor requirements and mounting considerations for seismic applications. Required anchor locations, size, style, and load capacities (tension and shear) may be specified on the installation drawings or specified by a 3rd party. Mounting requirement details such as anchor brand, type, embedment depth, edge spacing, anchor-to-anchor spacing, concrete strength, special inspection, wall design, and attachment to non-building structures must be outlined and approved by the Engineer of Record for the project or building. Structural walls, structural floors, and housekeeping pads must also be seismically designed and approved by the project or building Structural Engineer of Record to withstand the seismic anchor loads as defined on the installation drawings. The installing contractor is responsible for ensuring the proper installation of all anchors and mounting hardware.

4. For this certificate and certification to remain valid, this certificate must correspond to the "Seismic Certification Label" found affixed to the unit by the factory. The label ensures the manufacturer built the unit in conformance to the IBC seismic design criteria set forth by the Certified Seismic Qualification Agency, the VMC Group, and meets the seismic design levels claimed by this certificate.

5. Mechanical, Electrical, and Plumbing connections to the equipment must be flexibly attached as to not transfer load through the connection. The structural integrity of any conduit, cable trays, piping, ductwork and/or flexible connections is the responsibility of others. This certification does not guarantee the equipment will remain compliant to NEMA, IP, UL, or CSA standards after a seismic event.

6. This certificate applies to units manufactured at:
   300 Twin Oaks Rd, Kohler, WI 53044

7. This certification follows the VMC Group's ISO-17065 Scheme.

8. The qualified seismic design level stated is the lowest for all series this certificate covers. For more information, see the certified product tables on page 2.

John P. Giuliano, PE
President, VMC Group

IAS ACCREDITED Product Certification Agency

VMA-46550-01C (Revision 9)
Issue Date: Sunday, November 3, 2013
Revision Date: Thursday, October 1, 2020
Expiration Date: Monday, October 31, 2022

IBC CERTIFIED VMC GROUP

Kohler Automatic Transfer Switch Test Program
Non-Bypass Models

Testing is an integral part of quality assurance. In keeping with our uncompromising commitment to quality, safety, and reliability, every Kohler Automatic Transfer Switch (ATS) undergoes an extensive series of performance and production testing.

Performance Testing

All Kohler ATSs are UL1008 listed, which includes the following performance tests:

- General – Normal Operation
- Overvoltage
- Undervoltage
- Overload
- Temperature Rise
- Endurance
- Dielectric Voltage – Withstand
- Short Circuit Withstand
- Short Circuit Close- On
- Dielectric Voltage – Withstand (repeated)
- Strength of insulating base and support

EMC/EMI Immunity Verification

Controls and printed circuit board assemblies are evaluated to IEC and IEEE tests, including:

- EN61000- 4- 4 Fast Transient Immunity Severity Level 4
- EN61000- 4- 5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
- IEC Specifications for EMI/EMC Immunity:
  - CISPR 11, Radiated Emissions
  - IEC 1000- 4- 2, Electrostatic Discharge
  - IEC 1000- 4- 3, Radiated Electromagnetic Fields
  - IEC 1000- 4- 4, Electrical Fast Transients (Bursts)
  - IEC 1000- 4- 5, Surge Voltage
  - IEC 1000- 4- 6, Conducted RF Disturbances
  - IEC 1000- 4- 8, Magnetic Fields
  - IEC 1000- 4- 11, Voltage Dips and Interruptions
- IEEE 472 (ANSI C37.90A) Ring Wave Test

Production Testing

Every Kohler ATS is fully tested prior to leaving the factory. Visual inspections are also performed by the mechanism manufacturer as well as Kohler personnel during assembly and final test. Production testing includes the following:

- Electrical operation testing on all ATSs
- Verification of controller communication
- Verification of controller settings
- Voltage calibration
- Automatic transfer switch operation when Normal source is lost
  - Verify engine start signal
  - Verify transfer to Emergency position when Emergency source is available
- Automatic Transfer switch operation when Normal source returns
  - Verify transfer to Normal position
  - Verify engine start signal is removed

CSA Certification

CSA Certification is also available upon request. CSA certification includes the following additional test:

- Dielectric test at 1000V plus twice the maximum rated voltage

Options Testing

The operation of all installed options is verified. Tested options include:

- Input/Output Modules
- Supervised Transfer Control Switch
- Preferred Source Switch
- Load Shed, Normal and Emergency
- Line-to- Neutral Monitoring
- Digital Meter setup and operation

Kohler offers other testing at the customer's request at an additional charge. These optional tests include customized load testing for specific application, witness testing, and contact resistance testing. A certified test report is also available at an additional charge.

KOHLER®

KOHLER CO., Kohler, Wisconsin 53044
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales/service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

G18-414 2/20

KOHLER®

Load Calculations

KOHLER Power Systems

Sizing Report

Project information

Project name: Orleans Collections PS # 1
Customer's name:
Customer contact:

Site requirements

Voltage:	277/480
Phase:	3
Frequency:	60Hz
Alt. Temp. Rise Duty:	130°C Standby
Qty of Gensets:	1
Fuel type:	Diesel
Country :	United States

Application:	Construction
Emissions Requirement:	Stationary emergency (US EPA)
Altitude:	500 Feet
Max. Ambient Temp.:	77 Degrees F
Min. Genset Loading :	5 %
Max. Genset Loading :	100 %

Site load requirements summary

Running kW:	111.28
Running kVA:	130.10
Running P.F.:	0.86

Max. Starting kW:	17.54 in step 2
Max. Starting kVA:	43.86 in step 2

Generator selection

Genset Model:	125REOZJG
Engine:	4045HF285
Emission level:	EPA Tier 3
BHP:	197.00
Displacement:	276.00
RPM:	1800

Alternator:	4R13X
Alternator Leads:	12
Alt. Starting kVA at 35% V dip:	540.00
Cal Alt Temp rise with site loads:	80C
Excitation System :	PMG

Rated kW :	128.00
Site Alt / Temp De-Rated kW :	128.00
UL 2200 Certified	

Generator Performance Summary

Voltage Dip Limit:	20.00 %
Frequency Dip Limit:	5.00 %
Harmonic Distortion Limit:	15.00 %

Calculated Voltage Dip:	4.23 %
Calculated Frequency Dip:	1.35 %
Calculated Harmonic Distortion:	9.85 %
Calculated Genset % Loaded:	86.94 %

Report prepared by: David Duchesneau

TOTAL SYSTEM INTEGRATION
GENERATORS | TRANSFER SWITCHES | SWITCHGEAR | CONTROLS

The analysis provided from Power Solutions Center are for reference only. The installer must work with the local distributor and technician to confirm actual requirements when planning the installation. Kohler Co. reserves the right to change design or specifications without notice and without any obligation or liability whatsoever. Kohler Co. expressly disclaims any responsibility for consequential damages.

Software version: 1.0038.5.212

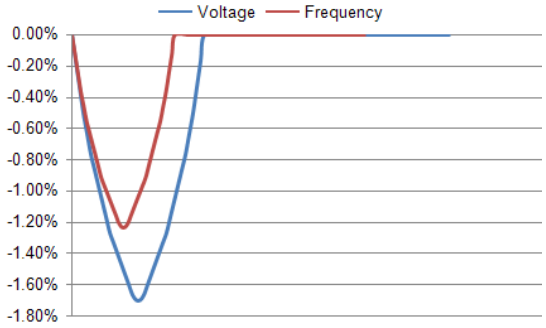
KOHLER Power Systems

Sizing Report

Model : 125REOZJG, Alternator : 4R13X

Load Profile

Step # 1	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor 1.00 HP 3 Phase Motor code : L Loaded NEMA Design across the line	1	0.99	1.42	0.70	6.46	9.50	0.68			
Misc. Linear Load 208 Load Panel 3 Phase	1	7.50	7.50	1.00	7.50	7.50	1.00			
Step Total		8.49	8.56	0.99	13.96	15.60	0.89	1.70	1.23	0.00
Cum.Total		8.49	8.56	0.99						



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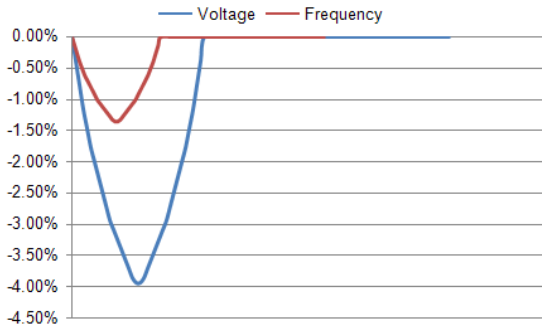
Software version: 1.0038.5.212

KOHLER Power Systems

Sizing Report

Step # 2	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor **40.00 HP** **3 Phase** **Motor code : G** **Loaded** **NEMA Design** **VFD**	1	34.26	40.79	0.84	17.54	43.86	0.40			
Step Total		34.26	40.79	0.84	17.54	43.86	0.40	3.94	1.35	3.28
Cum.Total		42.76	48.62	0.88						



Report prepared by: David Duchesneau

TOTAL SYSTEM INTEGRATION
GENERATORS | TRANSFER SWITCHES | SWITCHGEAR | CONTROLS

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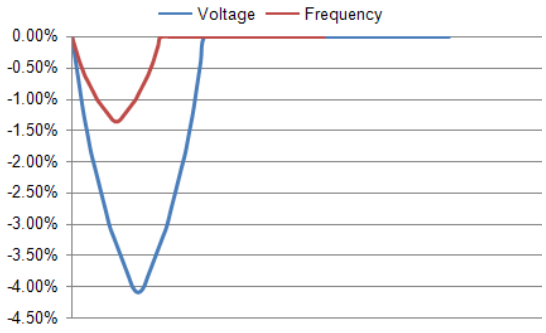
Software version: 1.0038.5.212

KOHLER Power Systems

Sizing Report

Step # 3	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor **40.00 HP** **3 Phase** **Motor code : G** **Loaded** **NEMA Design** **VFD**	1	34.26	40.79	0.84	17.54	43.86	0.40			
Step Total		34.26	40.79	0.84	17.54	43.86	0.40	4.08	1.35	6.57
Cum.Total		77.02	89.34	0.86						



Report prepared by: David Duchesneau

TOTAL SYSTEM INTEGRATION
GENERATORS | TRANSFER SWITCHES | SWITCHGEAR | CONTROLS

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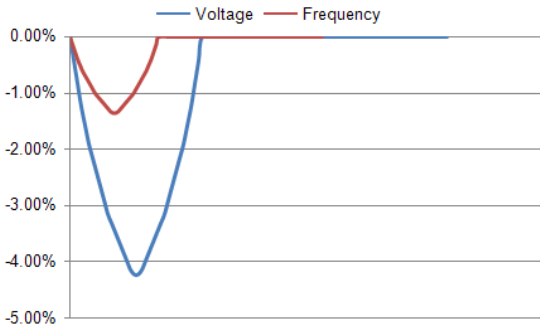
Software version: 1.0038.5.212

KOHLER Power Systems

Sizing Report

Step # 4	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor **40.00 HP** **3 Phase** **Motor code : G** **Loaded** **NEMA Design** **VFD**	1	34.26	40.79	0.84	17.54	43.86	0.40			
Step Total		34.26	40.79	0.84	17.54	43.86	0.40	4.23	1.35	9.85
Cum.Total		111.28	130.10	0.86						
Grand Total		111.28	130.10	0.86				4.23	1.35	9.85



Report prepared by: David Duchesneau

TOTAL SYSTEM INTEGRATION

GENERATORS | TRANSFER SWITCHES | SWITCHGEAR | CONTROLS

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Software version: 1.0038.5.212

KOHLER®

Generator Enclosure Drawings

DRAWINGS PREPARED FOR:
KRAFT POWER
DOWNTOWN AREA WWTF PUMP #1
250 USEABLE / 317 ACTUAL GALLON UL#142 SEALED SECONDARY TANK
w/ 30 dBA REDUCTION ENCLOSURE
WO# 48373
10/9/2020

FIDELITY MANUFACTURING
Forward Thinking Solutions

1900 NE 25TH AVE, OCALA, FL 34470
PHONE (352) 414-4700 FAX (352) 414-4642

SPECIAL INSTRUCTIONS:

1	ENCLOSURE WIND-LOAD RATED AT 150 MPH
2	MOTORIZED INTAKE DAMPER AND GRAVITY DISCHARGE DAMPER
3	ELECTRICAL PKG - 100 AMP MAIN 3ϕ PANEL BOARD, THREE LED LIGHTS, TWO 20A GFCI OUTLETS, AND TWO 3-WAY SWITCHES. ALSO INCLUDES GENERATOR ACCESSORY CONNECTIONS FOR JACKET WATER HEATER, BATTERY CHARGER, AND ALTERNATOR HEATER
4	5KW SPACE HEATER AND THERMOSTAT INSTALLED IN ENCLOSURE
5	EXHAUST FAN AND THERMOSTAT INSTALLED IN ENCLOSURE
6	EXHAUST ELBOW, SILENCER, AND FLEX TO BE WRAPPED IN INSULATION BLANKETS
7	INSTALLATION OF TWO GROUND LUGS ON FUEL TANK
8	PROVIDE AND INSTALL NEOPRENE KORFUND PADS (CP4X4) BETWEEN GENSET AND FUEL TANK
9	FUEL TANK STUB SLEEVE ADDED FOR FULL EXTENSION TO CONCRETE FOR SOUND ATTENUATION
10	CRANKCASE VENT (CCV) ROUTED TO DISCHARGE PLENUM
11	BALL VALVES INSTALLED IN THE SUPPLY/RETURN LINE TO/FROM THE ENGINE
12	PROVIDE AND INSTALL 4-20 MA ULTRASONIC FUEL SENDER
13	MOUNT GENSET AND INSTALL FUEL LINES
14	THREE YEAR WARRANTY
15	SOUND CHECK TEST RUN ON COMPLETED GENERATOR PACKAGE AT FIDELITY'S OCALA FACILITY. TECHNICIAN TO TAKE MULTIPLE POINT READINGS AND PROVIDE DIGITAL PHOTOS OF METER SCREEN AT EACH POSITION. WILL PROVIDE A LOCATIONS/READINGS DIAGRAM. READINGS WILL BE TAKEN AT NO LOAD. DIESEL FUEL FOR TESTING INCLUDED
16	STAMPED PE DRAWINGS AND CALCULATIONS FOR WIND/SEISMIC CERTIFICATION FOR ENCLOSURE DESIGN TO BE SUPPLIED BY STATE OF MASSACHUSETTS PROFESSIONAL ENGINEER WIND/SEISMIC QUALIFICATION CERTIFICATE CERTIFYING THAT ENCLOSURE PACKAGE WILL WITHSTAND THE EFFECTS OF WIND AND EARTHQUAKE LOADING DETERMINED ACCORDING TO ASCE/SEI 7, INCLUDING: -WIND LOAD -ENCLOSURE TO TANK, TANK TO PAD, AND GENERATOR TO TANK ANCHORING -ROOF LOAD SHALL BE EQUAL TO OR GREATER THAN 53 LBS PSF -VERIFICATION OF MEMBER STRESSES -VERIFICATION OF WELDING -ADDITIONAL ACCESSORIES AND COMPONENTS (WEIGHING AT LEAST 20 LBS) ATTACHED TO TANK OR ENCLOSURE

PLEASE NOTE THAT THE FOLLOWING ITEMS WILL SHIP LOOSE AND REQUIRE ON-SITE ASSEMBLY BY OTHERS

1	EXHAUST ELBOW AND RAIN CAP
2	PLENUM DRAIN SHIELD

TANK NOTES:

1. ALL FITTINGS TO BE CARBON STEEL WELD FLANGES (UNLESS OTHERWISE NOTED)
2. EXTERIOR FINISH: "BLACK" FIDELITY STANDARD PAINT
3. INNER TANK DIMENSIONS: 158.5"L x 59.875"W x 8.742"H
4. APPROXIMATE USEABLE TANK CAPACITY: 250 GALLONS @ 90 %
5. ACTUAL TANK VOLUME (100%): 317 GALLONS
6. APPROXIMATE TANK WEIGHT: 2600 LBS

NOTES:

1. GENERATOR, KOHLER 125 REOZJG
   DIMENSIONS: 106.3"L x 44.1"W x 60.1"H
   WEIGHT:2702 LBS
   DRAWING # : ADV-8182
2. TOTAL AIRFLOW REQUIRED: 8341 CFM
3. SOUND ATTENUATION LEVEL: 30 dB(A) REDUCTION AT 23 FEET
4. INSULATION: DOUBLE LAYER OF 2" MINERAL WOOL
5. LINING: MILL-FINISH PERFORATED ALUMINUM
6. ENCLOSURE WALLS: 4" ALUMINUM TUBE WELDED FRAME
7. ENCLOSURE ROOF: 2" ALUMINUM TUBE WELDED FRAME
8. ENCLOSURE DIMENSIONS: 191"L x 66"W x 84"H
9. ENCLOSURE WEIGHT (APPROX.): 3200 LBS
10. ENCLOSURE COLOR: WHITE
11. ENCLOSURE SHALL BE PROVIDED w / 4-POINT LIFTING LUGS
12. TOTAL PACKAGE WEIGHT:8,502 LBS

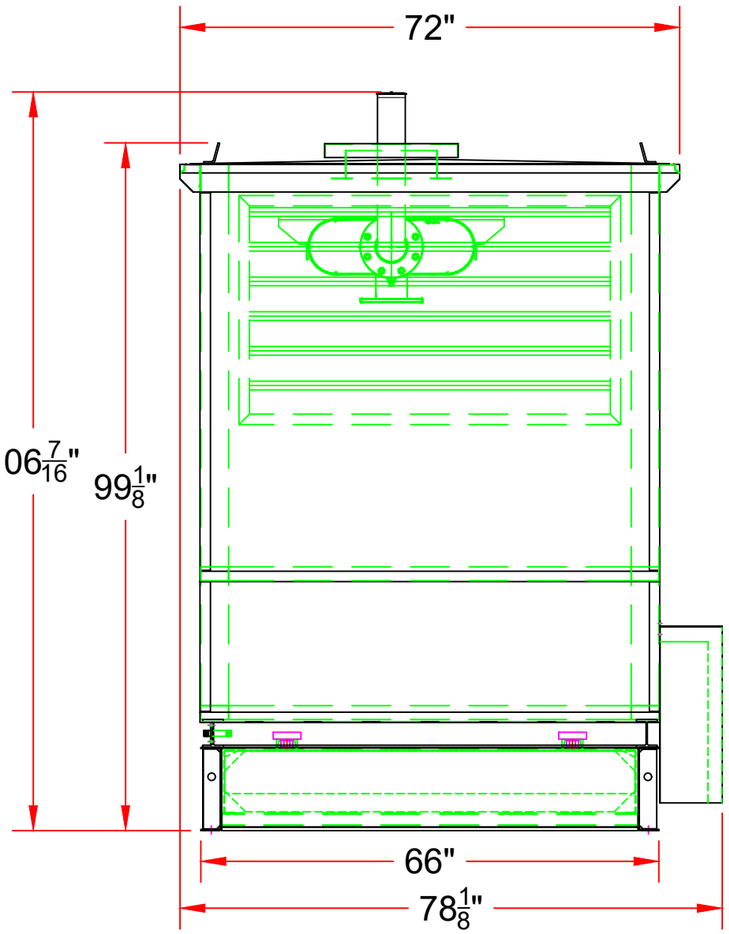
Sheet List Table

Sheet Number	Sheet Title
1	COVER SHEET
2	ASSEMBLY
3	SA LVL 3 ENCLOSURE
4	ELECTRICAL PLAN
5	UL 142 SEALED SECONDARY TANK
6	STAIRS
7	SUGGESTED PAD LAYOUT

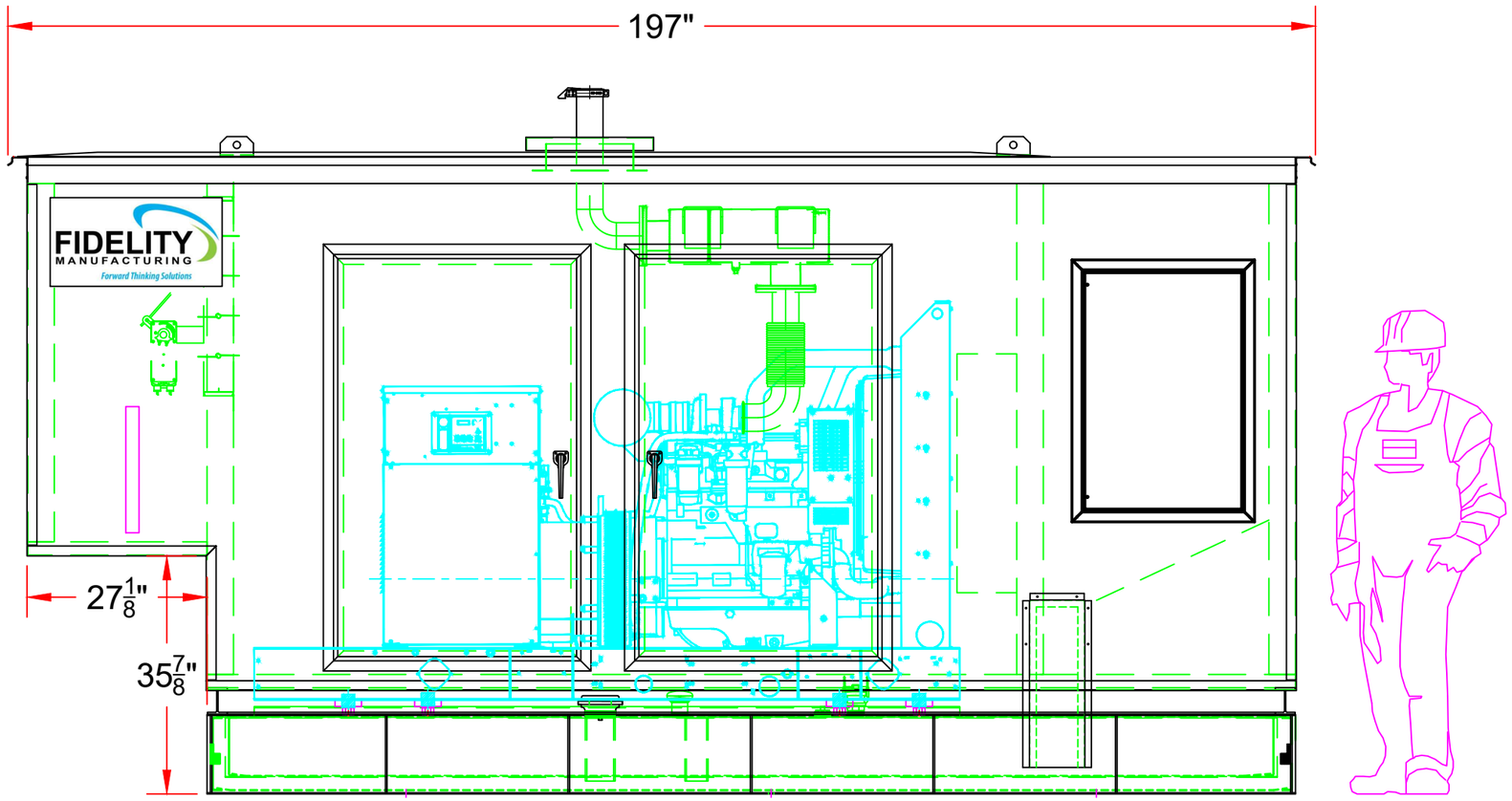
REVISIONS:

REVISION LEVEL	REVISION DESCRIPTION	SHEET OF CHANGE(S)	ENGINEER	DATE
00	INITIAL RELEASE (QUOTE # 84744REV1)		BK	10/9/2020
01				
02				
03				
04				

DRAWING ACCEPTED FOR PRODUCTION	
SIGNATURE	
PRINT NAME-TITLE	DATE / /



REAR VIEW



RIGHT SIDE VIEW (TYPICAL)

ENCL. WEIGHT	TANK WEIGHT	GEN. WEIGHT	TOTAL WEIGHT
3,200 LBS.	2,600 LBS.	2,702 LBS.	*8,502 LBS.*

UL #142
File No. MH27650

CUSTOMER: KRAFT POWER

KOHLER 125 REOZJG

DESCRIPTION ASSEMBLY

THIRD-ANGLE PROJECTION

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REVISION

USEABLE GALLONS / dBA REDUCTION

250 AT 90% / 30

DOWNTOWN AREA WWTF PUMP #1

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WO# 48373

SCALE:

SHEET 2 OF 7

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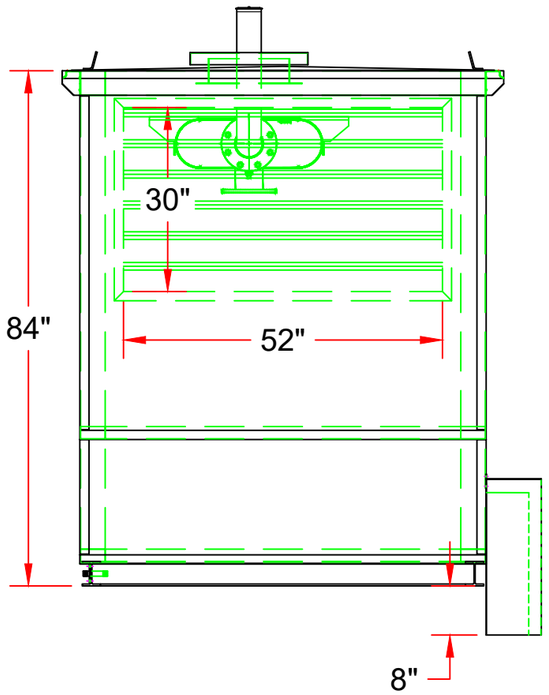
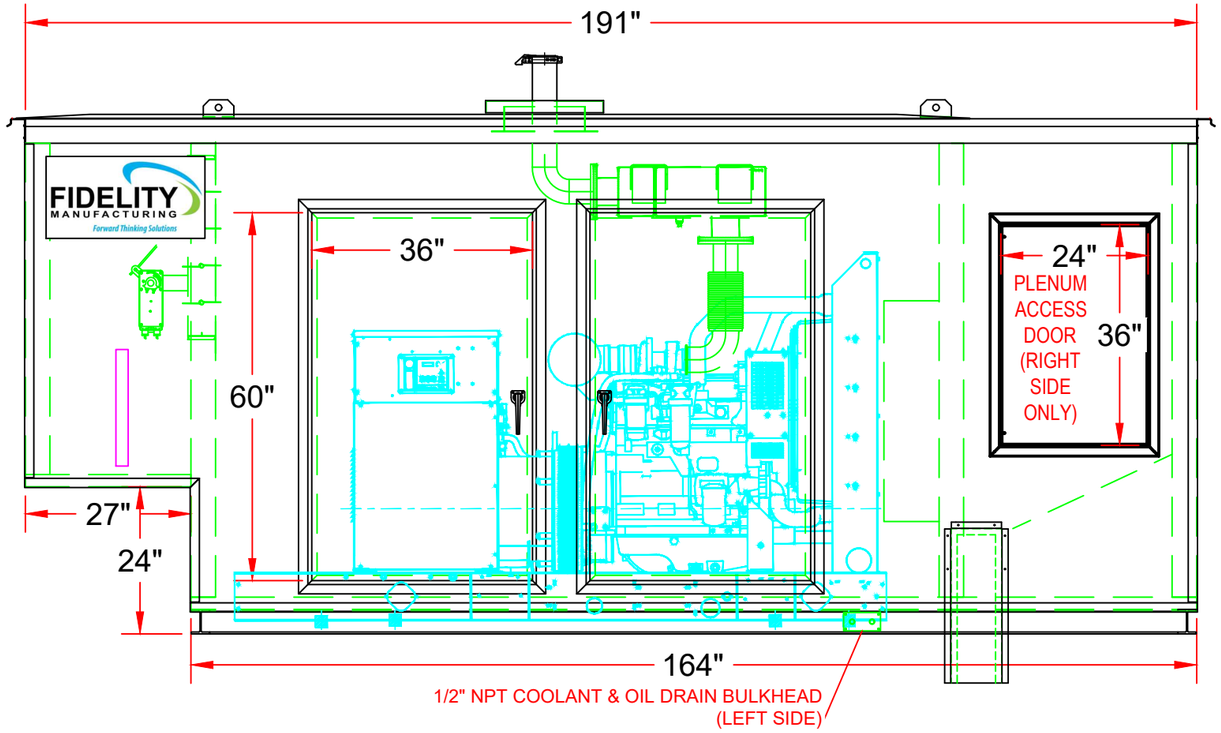
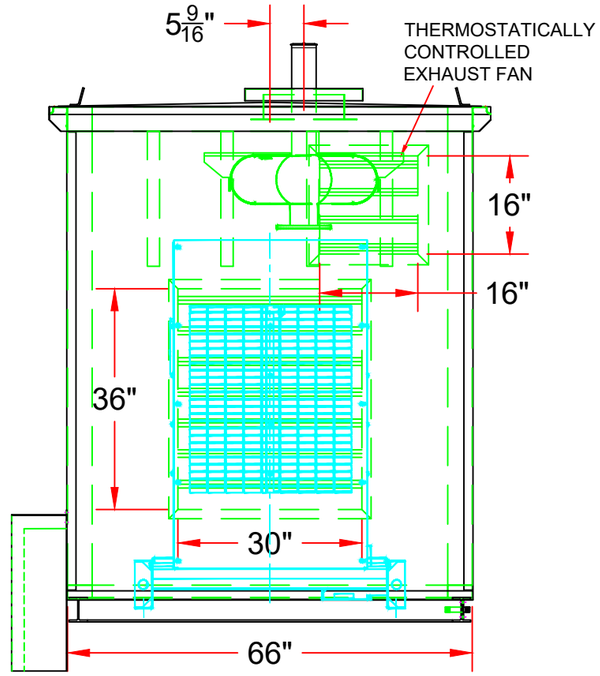


REAR VIEW



RIGHT SIDE VIEW (TYPICAL)



FRONT VIEW

DAMPER LIST		
QTY.	DIMENSIONS	PART #
1	52"W X 30"H	CD-101 (MOTOR IN AIRSTREAM)
1	16"W X 16"H	E2 P/N 551-053 / CB-600
1	30"W X 36"H	CB-601

EXHAUST LIST		
QTY.	PART	PART #
1	4" RAINCAP	RC-0400
1	90° 4" ELBOW FLANGE O.E. A=8", B=22"	MIRATECH
1	INSULATION BLANKET FOR ELBOW A=8", B=11"	MIRATECH
1	4" CRITICAL GRADE SILENCER	OCBE0T-04PF-2-0000001V SD
1	INSULATION BLANKET FOR SILENCER	MIRATECH
2	INSULATION DONUT FOR 4" ANSI FLANGE	MIRATECH
2	4" ANSI NUT, BOLT, GASKET KIT	FIDELITY
1	4" FLEX ELBOW, 4" TURBO FLARE FLANGE O.E., FLARE P/N J009391, 4" ANSI FLOATING FLANGE OE, X=6.5, Y=19.5"	MIRATECH
1	INSULATION BLANKET FOR FLEX	MIRATECH
1	4" DONALDSON V-BAND CLAMP P/N P206605	MIRATECH

NOTE: DRAIN BULKHEAD FOR REFERENCE ONLY. ACTUAL LOCATION TO BE DETERMINED BY TECHNICIAN.

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ENCL. WEIGHT	TANK WEIGHT	GEN. WEIGHT	TOTAL WEIGHT
3,200 LBS.	2,600 LBS.	2,702 LBS.	***8,502 LBS.***

CUSTOMER: KRAFT POWER

KOHLER 125 REOZJG

DESCRIPTION SA LVL 3 ENCLOSURE

THIRD-ANGLE PROJECTION

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REVISION

dBA REDUCTION

30

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— SURFACED MOUNTED LED CEILING LIGHT FIXTURE

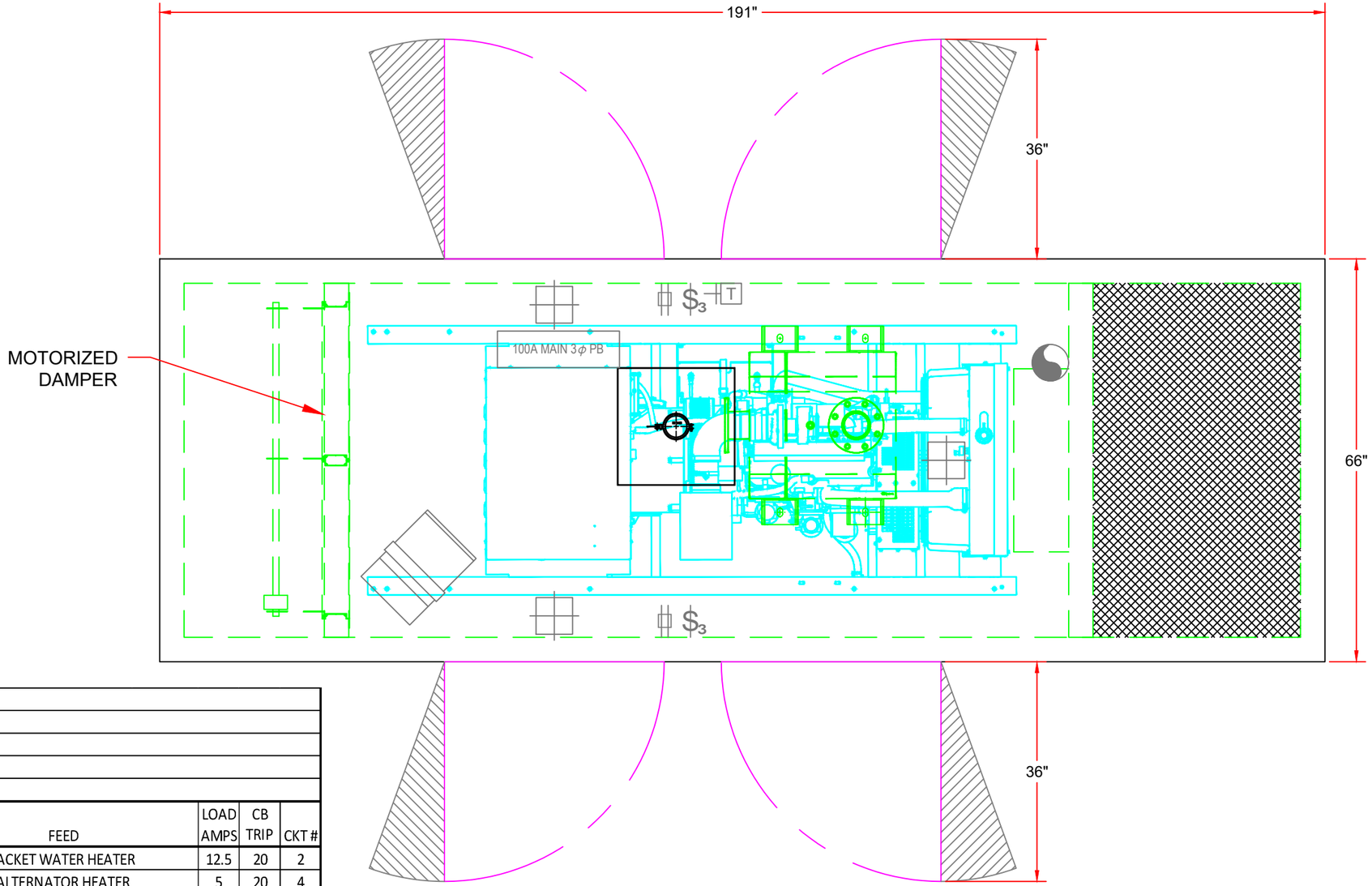
— EXHAUST FAN - VENTED TO OUTSIDE

— THERMOSTAT

— GROUND FAULT INTERRUPTED DUPLEX OUTLET

— 3-WAY SWITCH

— 5KW CEILING MOUNT HEATER WITH THERMOSTAT (208V)



PLAN VIEW

PANEL DESIGNATION	EG1	AIC RATING	10,000
VOLTAGE AND PHASE	208/120VAC 3PHASE	ENCLOSURE	NEMA 1
PANEL BUS SIZE	125A	MANUFACTURER	SIEMENS
MAIN TYPE	MAIN BREAKER		
MAIN AMPS	100		

CKT #	CB TRIP	LOAD AMPS	FEED	LOAD IN AMPS A PH	LOAD IN AMPS B PH	LOAD IN AMPS C PH	FEED	LOAD AMPS	CB TRIP	CKT #
1	20	10	GFCI	22.5			JACKET WATER HEATER	12.5	20	2
3	20	2	INTERIOR LIGHTS		7		ALTERNATOR HEATER	5	20	4
5	20	6	BATTERY CHARGER			30	5 KW SPACE HEATER	24	30	6
7	20	6	EXHAUST FAN/ MOTORIZED DAMPER	30				24		8
9					0					10
11						0				12
13				0						14
15					0					16
17						0				18
			PHASE AMPS TOTAL	52.5	7	30				
			PANEL AMPS MAX PHASE	52.5						
			MINIMUM PANEL SIZE AT 80% LOADING =	65.625 AMPS						

NOTE: THE LIGHTING FIXTURES SHOWN ARE REPRESENTATIVE OF QUANTITY ONLY. ACTUAL LOCATION WILL BE DETERMINED AT TIME OF INSTALLATION FOR MAXIMUM ILLUMINATION OF THE ENCLOSURE.

ENCL. WEIGHT	TANK WEIGHT	GEN. WEIGHT	TOTAL WEIGHT
3,200 LBS.	2,600 LBS.	2,702 LBS.	*8,502 LBS.*

CUSTOMER: KRAFT POWER

KOHLER 125 REOZJG

THIRD-ANGLE PROJECTION

DESCRIPTION ELECTRICAL PLAN

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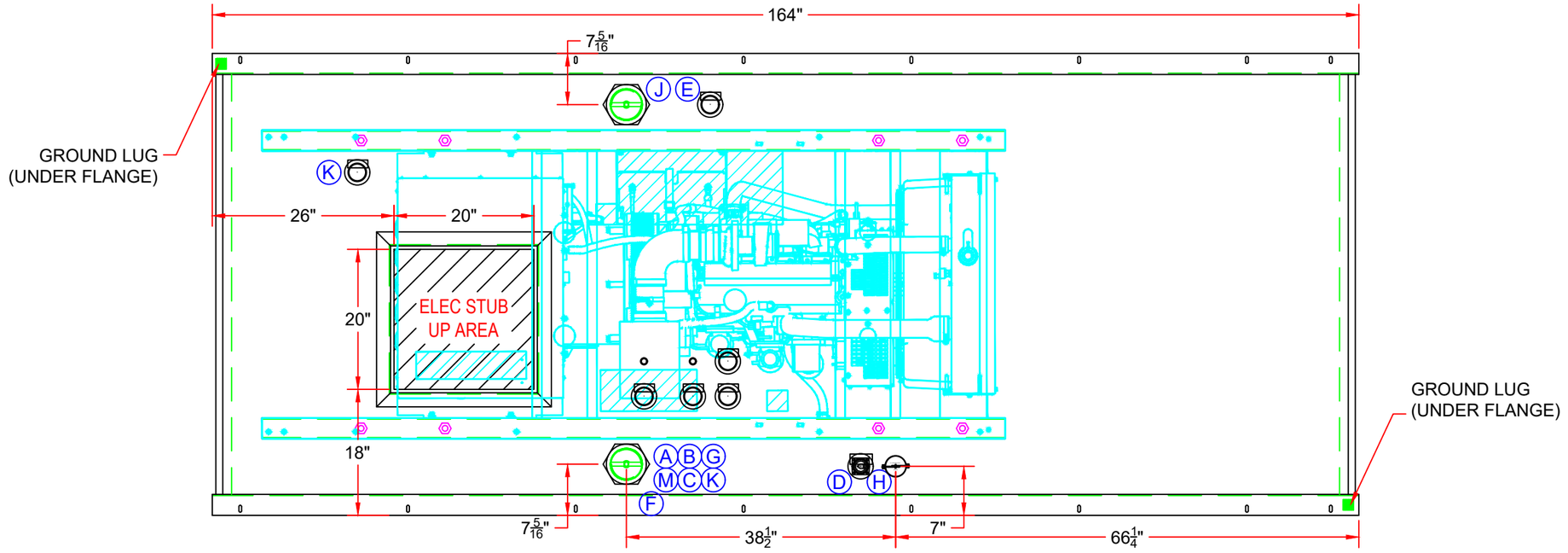
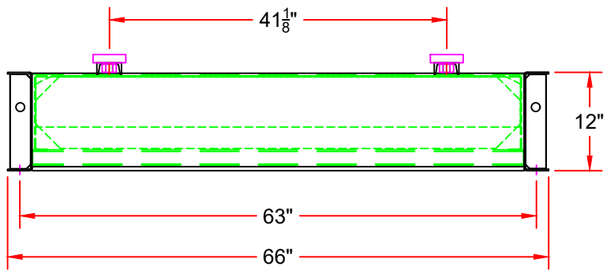
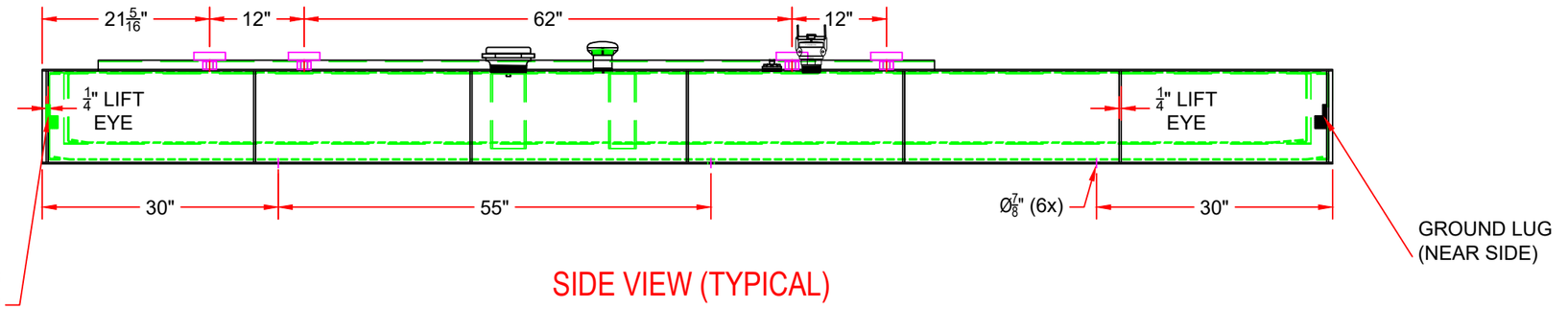
FITTING	DESCRIPTION	LENGTH
A	1/2" NPT FUEL SUPPLY DROP TUBE WITH BALL VALVE	10"
B	1/2" NPT FUEL RETURN DROP TUBE WITH BALL VALVE	10"
C	2" NPT LOW FUEL SWITCH AT 25%	6-3/8"
D	1-1/2" NPT FUEL GAUGE	7-1/2"
E	2" NPT NORMAL VENT	
F	4" NPT EMERGENCY VENT (PRIMARY)	
G	2" NPT TOP MOUNT LEAK DETECTION SWITCH & DRAIN PORT	
H	2" NPT LOCKABLE FUEL FILL	
J	4" NPT EMERGENCY VENT (SECONDARY)	
K	2" NPT SPARE FITTINGS (QTY 2)	
L	NOT USED	-"
M	2" NPT 4-20 MA ULTRASONIC FUEL SENDER	8"



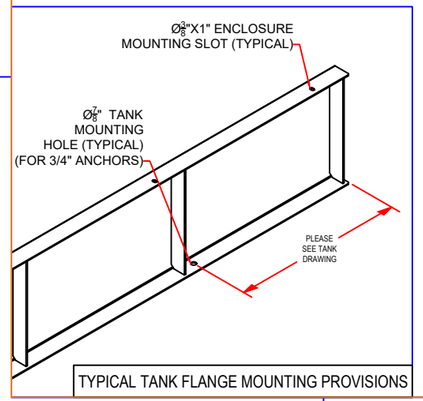
TOP VIEW



END VIEW (TYPICAL)



SIDE VIEW (TYPICAL)



TYPICAL TANK FLANGE MOUNTING PROVISIONS

ENCL. WEIGHT	TANK WEIGHT	GEN. WEIGHT	TOTAL WEIGHT
3,200 LBS.	2,600 LBS.	2,702 LBS.	*8,502 LBS.*

UL #142
File No.
MH27650

CUSTOMER:

KRAFT POWER

KOHLER 125 REOZJG

DESCRIPTION UL 142 SEALED SECONDARY TANK

THIRD-ANGLE PROJECTION

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REVISION

USEABLE GALLONS / ACTUAL GALLONS

250 AT 90% / 317

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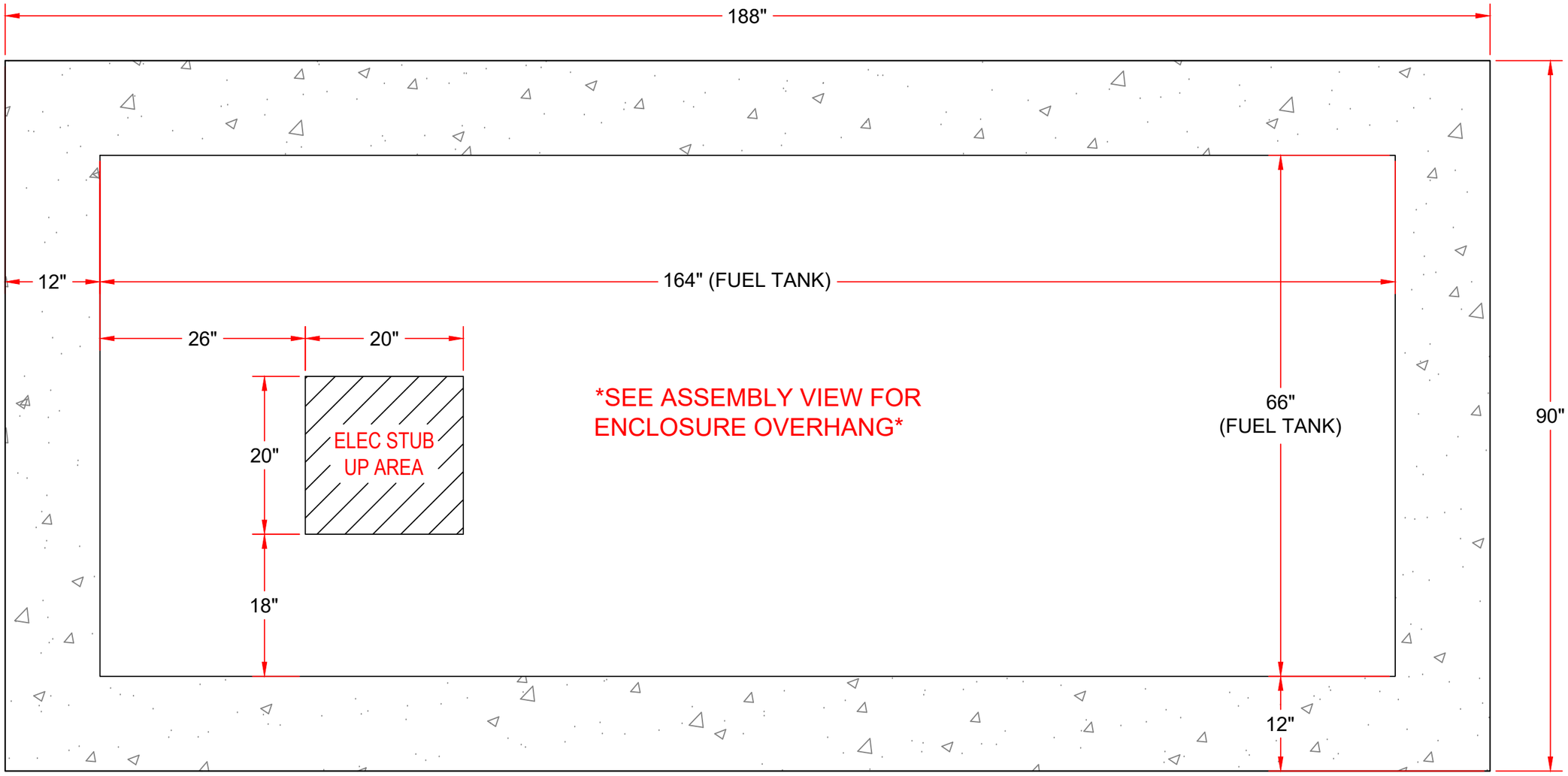

SUGGESTED PAD LAYOUT DRAWING IS FOR STUB-UP LOCATION REFERENCE ONLY. TO OBTAIN FULL FUEL CAPACITY PAD SHOULD BE SLOPED NO MORE THAN 1/4". ACTUAL PAD DESIGN IS TO BE ACCORDING TO PLANS, SPECS, & APPLICABLE JURISDICTIONAL AUTHORITIES.

ENCL. WEIGHT	TANK WEIGHT	GEN. WEIGHT	TOTAL WEIGHT
3,200 LBS.	2,600 LBS.	2,702 LBS.	***8,502 LBS.***

CUSTOMER:

KRAFT POWER

KOHLER 125 REOZJG

DESCRIPTION SUGGESTED PAD LAYOUT

THIRD-ANGLE PROJECTION

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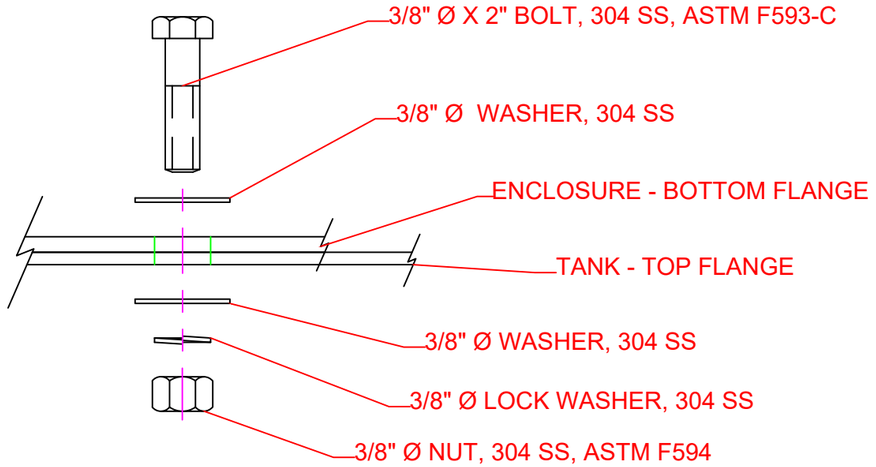
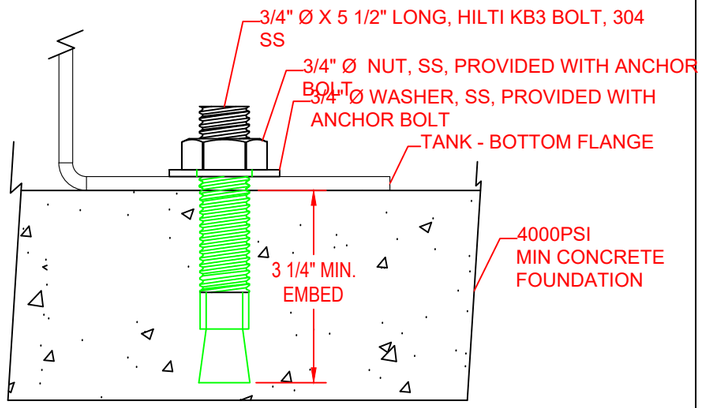
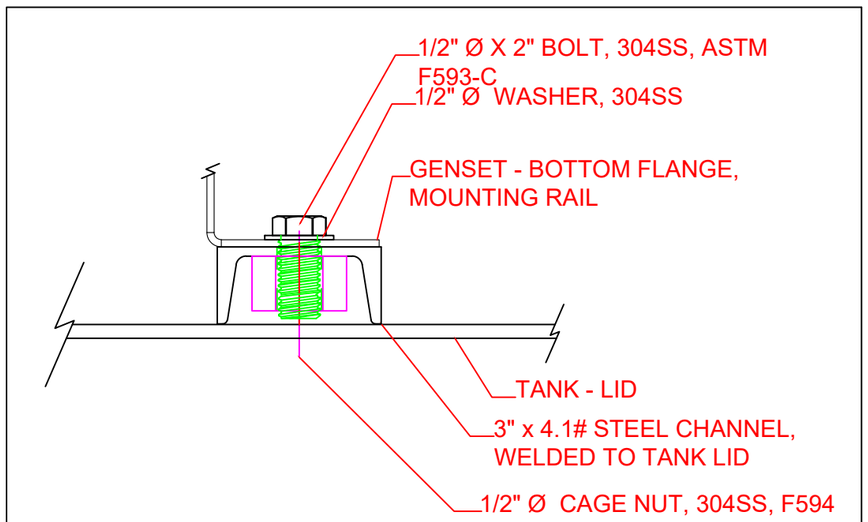


ENCLOSURE TO TANK	BOLT DETAIL



TANK TO CONCRETE FOUNDATION	BOLT DETAIL



GENSET TO TANK MOUNTING	BOLT DETAIL

ENCL. WEIGHT	TANK WEIGHT	GEN. WEIGHT	TOTAL WEIGHT
3,200 LBS.	2,600 LBS.	2,702 LBS.	***8,502 LBS.***

CUSTOMER: KRAFT POWER

KOHLER 125 REOZJG

DESCRIPTION ANCHOR DETAIL

THIRD-ANGLE PROJECTION

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APP.	
DATE	10/9/2020

SCALE:

SHEET 7 OF 7

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Miscellaneous

SECTION 11398

DIESEL ENGINE-GENERATOR SET AND APPURTENANCES

PART 1 – GENERAL 2
1.01 - SCOPE 2
1.02 - MEASUREMENT AND PAYMENT 2
1.03 - DEFINITIONS 2
1.04 - SUBMITTALS 3
1.05 - PRODUCT HANDLING 5
1.06 - DESIGN CRITERIA 5
1.07 - QUALITY ASSURANCE 5
1.08 - REFERENCES 5
1.09 - SEISMIC REQUIREMENTS: 5
1.10 - UNIT PERFORMANCE 6
PART 2 - PRODUCTS 6
2.01 - MANUFACTURERS 6
2.02 - GENERAL 6
2.03 - ENGINE 6
2.04 - ENGINE GENERATOR ENCLOSURE 6
2.05 - EQUIPMENT 7
2.06 - GENERATOR AND EXCITATION SYSTEM 7
2.07 - SYSTEMS 8
2.08 - SYSTEM OPERATING SEQUENCE 10
2.09 - ENGINE CONTROL PANEL 11
2.09 - SHOP PAINTING 13
2.10 - SHOP TESTING 13
2.11 - SPARE PARTS 13
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3.01 - INSTALLATION AND START UP 13
3.02 - FIELD TEST 13
3.03 - CONTRACT CLOSEOUT 13

PART 1 – GENERAL

1.01 - SCOPE Confirmed

A. Furnish, place in operation, and test standby diesel engine driven generator set, EPA Compliant, complete with enclosure, instrumentation and controls, and required supporting systems as specified herein.

B. The unit shall be provided in an outdoor, weather proof, non-walk-in, sound attenuated enclosure with an integral sub-base fuel storage tank with a capacity for 24 hours of standby operation.

C. The unit shall have a minimum power rating as indicated on Contract drawings, standby at 80 percent lagging power factor with three-phase, 60-Hertz, 480 volt, four-wire, alternating current generator.

D. The unit shall be arranged for automatic starting and stopping-, and load transfer upon failure of the normal source of power through the pump station electrical enclosure automatic transfer switch specified in SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT.

E. The engine generator set shall exhibit less than 20 percent voltage dip and less than 5 percent frequency dip during starting of the loads identified in Attachment A, Attachment B and Attachment C to this Section.

F. The engine-generator package shall be complete in all respects and shall include all equipment and controls necessary for a fully operational standby power supply system.

G. The generator unit shall comply with the Commonwealth of Massachusetts, local and federal codes and regulations for standby diesel generators.

H. Attention is directed to the DOCUMENT 00700, GENERAL CONDITIONS and all sections within DIVISION 1, GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.

1.02 - MEASUREMENT AND PAYMENT

A. Measurement and payment for the work described in this section will be made in accordance with the provisions of SECTION 01025, MEASUREMENT AND PAYMENT.

1.03 - DEFINITIONS

A. Definitions shall be as specified in DOCUMENT 00700, GENERAL CONDITIONS.

B. As used in this section, the following terms are understood to have the following meanings:

1. "Furnish" shall mean purchase and deliver to the Project Site, complete with every necessary appurtenance and support.
2. "Install" shall mean unload at the delivery point at the Project Site and perform all Work necessary to establish proper location, secure mounting and operation in the Project.
3. "Provide" shall mean furnish and install.
4. “Work” shall mean all labor, materials, equipment, apparatus, controls, accessories, and all other items required for a proper and complete installation.
5. "Piping" shall mean, in addition to pipe or tubing all backfilling and bedding, fittings, flanges, unions, valves, strainers, specialties, drains, hangers and supports, and all other accessories relative to such pipe or tubing.
6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, crawl spaces, embedded in construction, buried, and/or similar conditions.
7. Exposed" shall mean not concealed as defined above.
8. “Furnished by others” shall mean materials or equipment purchased and set in place under other sections of the Contract and connected to the systems covered by this section of the Specifications by this trade Contractor.
9. "Coordinate" shall mean all Work provided under this section shall be correlated with the Work of other trades.

Confirmed **1.04 - SUBMITTALS**

A. Shop Drawings and/or brochures shall be submitted for all items to be furnished in accordance with the provisions of the DOCUMENT 00700, GENERAL CONDITIONS and SECTION 01300, SUBMITTALS.

B. Submittals required under this section include, but are not limited to the following:

1. A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance.

2. Outline equipment drawings and elevation drawings with shipping splits with estimated weights defined.

3. Bill of Materials including manufacturer name, model number, and quantities.

4. Equipment catalog cuts clearly annotated to show which products and options are being supplied.

5. Wiring diagrams showing internal and external wiring. Wiring diagrams shall clearly indicate all required field wiring and terminations.

6. Enclosure layout drawings showing locations of internal and external mounted devices including light fixtures, receptacles, panelboards, heaters, batteries and battery chargers and fire alarm system components.

7. Submit catalog cut sheets for devices including light fixtures, receptacles, panelboards, batteries, battery chargers, and fire alarm system components.

8. Engine-generator skid base drawings.

9. Performance specifications of all items of equipment.

10. Engine generator loading calculation, per the requirements of Attachment A, Attachment B and Attachment C to this section.

11. Provide certificate of conformance to UL Standard 2200, Stationary Engine Generator Assemblies.

12. Attenuation curve for the silencing equipment as offered to accomplish the required silencing for this installation.

13. EPA Tier compliance certificate.

14. Data to be provided by engine generator system supplier:

    a. Submit generator loading calculations and data for engine, generator, and accessories: (for rated kW capacity).

        (1) Engine Data

            (a) Manufacturer

            (b) Model

            (c) Number and arrangement of cylinders

            (d) RPM

            (e) Bore X stroke

            (f) Maximum power at rated RPM

            (g) BMEP at rated kW (including any parasitic loads and generator efficiency)

            (h) Piston speed, feet per minute

            (i) Make and model of governor

            (j) Make and model of overspeed shutdown device

Confirmed

(2) Generator Data

(a) Manufacturer

(b) Model

(c) Rated kVA

(d) Rated kW

(e) Voltage

(f) Temperature rise above 40 degrees C ambient. Stator by thermometer and field by resistance in degrees C.

(g) Class of insulation

(h) Generator efficiency including excitation losses at 80 percent PF

1) Full load

2) Three quarters load

3) Half load

(i) Generator sub-transient reactance in ohms

(3) Guaranteed maximum fuel consumption rate at generator terminals @ 138,000 BTU/gallon of ultra-low sulfur diesel fuel:

(a) Full load, gal/hr

(b) Three-quarters load, gal/hr

(c) Half load, gal/hr

(4) Generator unit and accessories

(a) Weight of unit

(5) Exhaust gas emissions data, maximum values at full load, 3/4 load, 1/2 load, and 1/4 load:

Temperature in degrees F

(6) Flow in ACFM (mass and volume)

(7) Combustion air volume in CFM

(8) Cold cranking amperes rating of engine starting batteries (CCA).

1. Provide manufacturer's printed installation instructions including anchoring details to meet earthquake requirements as specified and indicated.
2. Information on the proposed jacket water treatment and procedures for flushing of the cooling systems.
3. Engine-generator skid base drawings, indicating size and location of anchor bolts, and conduit locations.
4. Operations and Maintenance Manuals.
5. As-built drawings and material summary shall be shipped with the equipment.
6. Control panel layout drawings, dimensions, and component bill of materials. Outline drawings showing conduit entry areas and anchoring information. Description of control including operation of interface equipment.
7. Electrical, instrumentation, control and wiring diagrams in sufficient detail to allow installation of instrumentation and controls and electrical components.
8. Time versus current characteristic curves for generator main circuit breaker.

Confirmed

1.05 - PRODUCT HANDLING

A. Products shall be shipped, stored and handled in a manner consistent with the written recommendations of the manufacturer and as to not to degrade quality, serviceability or appearance. All products delivered to the project site shall be accompanied by test reports certifying that the pipe conforms to the ASTM specifications listed herein. Any unit found to be defective either before or after installation shall be removed from the project site and replaced with a sound unit.

B. If stored for more than two weeks, the materials shall receive all maintenance considerations required by the manufacturer for proper storage of the materials.

1.06 - DESIGN CRITERIA

A. The materials and equipment specified are intended to be standard materials and equipment of demonstrated successful performance, as manufactured by reputable concerns. Equipment shall be designed and constructed in accordance with the highest standards of the industry and shall be installed in accordance with the manufacturer's written recommendations and the Contract Documents. The specifications call attention to certain features but do not purport to cover all details entering into the construction of the equipment.

B. The design conditions and other pertinent requirements for the equipment are listed on the Contract Drawings.

1.07 - QUALITY ASSURANCE

A. The engine-generator set shall be factory designed, certified prototype tested, and as specified. The manufacturer shall be regularly engaged in the production of this type of equipment and shall maintain a permanent service organization and supply of spare parts, of the types utilized for the equipment specified herein.

1.08 - REFERENCES

A. American Gear Manufacturers Association (AGMA)

B. American Institute of Steel Construction (AISC)

C. American Iron and Steel Institute (AISI)

D. American Society of Mechanical Engineers (ASME)

E. American National Standards Institute (ANSI)

F. American Society for Testing Materials (ASTM)

G. American Welding Society (AWS)

H. American Bearing Manufacturers Association (ABMA)

I. Institute of Electrical and Electronic Engineers (IEEE)

J. National Electrical Code (NEC)

K. National Electrical Manufacturers Association (NEMA)

L. Occupational Safety and Health Administration (OSHA)

M. Steel Structures Painting Council (SSPC)

N. Underwriters Laboratories, Inc. (UL)

O. National Fire Protection Association (NFPA)

P. Where reference is made to one of the above standards, the version in effect at the time of bid opening shall apply.

1.09 - SEISMIC REQUIREMENTS:

A. Generator unit shall conform to the seismic requirements as indicated and as specified in SECTION 01900, SEISMIC AND WIND REQUIREMENTS.

1.10 - UNIT PERFORMANCE

Confirmed

A. The units shall be utilized to provide standby power service in the event the normal source is not available.

B. The voltage regulation shall be within plus or minus one percent from zero load to full-rated load. Upon application or removal of full-rated load in one step, the transient voltage dip and recovery to steady state operation shall be within five seconds.

C. Stable or steady state operation is defined as operation with the frequency variation not exceeding plus or minus 0.25 percent (0.15 Hertz) and voltage variation plus or minus one percent of their mean value for constant load from zero load to full rated load. A rheostat shall provide plus or minus five percent voltage adjustment from rated voltage.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

A. The Owner has standardized on standby diesel engine driven generator sets as manufactured by Kohler.

B. This is a proprietary specification. No other manufacturers are acceptable.

2.02 - GENERAL

A. Engine-generator set shall be a factory-assembled unit that is a standard production unit with existing torsional analysis data. Mixing and matching engine and generator by a third-party supplier is not acceptable.

B. The engine and generator shall be directly connected with a flexible coupling, shall be free from injurious torsional or other vibration and shall be mounted on a heavy steel sub-base.

C. The engine and generator shall be directly connected and shall operate at the same rotative speed. The use of gearing or other speed adjustment between the engine and the generator, such that the engine and generator operate at different rotative speeds will not be allowed.

D. The engine-generator set shall allow easy access to the various parts for maintenance purposes.

E. The engine-generator set shall be pre-piped and pre-wired.

F. The complete engine-generator unit shall be free from harmful torsional or other vibration throughout the entire operating range of speed and load. The engine manufacturer shall provide an analysis of the complete engine-generator unit, which shall show where any critical speed will be encountered, together with the order, the frequency and magnitude of any critical speed.

2.03 - ENGINE

In line type

A. The diesel engine shall be of ~~V-type~~ construction, four-stroke cycle, turbo-charged, full compression ignition, diesel, with mechanical fuel injection. The unit shall operate at a speed of not more than 1800 rpm.

B. The rating of the engine shall not exceed the manufacturer's published standby rating. The gross engine horsepower required to produce the standby rating shall not exceed the manufacturer's published continuous duty rating by more than 150 percent. Continuous duty rating shall be as defined in BS649 or DIN6270 but in no case shall it exceed the manufacturer's published continuous duty rating. The gross engine horsepower required for the generator set standby rating described above shall include all parasitic demands such as generator inefficiencies, fuel pumps, water pumps, and all accessories necessary to the unit's proper operation while operating at rated loads.

C. The engine shall be capable of satisfactory operation on ultra-low sulfur diesel fuel.

2.04 - ENGINE GENERATOR ENCLOSURE

A. Provide complete factory pre-wired, weatherproof, sound attenuated, non walk-in enclosure.

B. Building capable of withstanding wind equal to 125 mph.

C. Roof load equal to 50 psf.

D. The sound attenuation shall be provided with noise reduction level of 65 dBA at 23ft from the enclosure.

E. The inlet and exhaust air handling system shall provide the necessary level of sound attenuation.

Confirmed

F. Provide enclosure with high efficiency, LED type, industrial, enclosed with acrylic lens, fiberglass housing and UL listed light fixtures. Provide light switches at each door.

G. The enclosure shall be provided with electrical space heater(s), designed to hold a minimum space temperature of 50 degrees F, with outside temperature of -1 degree F. Building shall be pre-painted aluminum stressed-skin construction, door and door frame, lifting rings, mounting frame, insulation, electrical package, louvers, muffler mounting bracket, and other appurtenances to provide complete unit.

H. Electrical Package

1. All equipment and devices shall be U.L. listed.
2. Provide enclosure electrical package complete and factory pre-wired. The enclosure package shall include lighting, receptacles, heating and ventilation equipment.
3. Provide ground studs for earth grounding.

I. Louvers and Dampers

1. Provide acoustical louvers and dampers for engine generator inlet, exhaust and ventilation air.
2. Fixed louvers, all aluminum construction, riveted into aluminized steel frame to form rigid, water resistant assembly.
3. Dampers shall be powered closed, spring open, fail safe type.
4. Properly size louvers and dampers to allow sufficient engine combustion air, radiator cooling air, and ventilation air with maximum 0.5 in. water restriction.

J. Enclosure shall be pre-painted steel construction, with removable panels to allow for maintenance with muffler mounting bracket, and other appurtenances to provide a complete unit.

1. Muffler and Mounting Bracket
   a. Critical grade silencer with bracket.
   b. Provide exhaust pipe with birdscreen and rain cap.
   c. All interior engine exhaust piping to be insulated.
2. Fuel Piping
   a. Provided integral with base fuel tank.

2.05 - EQUIPMENT

A. Governor

1. Provide isochronous solid state governor, capable of maintaining isochronous regulation from no load to full rated load within 0.25 percent of rated frequency.
2. The governor controller shall be mounted within the generator control panel. The governor shall have the capability for manual adjustment of speed setting and speed droop. Speed droop shall be adjustable from 0 to 5 percent from no load to full load. The controller shall eliminate all electromagnetic interference.
3. Provide a separate overspeed shutdown device which shall, in case of predetermined overspeed of the operation of various protective devices as later specified, instantly stop the engine without the fuel injection system losing its prime.

2.06 - GENERATOR AND EXCITATION SYSTEM

A. The generator shall be drip-proof, guarded, and be able to connect to the specified engine output and shall be 3-phase, 60-Hertz, 4-wire, 480-volt operation, "WYE" connected. The generator shall be mechanically and torsionally matched to the engine driver and shall be provided to withstand inherent pulsating torques of the engine. Full load efficiency of the combined generator, exciter and regulator shall be not less than 95 percent.

Confirmed

B. The generator shall conform to the applicable parts of the following standards, unless otherwise specified:

1. NEMA MG1, Motors and Generators
2. IEEE 43, Recommended Practice for Insulation Testing of Large AC Rotating Machinery
3. CSA C22.2-100 Designation ABL3
4. Testing shall be in accordance with IEEE-115 and NEMA MG-1 standards

C. The generator windings, insulation and excitation system shall be braced to withstand any possible short-circuit stresses.

D. The temperature rise of the generator windings, when operated at rated prime power load and under continuous duty conditions with cooling air inlet temperature of 40 degrees C, shall not exceed 130 degrees C when measured by the resistance method.

E. The stator frame shall be fabricated bar and plate steel construction.

1. All insulation materials used in the stator shall have a temperature rating of Class H per IEEE Standard 1. The coils shall be of a formed coil construction using a magnet wire meeting NEMA MW36-C specifications.
2. The complete stator shall be wound with a 2/3 stator winding pitch and processed in a vacuum pressure impregnation chamber. Encapsulation of the stator shall be accomplished with a two-part epoxy system.

F. The rotor shall be of the fully laminated, salient pole type. Cooling fans shall be an integral part of the rotor assembly. The rotor shall be dynamically balanced for all speeds up to 125 percent of rated speed per NEMA specification.

1. Insulation materials used on the rotor shall have a temperature rating of Class H. The poles shall be of a layer wound construction using a magnet wire meeting NEMA MW35-C or MW36-C specifications.
2. The complete winding and rotor pole assembly shall be in a vacuum pressure impregnation chamber. Encapsulation of the assembly shall be accomplished with a thixotropic, single component epoxy resin.

G. The exciter shall be a high frequency, direct connected, rotating brushless type, three phase, full wave rectified, and shall be matched with the generator rotor and control system. Both the armature and field windings shall be a vacuum pressure impregnated with epoxy resin.

H. The pilot exciter shall be permanent magnet generator type. The stator winding shall be vacuum pressure impregnated with epoxy resin. The permanent magnet generator shall have the ability to provide a nominal 300 percent of the 130 degrees C rise rated three-phase short circuit for ten seconds at the alternator terminals.

I. The digital voltage regulator shall be hermetically sealed, silicon controlled rectifier type and shall employ a zener reference and three phase sensing. The voltage regulator shall provide automatic protection of the entire unit on 3 phase short-circuits. The voltage regulator shall include automatic over-excitation and under-frequency protection. Input isolation transformers and filters shall be provided. Exciter shall be fast response type with a rotating rectifier and surge suppresser, 3-phase, full-wave bridge.

J. The voltage regulator and associated equipment shall be mounted in the generator terminal box. Manual voltage adjustment potentiometer shall be mounted in the Generator Control Panel.

K. Generator stator leads shall be connected to tinned copper bus bars in an oversize terminal box. The box shall allow bottom entry of cables and conduits shown on the contract drawings.

2.07 - SYSTEMS

A. Fuel Storage System:

1. Provide base fuel storage tank, integral to the mounting of the engine generator unit.
2. The fuel tank shall be UL listed as “primary containment aboveground tank for flammable and combustible liquids”.
3. Provide necessary supply and return lines; drainage and supply valve control.

Confirmed

4. Tapped openings in tank shall be bushed to desired size with double-tapped cast-iron tank bushing.

5. Tank vent shall be standard weight, black steel pipe with screwed malleable-iron fittings.

6. Provide double-walled tank, with level indication and auxiliary pre-wired leak detection alarm contacts.

B. Engine Fuel System:

1. Diesel fuel system shall consist of an engine-driven fuel supply pump, fuel filters, and a base tank and lift pump set.

C. Electric (Battery) Starting System:

1. Starting shall be accomplished by a 24-volt, engine mounted, solenoid shift electric starter, capable of withstanding four consecutive continuous cranking periods of 15 seconds duration each separated by 15 seconds rest periods before shutting down completely and sounding the overcrank alarm.

2. The starting batteries shall be low maintenance, premium industrial grade, high-output, long-life, lead acid type especially designed for diesel engine cranking service, and of a capacity as recommended by the battery manufacturer for cranking the engine being furnished. The engine starting batteries shall be sized to also supply power to the generator control panel.

3. Furnish an engine starting battery charger for charging the starting batteries for the engine. The battery charger shall be U.L. listed, fully automatic, filtered, equalize and float-type, appropriate for wall or rack mounting. Supply voltage shall be 120 volts, AC, single phase, 60 Hz obtained from the generator electrical package. The DC output shall be not less than 20 amperes, regulated to within one percent with plus or minus ten percent fluctuations of the input voltage, and shall be current limited at 120 percent of rated output. Accessories shall include DC ammeter and voltmeter (panel type; 2 percent accuracy), adjustable float and equalize controls toggle switch, AC and DC circuit breakers, AC power failure alarm relay, low DC voltage alarm relay and DC ground fault relay. Fault relays shall operate individual alarm indicators on the face of the charger panel and shall also operate a common alarm relay for remote transmission of alarm. Charger shall have a continuous power rating sufficient to power all generator control devices in both the standby mode and the running mode.

D. Lubrication System:

1. The engine shall be provided with a full pressure lubricating oil system arranged to lubricate and cool the pistons and distribute oil to all moving parts of the engine including the turbocharger bearings. The system shall include a full flow oil filter of the replaceable element type, an appropriately sized shell and tube type oil cooler, and an automatic temperature regulator.

2. Furnish a low oil level float switch to alarm to the generator control panel.

E. Engine Cooling System Radiator:

1. General: Provide a unit mounted radiator complete with integral jacket water circulating pump, thermostatic central of cooling system, fan and drive motor sized to maintain full load operation continuously as specified herein for engine-generator set.

2. Provide radiator to operate engine at full rated generator load at 104 F ambient temperature.

3. Provide jacket water treatment for the prevention of both scale formation and corrosion in the engine water jackets and cooling system components which are in contact with the engine jacket water. This treatment shall be added to the cooling system prior to running the field acceptance test

F. Miscellaneous Equipment and Requirements

1. Heaters

a. Automatic thermostatically controlled heater(s), shall be provided to maintain not less than 90º F temperature for the engine jacket water system.

b. Heater(s) shall be rated 208/120VAC. Deviation - The factory heater voltage for this size unit is 120V

c. Heater shall be automatically deactivated when the engine-generator unit is in operation.

Confirmed

2. Emergency Stop Pushbuttons

   a. Furnish an emergency stop pushbutton on the engine control panel.

   b. The emergency stop buttons shall be maintained type, red colored, push to stop, mushroom type with a hinged plastic Lexan cover, labeled as "Emergency Stop," "Push."

   c. The pushbutton shall be wired to the engine-generator instrument/control panel and shall immediately stop the engine.

3. Control Power Fuses

   a. Fuses shall be mounted in locations where they are accessible. Pullout type fuses shall be provided.

4. Main Circuit Breaker

   a. Provide generator with a molded case circuit breaker to protect generator against overload and short circuit conditions. Circuit breaker shall be rated for 65 kA short circuit symmetrical and shall conform to the provisions of NEMA Standard AB1 and UL Standard 489.

   b. Provide circuit breaker with adjustable trip unit, rating plug, long-time, short-time and instantaneous protective relaying and ground fault protection.

5. Terminal Blocks

   a. Terminal blocks shall be one-piece, 20 AMP rated, with barriers appropriate for ring tongue terminals and provided with binding head screws. The terminal block rating shall be 600 V.

6. Solid State Circuitry

   a. Heavy-duty solid state controls, relays, timers or monitors shall meet the following specifications:

Accuracy:	+ 2% of set point
Temp Range:	- 40 C to +65 C (-40 F to 150 F)
Protection:	Transient overvoltage with-stand of 1500 volts peak, 1 m sec. time constant
Ratings:	Current ratings to exceed application of devices. Devices shall be UL listed.

2.08 - SYSTEM OPERATING SEQUENCE

A. The engine generator unit shall be operated in the following manner:

   1. The engine generator unit shall be arranged for automatic or manual starting and stopping.

   2. The engine generator shall be brought up to rated voltage and frequency and closed onto facility main Switchboard through open transition automatic throw-over system.

B. Normal – system utility powered:

   1. During normal system operation, the normal (utility) shall power the electrical distribution system with loads as indicated.

Confirmed

C. Loss of utility power - standby operation:

1. Upon loss of utility power, automatic transfer switch shall sense loss of power and after an adjustable time delay the automatic transfer system shall initiate generator start.
2. When the generator is up to speed and capable of accepting load, pump station loads will transfer to generator power.
3. Upon return of utility power, the automatic transfer switch shall initiate transfer back to the utility after an adjustable time delay.
4. After an adjustable cool-down period, the engine-generator shall shutdown.

2.09 - ENGINE CONTROL PANEL

A. The engine starting control logic shall be microprocessor based and shall automatically start, protect and monitor the engine-generator set. Electro-Mechanical controls are unacceptable.

B. The following gauges shall be mounted within an engine mounted control panel. Gauges shall be digital:

1. Jacket water temperature cooler temperature into heat exchanger
2. Lube oil temperature
3. Lube oil pressure
4. Lube oil filter differential pressure.

C. An engine coolant level switch shall be furnished. Level switch shall shut down generator on low level.

D. The engine starting control logic shall be capable of controlling the following engine devices.

1. Starting motor magnetic switch.
2. Electrically operated fuel control.
3. Normally open protective switches that close for abnormal conditions of pressure, temperature, speed and liquid level.

E. The panel shall have the following controls:

1. Emergency stop
2. Lamp test
3. Cycle crank
4. Voltage control
5. Cool-down timer
6. Phase selector switch
7. Programmable relays 4 (std)
8. Stop/Auto/Test.

F. The panel shall be provided with the following indicating lights:

1. Low oil pressure
2. High coolant temperature
3. Over speed
4. Over crank
5. Emergency stop
6. Fault shutdown

Confirmed

7. 3 spare lights, programmable input.
8. Not in Auto

G. Protection shall include:

1. Over and under voltage
2. Over and under frequency
3. Low coolant level
4. Oil temperature.

G. Provide contacts to alarm the following functions:

1. Low oil pressure
2. Sub-base oil tank rupture
3. Low fuel
4. Fuel tank leak
5. Battery malfunction
6. Low battery voltage
7. Common fault alarm
8. Not in automatic
9. In exerciser mode
10. E-stop activated
11. Generator run status
12. Low coolant level

H. Provide analog (4-20mA) output from fuel tank control panel for fuel level.

I. Engine Start/Stop Operation: The automatic engine control logic shall initiate operation of the engine upon receipt of a signal from a contact at the facility main Switchboard automatic transfer system. The contact(s) shall close for engine run and open for engine stop.

J. If the engine fails to start after 4 adjustable cranking attempts (factory set at 10 seconds on, 10 seconds off, adjustable from 5 to 30 seconds) or if any protective device should operate while the engine is running, the engine shall be disconnected from service and immediately stopped. The engine control logic shall lock the failed set out of service and requires a manual reset. The engine control logic shall include a provision for conversion to single cycle cranking, adjustable from 35 to 210 seconds.

K. Three-position engine control switch:

1. **Stop/Reset:** In this position, the engine shall not be capable of starting and/or running. If the engine was shutdown due to the operation of a protective device, the shutdown malfunction shall be reset when the switch is moved to this position. If the engine is running when the switch is moved to this position, it shall be immediately shutdown.
2. **Automatic:** In this position, the engine control shall be in readiness for fully automatic operation upon receipt of a start signal.
3. **Test:** When placed in this position, the engine shall start and run as if a start signal were received except it shall not be connected to the bus unless a start signal is received. When returned to the automatic position, the engine will shut down.

Confirmed

2.09 - SHOP PAINTING

A. The engine-generator set shall be shop primed and finished coated in accordance with the manufacturer's standard practice prior to shipment. A supply of touch-up paint shall be supplied by the manufacturer.

2.10 - SHOP TESTING

A. The complete engine-generator set shall be shop tested to simulate a complete and integrated system prior to shipment.

B. The procedure for the shop test of the diesel engine shall cover the engine manufacturer’s standard practice.

2.11 - SPARE PARTS

A. Provide a recommended list of spare parts.

PART 3 – EXECUTION

3.01 - INSTALLATION AND START UP

A. The generator unit shall be mounted on a concrete pad.

3.02 - FIELD TEST

A. Upon completion of the installation and as soon as conditions permit, the diesel engine driven generator, including the engine, generator, electrical circuit controls, transfer controls other devices shall be tested to assure that the system functions as specified.

3.03 - CONTRACT CLOSEOUT

A. Provide in accordance with SECTION 01700, CONTRACT CLOSEOUT.

END OF TEXT

See Attachments

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ATTACHMENT A
Pump Station No. 1

Loads to be powered up by the engine-generator for engine generator load calculation.
The Generator shall be capable of picking up the loads in order shown.

Equipment List

Equipment	Total Quantity	Quantity Operating	HP/AMPS/kVA/kW
Step 1			
Mini Power Center MPC.01-1	1	1	7.5kVA
Odor Control Fan PS1.OC-1*	1	1	1HP
Step 2			
PS1.P-1**	1	1	40HP
Step 3			
PS1.P-2**	1	1	40HP
Step 4			
PS1.P-3**	1	1	40HP

* Motor is powered by full voltage motor starter.

** Motor is powered with 6-pulse variable frequency drive with 5% input line reactor.

ATTACHMENT B
Pump Station No. 2

Loads to be powered up by the engine-generator for engine generator load calculation.
The Generator shall be capable of picking up the loads in order shown.

Equipment List

Equipment	Total Quantity	Quantity Operating	HP/AMPS/kVA/kW
Pump Station No. 2			
Step 1			
Mini Power Center MPC.02-1	1	1	7.5kVA
Odor Control Fan PS2.OC-1*	1	1	1HP
Step 2			
PS2.P-1**	1	1	40HP
Step 3			
PS2.P-2**	1	1	40HP

* Motor is powered by full voltage motor starter.

** Motor is powered with 6-pulse variable frequency drive with 5% input line reactor.

ATTACHMENT C
Pump Station No. 3

Loads to be powered up by the engine-generator for engine generator load calculation.
The Generator shall be capable of picking up the loads in order shown.

Equipment List

Equipment	Total Quantity	Quantity Operating	HP/AMPS/kVA/kW
Step 1			
Mini Power Center MPC.03-1	1	1	7.5kVA
Odor Control Fan PS3.OC-1*	1	1	1HP
Step 2			
PS3.P-1**	1	1	30HP
Step 3			
PS3.P-2**	1	1	30HP

* Motor is powered by full voltage motor starter.

** Motor is powered with 6-pulse variable frequency drive with 5% input line reactor.

10. SECTION 02629, POLYVINYL CHLORIDE LOW-PRESSURE SEWER PIPE

    A. Page 02629-3, ARTICLE 2.01 – MATERIALS, delete Paragraph D. in its entirety and replace with the following new paragraph:

        D. The Contractor has the option of substituting SDR 11 HDPE I.P.S. butt-fused pipe for the SDR 21 PVC gasketed pipe used for pressure main and services at no additional cost to the Owner. All couplings, fittings, adapters, valves, reducers, tees, and wyes shall be compatible with the type of pipe used. HDPE pipe shall be pressure rated for 200 psi and shall conform to ASTM D1248, ASTM D3350, ASTM D2239, and NSF-14. Compression fitting shall be brass and manufactured by Ford, or equal.

    B. Page 02629-3, ARTICLE 2.01 – MATERIALS, add the following new Paragraph K.:

        K. Pipe and fittings using glued connections is not acceptable.

11. SECTION 11398, DIESEL ENGINE-GENERATOR SET AND APPURTENANCES

    A. Page 11398-2, ARTICLE 1.01 – SCOPE, delete Paragraph B. in its entirety and replace with the following new paragraph:

Confirmed

        B. The unit shall be provided in an outdoor, weather proof, non-walk-in, sound attenuated enclosure with an integral sub-base fuel storage tank with a capacity for 24 hours of standby operation running at full load.

12. SECTION 13300, INSTRUMENTATION AND CONTROL SYSTEM – GENERAL

    A. Page 13330-5, ARTICLE 1.08 – WARRANTY, delete the article in its entirety and replace with the following new article:

    1.08 - WARRANTY

        A. Guarantees and warranties shall be furnished in accordance with DOCUMENT 00700, GENERAL CONDITIONS.

        B. Equipment Manufacturer

            1. The Equipment Manufacturer shall provide a warranty that all of the equipment is new and of recent manufacture, all materials and workmanship are of good quality, free from faults or defects in accordance with the requirements of these specifications. In addition, the Equipment Manufacturer shall warrant that the system will function in accordance with the manufacturer's published technical description guides and as specified herein. The Warranty, obtained by the Equipment Manufacturer, shall be secured by a Performance Bond issued jointly to the Equipment Manufacturer and the Owner. The Equipment Manufacturer agrees to furnish a Warranty in the sum of the 100 percent of the equipment price and duly executed by the said Equipment Manufacturer as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Owner, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Equipment Manufacturer. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

            2. The Warranty shall be for a period of two (2) years from Substantial Completion of the construction contract.

            3. The Equipment Manufacturer shall be responsible for execution of warranties during the warranty period should the need arise.

C. Contactor

1. The Contractor shall provide a warranty that the installation of materials and hardware are in compliance with applicable provisions of the National Electric Code, UL, NEMA, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply. The Warranty, obtained by the Contractor, shall be secured by a Performance Bond issued jointly to the Contractor and the Owner. The Contractor agrees to furnish a Warranty in the sum of the full amount of the equipment price and duly executed by the said Contactor as Principal and by a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Owner, as Surety, for the faithful performance of the work proposed. The premiums for such Bonds shall be paid by the Equipment Manufacturer. Bonds must be issued by surety companies listed on the latest IRS Circular 570.

2. The Warranty shall be for a period of one (1) year from Substantial Completion of the construction contract.

3. The Contractor shall be responsible for execution of warranties during the warranty period should the need arise.

D. It is the Contractor's and Equipment Manufacturer's responsibility to resolve any and all warranty claims.

E. The Warranties shall be provided as part of the shop drawing submittal. Submittals which do not include the required Warranty Bonds will be summarily rejected and returned to the Contractor without further review and consideration.

B. At the end of the section include SECTION 13330 ATTACHMENT A - INSTRUMENTS PRODUCT SHEETS, as attached.

13. SECTION 16900, ELECTRICAL CONTROLS AND MISCELLANEOUS ELECTRICAL EQUIPMENT

A. Page 16900-5, ARTICLE 2.07 – WALL-MOUNTED COMBINATION STARTERS, delete Paragraph A in its entirety and replace with the following new Paragraph:

A. Unless otherwise indicated, provide each combination starter with motor circuit protector and full-voltage magnetic starter. Provide starters in enclosures rated in accordance with the Area Classification Schedule on Contract drawings.

B. Page 16900-6, add the following new ARTICLE 2.13- AUTOMATIC TRANSFER SWITCH:

Confirmed

2.13 – AUTOMATIC TRANSFER SWITCH

A. Provide UL listed, 480VAC, 3-phase, 3-wire, automatic transfer switches (ATS) to automatically transfer between normal utility power source and standby generator power source.

B. Provide open-transition, electrically operated automatic transfer switch of the current, voltage, and short circuit ratings indicated on the Contract drawings capable of switching all classes of load and fully rated.

C. Provide service entrance rated ATS.

D. Provide ASCO 7000 Series or approved equal.

E. Provide ATS with dry-type contacts to PLC for remote indication of transfer switch position and status:

1. Utility Power Position

2. Standby Generator Power Position

3. General Fault Alarm