

City of Taunton, MA

Wastewater Treatment Facility

Solids Handling Improvements

Contract S-2020-3, CWSRF 6690

March 24, 2021

Bidding Requirements, Bond Forms, Contract Agreement,
Conditions of the Contract and Technical Specifications

Bid Package #3 - Sludge Dewatering Centrifuges



The image shows a circular professional seal for Joseph Federico, Jr., a Registered Professional Engineer in the Commonwealth of Massachusetts. The seal contains the text: "COMMONWEALTH OF MASSACHUSETTS", "JOSEPH FEDERICO, JR.", "No. 30863", "REGISTERED", and "PROFESSIONAL ENGINEER". Below the seal is a handwritten signature in cursive that reads "Joseph Federico, Jr.".

Professional Registration No.: ###



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DIVISION 00

SECTION 00100
INVITATION TO BID

CITY OF TAUNTON, MA
WASTEWATER TREATMENT FACILITY
SOLIDS HANDLING IMPROVEMENTS – BID PACKAGE 3
CONTRACT S-2020-3
CWSRF NO. 6690

Sludge Dewatering Centrifuges
Specification Section 11350

March 24, 2021

Veolia Water North America-Northeast, LLC

Veolia Water North America-Northeast, LLC (hereinafter called “Veolia”) invites your company (hereinafter called “Bidder”) to submit a Bid for Sludge Dewatering Centrifuges. Bidder will be responsible for providing Two (2) Centrifuges and all required accessories for a fully functional system in accordance with the following documents:

1. SECTION 11350 - SLUDGE DEWATERING CENTRIFUGES
2. SECTION 01300 - SUBMITTALS
3. SECTION 01665 - SERVICES OF MANUFACTURER’S REPRESENTATIVE
4. SECTION 01680 - EQUIPMENT AND SYSTEM CHECKOUT, CERTIFICATION, AND TESTING
5. SECTION 01730 - OPERATION AND MAINTENANCE MANUALS
6. SECTION 11305 - THICKENED SLUDGE HOSE PUMPS
7. SECTION 11961 - INTERIOR AND EXTERIOR PROCESS PIPE
8. SECTION 13321 - INSTRUMENTATION AND CONTROL SYSTEM
9. DRAWING G-2.1 & M-7.8

All other Specification Sections are provided for assistance with preparing the Bid.

A .pdf copy of the Contract Documents for the Work may be obtained from the office of Veolia by contacting Daniel Finan, m: (978) 320-6898, daniel.finan@veolia.com. Hard copies will not be provided. The Contract Documents may be examined during normal business hours from 7:00 a.m. to 3:30 p.m. at the following location:

Taunton Wastewater Treatment Facility
825 West Water Street
Taunton, MA 02780

Bidding Documents shall not be construed in any manner to be an obligation by Veolia to enter into an Agreement or Contract with the Bidder.

As Security, each Bid must be accompanied by a Bid Bond having as surety thereto, such Surety Company or Companies as are authorized to do business in the Commonwealth of Massachusetts of an amount not less than five (5) percent of the Bid. No bid will be accepted unless accompanied by the required bid deposit.

Schedule of Events

	Event / Activity	Action Required	Deadline
1	Veolia distributes Bidding Documents		03/24/2021
2	Bidders Submit Questions	Submit questions to Daniel Finan daniel.finan@veolia.com NOTE: Veolia will provide answers to questions and distribute to all participating bidders	04/15/2021
3	Submission of Bids	Send your Bids to Veolia via email: daniel.finan@veolia.com	4:00pm EDT 04/22/2021

This project is to be funded in part by the Massachusetts Clean Water Trust (the “Trust”).

The Project requires compliance with the Massachusetts Department of Environmental Protection Diesel Retrofit Program (MDRP) by use of engine emission controls that are EPA certified, or their equivalent, on all diesel powered non-road construction equipment used at the job site.

Minimum Wage Rates as determined by the Commissioner of Department of 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 Contractor shall complete all work required under the Contract within 365 calendar days after the date of the Notice of Award. Work performed beyond the completion date will be subjected to liquidated damages in the amount specified herein.

- 4 weeks engineering submittals
- 2 weeks engineering review
- 24 weeks delivery upon approval of submittals

Confidentiality

Bidding Documents and any information contained in, or otherwise pertaining to, is deemed to be confidential information of Veolia and is being provided to you for the sole purpose of requesting a Bid. You are required to maintain such information on a confidential basis and not disclose such information to any third party, or use such information for any other purpose, without the prior written consent of Veolia. You agree that only those of your employees who

have a “need to know” such information for purposes of preparing and submitting a proposal shall be granted access to such information.

Disadvantaged Business Enterprise (DBE) goals are applicable to the total dollars paid to the the construction contract. The goals for this project are a minimum 4.2 percent D/MBE participation and a 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)

If you do not wish to submit a Bid, please notify daniel.finan@veolia.com via e-mail.

Sincerely,

Daniel Finan

SECTION 00200
INSTRUCTIONS TO BIDDERS

ARTICLE 1. COPIES OF PROCUREMENT DOCUMENTS

1.1 Complete sets of Procurement Documents shall be used in preparing Bids; neither Veolia nor Engineer assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Procurement Documents.

1.2 Veolia and Engineer in making copies of Procurement Documents available do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

ARTICLE 2. EXAMINATION OF PROCUREMENT DOCUMENTS

2.1 Before submitting a Bid, each Bidder must (a) examine the Procurement Documents thoroughly, (b) become familiar with Federal, State and local laws, ordinances, rules and regulations that may in any manner affect cost, progress or performance of the Work; and (c) study and carefully correlate Bidder's observations with the requirements of the Procurement Documents.

2.2 The submission of a Bid will constitute an incontrovertible representation that the Bidder has complied with every requirement of this Article 3 and that the Procurement Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for providing the Goods and Services.

ARTICLE 3. INTERPRETATIONS

3.1 All questions about the meaning or intent of the Procurement Documents shall be received **via e-mail** by Veolia, Attn: Mr. Daniel Finan, e: daniel.finan@veolia.com, m: (978) 320-6898 at least ten days before the date herein set for the opening of bids.

3.2 Written clarifications or interpretations will be issued by Addenda not later than five days before the bid opening date. Only questions answered by formal written Addenda will be binding. Oral and other clarifications or interpretations will be without legal effect. Addenda will be e-mailed to all parties recorded as having received the Procurement Documents.

3.3 Bidders are responsible for determining that they have received all Addenda issued.

ARTICLE 4. BID FORM

4.1 Each Bid shall be submitted on the Bid Form on the pages appended to the Procurement Documents. One such copy of the Bid Form shall be removed and submitted separately. All blank spaces must be filled in.

4.2 Bid Forms shall be completed in ink or by typewriter. The Bid price of each item on the form shall be stated in words, and figures. Discrepancies between words and figures will be resolved in favor of words. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

4.3 Firm bids are required. Conditional bids will not be considered.

4.4 All names shall be typed or printed below the signature.

4.5 The Bid shall contain an acknowledgement of receipt of all Addenda (the numbers of which shall be filled in on the Bid Form).

4.6 The address to which communications regarding the Bid are to be directed shall be shown.

4.7 One copy of each Bid shall be submitted via e-mail.

ARTICLE 5. RECEIPT OF BIDS

5.1 Bids will be received at the time and place indicated in the Invitation to Bid.

5.2 Veolia may consider informal any Bid not prepared and submitted in accordance with the provisions hereof.

5.3 Bidders are cautioned that it is the responsibility of each individual bidder to assure that their bid is in the possession of the responsible official or the designated alternate prior to the stated time and at the place of the Bid Opening. Owner is not responsible for bids delayed by e-mail services, of any nature.

ARTICLE 6. MODIFICATION AND WITHDRAWAL OF BIDS

6.1 Bids may be modified only by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

6.2 Bids may be withdrawn prior to the scheduled time (or authorized postponement thereof) for the opening of Bids.

6.3 Any Bid received after the time and date specified shall not be considered. No Bid may be withdrawn for a period of thirty days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids.

ARTICLE 7. AWARD OF CONTRACT

7.1 The Contract will be awarded to the lowest responsible and eligible Bidder (Successful Bidder). Such a Bidder shall possess the skill, ability, and integrity necessary for the faithful performance of the work. The term "lowest responsible and eligible Bidder" as used herein shall mean the Bidder whose Bid is the lowest of those Bidders possessing the skill, ability, and integrity necessary to the faithful performance of the Work.

7.2 Veolia reserves the right to reject any and all Bids, to waive any and all informalities if it is in Veolia's best interest to do so, and the right to disregard all nonconforming, non-responsive or conditional Bids.

7.3 If the Contract is to be awarded, Veolia will give the Successful Bidder an agreement within sixty days, excluding Saturdays, Sundays, and legal holidays.

ARTICLE 8. SALES TAX

8.1 The goods and services to be provided under this Contract are exempt from the Sales and Use Taxes of the Commonwealth of Massachusetts.

ARTICLE 9. COMMONWEALTH OF MASSACHUSETTS REQUIREMENTS

9.1 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. Note that the City of Taunton has special legislation for contracts associated with water and wastewater treatment facilities.

9.2 Minimum Wage Rates as determined by the Commissioner of Department of 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.

9.3 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.

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."

9.4 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.

9.5 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.

9.6 This project is subject to the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014. See Appendix I to the Agreement.

9.7 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.

SECTION 00300 BID FORM

PROJECT IDENTIFICATION: CITY OF TAUNTON, MA
WASTEWATER TREATMENT FACILITY
SOLIDS HANDLING IMPROVEMENTS
CONTRACT S-2020-3
CWSRF NO. 6690
Bid Package #3 - Sludge Dewatering Centrifuges (Section 11350)
825 West Water Street, Taunton, MA 02780

THIS BID IS SUBMITTED TO: Veolia Water North America-Northeast, LLC
Attn: Daniel Finan

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement to furnish all equipment as specified. Veolia Terms & Conditions will apply.
2. This Bid will remain subject to acceptance for 180 days after the day of Bid opening.
3. Bidder understands that Veolia reserves the right to reject any or all bids.
4. Bidder understands that, if the contract is to be awarded, it will be awarded to the lowest responsive, responsible Bidder whose evaluation by Veolia indicates that the award will be in the best interests of the Project.
5. A Labor and Material or Payment Bond in the amount of 100% of the total contract price shall be provided.
6. A Performance Bond in the amount of 100% of the total contract price shall be provided.
7. The time of completion for this contract is 365 days. Interim completion milestones are as follows:
4 weeks engineering submittals
2 weeks engineering review
24 weeks delivery upon approval of submittals
8. Liquidated damages specified in this contract are \$1,000 per day for each calendar day beyond the contract completion date that work remains uncompleted.
9. 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.
10. 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 are not eligible for award of any contracts funded by the Massachusetts State Revolving Fund.
11. The undersigned acknowledges receipt of addenda:

Number: _____

Dated: _____

12. Bidder will furnish the equipment described in the Documents for the following price.
13. The Bidder shall complete all work required under the Contract within 365 days of the issuance of a Notice to Proceed. Work performed beyond the completion date will be subjected to liquidated damages in the amount specified herein.
- 4 weeks engineering submittals
 - 2 weeks engineering review
 - 24 weeks delivery upon approval of submittals
14. Liquidated damages specified in this contract are \$1,000 per day for each calendar day beyond the contract completion date that work remains uncompleted.

BID SCHEDULE

Two (2) Sludge Dewatering Centrifuges

_____ (\$_____).

Amounts shall be shown in both words and figures, where indicated. In case of discrepancy, the amount shown in words will govern.

The above prices shall include all labor, materials, delivery, overhead, profit, insurance, and incidentals required to complete the Work.

RESPECTFULLY SUBMITTED on _____, 20____

(SEAL)

(Name of Bidder)

By _____
(Signature and Title of Authorized Representative)

(Business Address)

(City & State)

(Phone No.)

(Date)

BIDDER CERTIFICATIONS

Pursuant to M.G.L.c.62C, §49A 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.

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 EO/AA provisions of this contract into all subcontracts and purchase orders so that such provisions will be binding upon each subcontractor or vendor.

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.

(Date) **(Name of General Bidder)**

(Federal Employer Identification No.)

By:

(Signature)

(Title & Name of person signing bid)

(Business Address)

(City, State, Zip)

STATEMENT OF INTENT TO COMPLY

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

Local Governmental Unit City of Taunton, MA SRF Project No. 6690

Contract No. S-2020-3 Contact Title WWTF Solids Handling Improvements

Bidder _____

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

1. the Bidder shall comply with the Department of Environmental Protection’s (“DEP”) 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 DEP (NAME and ADDRESS) 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)

SECTION 00500
PURCHASE ORDER

CITY OF TAUNTON, MA WASTEWATER TREATMENT FACILITY
SOLIDS HANDLING IMPROVEMENTS CONTRACT S-2020-3, CWSRF NO. 6690
Bid Package #3 - Sludge Dewatering Centrifuges (Section 11350)

- 1) **ACCEPTANCE** – Commencement of performance of this purchase order (“Order”) shall constitute acceptance hereof by Seller, provided that Buyer may unilaterally cancel this Order without cost at any time prior to having received Seller’s written unqualified, unconditional acceptance hereof. Seller’s acceptance of this Order shall be unqualified, unconditional and subject to and expressly limited to the terms and conditions hereof. Buyer shall not be bound by and hereby rejects any provisions additional to or at variance with the terms hereof that may appear in Seller’s quotation, acknowledgment, confirmation, invoice or in any other communication from Seller to Buyer unless such provision is expressly agreed to in a writing signed by an authorized agent of Buyer. Buyer’s acceptance of the goods or services described in the Order (the “Goods” or “Services”) shall constitute acceptance of such Goods or Services subject to the provisions hereof only, and shall not constitute acceptance of any counter proposal submitted by Seller not otherwise accepted in a writing signed by an authorized agent of Buyer. Upon acceptance, this Order shall constitute the entire agreement between Buyer and Seller, supersede all prior negotiations, discussions and dealings and may not be modified or rescinded except by a writing signed by both Seller and Buyer.
- 2) **ANTI-CORRUPTION COMPLIANCE**
- a) In carrying out the terms of this Order, Seller hereby undertakes to strictly comply with applicable laws prohibiting the bribery of public officials and private persons, influence peddling, money laundering that may in particular entail a public contract debarment, including:
- i) the 1977 Foreign Corrupt Practices Act of the United States,
 - ii) the 1998 Canadian Corruption of Foreign Public Officials Act,
 - iii) the 2010 UK Bribery Act, the OECD Convention on Combating Bribery of Foreign Public Officials in International Business Transactions of December 17, 1997.
- Seller undertakes to put in place and implement all necessary and reasonable policies and measures to prevent corruption.
- b) Seller declares that to its knowledge, its legal representatives, directors, employees, agents, and anyone performing services for or on behalf of Buyer pursuant to this Order do not and will not directly or indirectly offer, give, agree to give, authorize, solicit, or accept the giving of money or anything else of value or grant any advantage or gift to any person, company or undertaking whatsoever including any government official or employee, political party official, candidate for political office, person holding a legislative, administrative or judicial position of any kind for or on behalf of any country, public agency or state owned company, official of a public international organization, for the purpose of corruptly influencing such person in their official capacity, or for the purpose of rewarding or inducing the improper performance of a relevant function or activity by any person in order to obtain or retain any business for Buyer or to gain any advantage in the conduct of business for Buyer.
- c) Seller further undertakes to ensure that neither Seller nor any of its legal representatives, directors, employees, agents, subcontractors and anyone performing services for or on behalf of Buyer under this Order
- d) has been, or is listed by any government agency as being debarred, suspended, proposed for suspension or debarment, or otherwise ineligible for participation in government procurement programs and/or bidding following invitations to bid advertised by the World Bank or any other international development bank.
- e) Seller undertakes to retain for an appropriate period following termination of this Order, accurate supporting documentation of its compliance with the terms of this clause.
- f) Seller agrees to notify Buyer of any breach of any term of this clause within a reasonable time.
- g) If Buyer notifies Seller that it has reasonable grounds to believe that Seller has breached any term of this clause:
- i) Buyer is entitled to suspend performance of this Order without notice for as long as Buyer considers necessary to investigate the relevant conduct without incurring any liability or obligation to Seller for such suspension;
 - ii) Seller is obliged to take all reasonable steps to prevent the loss or destruction of any documentary evidence in relation to the relevant conduct.
- h) If Seller breaches any term of this clause:
- i) Buyer may immediately terminate this Order without notice and without incurring any liability.
 - ii) Seller undertakes to indemnify Buyer, to the maximum extent permitted by law, for any loss, damages, or expenses incurred or suffered by Buyer arising out of such breach.
- 3) **GENERAL PRINCIPLE FOR SUPPLIERS RELATIONSHIP** – Seller acknowledges that it has reviewed and shall comply with Buyer’s **General Principle for Suppliers Relationship Charter** effective March of 2019 and incorporated by reference herein.
- 4) **SUSTAINABLE DEVELOPMENT COMPLIANCE**
- a) Buyer maintains a sustainable development policy (“**Sustainable Development Policy**”) which aims to promote human rights, to facilitate social welfare and to preserve the environment. The Seller undertakes to vigorously respect and comply with the regulations applicable in these domains as well as the standards maintained by Buyer, in particular in Buyer’s commitments to Sustainable Development, in

addition to the commitment to diversity, accident prevention and health & safety. Seller agrees that committing to the responsibilities contained within the Sustainable Development Policy constitutes one of the essential conditions required in entering into this Order.

- b) **Ethics and Labor Laws.** In carrying out the terms of this Order, Seller hereby undertakes to strictly comply with the following ethics and labor law regulations:
- i) Universal Declaration of Human Rights and the United Nations Convention on the Rights of the Child, as well as International Labor Organization conventions.
 - ii) imperative regulations applicable by virtue of labor laws, in particular regulations governing undeclared work, child labor, forced labor and trade union rights; and
 - iii) the prevention, health & safety policy in force with Buyer, in particular as regards to the safety regulations applicable at the site(s), to deliver products and Services in conditions that make it possible to minimize danger to the health and safety of its own employees as well as to the employees of Buyer, and to strive to continue to improve the health and working conditions of its employees.
- c) **Diversity and Non-Discrimination.** In carrying out the terms of this Order, Seller undertakes to strictly comply with the principles of the Diversity Action Plan implemented by Buyer, which is based on the principle that promoting pluralism and the search for diversity via recruitment and career management is a key factor for Buyer. The Seller undertakes to:
- i) Comply with all applicable legislation concerning non-discrimination, whether direct or indirect (within the framework of its internal management, and in particular in terms of Human Resources, at each stage of the assignments entrusted to it by Buyer);
 - ii) Ensure that its Seller Personnel are familiar with and promote the principles of nondiscrimination and of fighting against prejudice.
 - iii) Ensure that its own suppliers and subcontractors respect the same obligations.
- d) **Protection of the environment.** In carrying out the terms of this Order, Seller undertakes to respect all regulations relating to the protection of the environment and to implement the action necessary to reduce its impact on the environment, in particular via the reduction of its consumption of energy and primary resources; the reduction of waste introduced into water, the air or the ground; the elimination of accidental pollution; the reduction of waste generated by its activity and the traceability of its elimination; controlling the impact and emission of substances that are dangerous for the environment and for health. The Seller also undertakes not to use any subcontractors who do not respect these obligations.
- e) **Adherence by Seller.** Buyer will continue to monitor Seller's adherence to the Sustainable Development Policy for the term of this Order. The Seller undertakes to inform Buyer regarding the current state of progress of its actions in terms of sustainable development and to update this data on a yearly basis. Buyer shall continually evaluate sustainable development actions implemented by the Seller and the Seller agrees to be evaluated and provide to Buyer all of the information and resources necessary to ensure adherence to the Sustainable Development Policy. In addition, the Seller also undertakes to take into account recommendations made following such evaluations, and to take the action necessary to ensure compliance and/or improvement.

5) DATA PRIVACY COMPLIANCE

- a) **Compliance with Applicable Laws and Buyer Policies** – Seller warrants and represents that it will comply with all laws, including data protection, data privacy, and data breach notification laws, applicable to the Seller's performance of Services and the type of Buyer information contemplated under this Order. Prior to gaining access to Buyer's systems and/or prior to gaining access to Buyer's facilities in order to perform Services, Seller personnel will execute Buyer's document(s) required for access privileges and at all times act in compliance with Buyer's policies and procedures. Seller and all individuals assigned by Seller to a project under this Order must comply with Buyer policies and sign the Buyer Remote Access Agreement (if applicable). Seller represents that its management and storage of Buyer Information shall in all respects, including, without limitation, administrative, physical and technical aspects, meet the privacy and security standards set forth in Gramm-Leach Biley Act, 15 U.S.C. sections 6801-6809 ("GLB") and its implementing regulations. Without representing that it is subject to GLB, Seller understands that it may have access under this Order to Buyer financial information and other nonpublic personal information protected thereby. To assist Buyer in meeting Buyer's various legal obligations, Seller will implement, maintain, and use appropriate administrative, technical and physical security measures to protect the confidentiality and integrity of all Buyer Information within its possession.
- b) **Information Security Program** – Without limiting the Seller's obligation of confidentiality as further described in the Order and herein, Seller will be responsible for establishing and maintaining an information security program that is designed to: (i) ensure the security and confidentiality of Buyer information; (ii) protect against any anticipated threats or hazards to the security or integrity of Buyer information; (iii) protect against unauthorized access to or use of Buyer information; (iv) ensure the proper disposal of Buyer information, as further defined herein; and (v) ensure that all subcontractors of Seller, if any, comply with all of the foregoing. Buyer will have the right to review Seller's information security program prior to the commencement of Buyer's entry of data into the Goods or delivery to Buyer of any Services and from time to time during the term of this Order. Seller will designate an individual to be responsible for the information security program. Such individual will respond to Buyer inquiries regarding computer security and to be responsible for notifying Buyer-designated contact(s) if a breach or a Security Incident occurs, as further described herein. The information security program will be audited annually as detailed in Seller's SOC 1 and/or SOC 2 audit reports. Any and all audit reports will be provided to Buyer at na.information.security@veolia.com.

Buyer shall have the right to terminate this Order (together with any related Orders, including licenses and/or Statement(s) of Work) and receive a full refund for all monies prepaid thereunder in the event that Seller fails to produce an acceptable SOC-1 or SOC-2 audit report.

- c) **Security Incident Response Handling** – Upon becoming aware of any unauthorized access to any Buyer information stored on Seller’s equipment or in Seller’s facilities, or unauthorized access to such equipment or facilities reasonably expected to result in loss, disclosure, or alteration of Buyer information (each a “Security Incident”), Seller will: (1) promptly notify Buyer at na.information.security@veolia.com of the Security Incident, no later than 72 hours; (2) investigate the Security Incident and provide Buyer with detailed information about the Security Incident; (3) take reasonable steps to mitigate the effects and to minimize any damage resulting from the Security Incident; (4) take prompt and appropriate corrective action aimed at preventing the reoccurrence of a similar Security Incident in the future; and (5) hold Buyer harmless from any costs associated with a data breach attributable to the actions or inactions of Seller. Buyer information, including but not limited to financial and personal data, hosted, stored, or held by Seller in the product(s) or in the platform operated by Buyer, or on any device owned or in the custody of Seller, its employees, agents or contractors, will be encrypted. Seller will not transmit any unencrypted Buyer Information over the internet or a wireless network, and will not store any Buyer information on any mobile computing device, such as a laptop computer, USB drive or portable data device, except where there is a business necessity and then only if the mobile computing device is protected by industry-standard encryption software approved by Buyer. The parties acknowledge and agree that any disclosure of Buyer information will in no way be construed to be an assignment, transfer, or conveyance of title to or ownership rights in such Buyer information.
- d) **Network and Communications Security** – All Seller connectivity to Buyer’s computing systems and all attempts at same will be only through Buyer’s security gateways/firewalls and always adhering to Buyer-approved security procedures. Seller will not access, and will not permit unauthorized persons or entities to access, Buyer computing systems and/or networks without Buyer’s express written authorization, and any such actual or attempted access will be consistent with any such authorization. Seller will take appropriate measures to ensure that Seller’s systems connecting to Buyer’s systems and anything provided to Buyer through such systems do not contain any Disabling Device. For purposes of this Order, “Disabling Device” means any programs, mechanisms, programming devices, malware or other computer code (i) designed to disrupt, disable, harm, or otherwise impede in any manner the operation of any software program or code, or any computer system or network (commonly referred to as “malware”, “spyware”, “viruses” or “worms”); (ii) that would disable or impair the operation thereof or of any software, computer system or network in any way based on the elapsing of a period of time or the advancement to a particular date or other numeral (referred to as “time bombs”, “time locks”, or “drop dead” devices); (iii) is designed to or could reasonably be used to permit a party or any third party to access any computer system or network (referred to as “trojans”, “traps”, “access codes” or “trap door” devices); or (iv) is designed to or could reasonably be used to permit a Party or any third party to track, monitor or otherwise report the operation and use of any software program or any computer system or network by the other party or any of its customers.
- e) **Buyer Information Handling Procedures Erasure of Information and Destruction of Electronic Storage Media** – If Buyer Information is required to be permanently deleted from any storage media owned or operated by Seller, all electronic storage media containing Buyer information must be wiped or degaussed for physical destruction or disposal, in a manner meeting forensic industry standards such as the NIST SP800-88 Guidelines for Media Sanitization. Seller must maintain documented evidence of data erasure and destruction. This evidence must be available for review at the request of Buyer.
- f) **Physical Security** – All facilities and other resources used to store and/or process Buyer information will employ reasonable and appropriate administrative, physical, and technical safeguards, to secure such data from unauthorized access, disclosure, alteration, and use. Such measures will be no less protective than those used to secure Seller’s own data of a similar type, and in no event less than reasonable in view of the type and nature of the data involved. Seller will use industry-standard and up-to-date security tools and technologies such as anti-virus protections and intrusion detection methods in providing Services under this Order. Seller will update its tools and technologies during the course of the Order as industry standards change and/or as updated tools and technologies become available. Seller will ensure that its employees, subcontractors and agents who perform work under this Order receive appropriate instruction as to how to protect data consistent with the provisions of this Order. All backup and archival media containing Buyer information must be contained in secure, environmentally-controlled storage areas owned, operated, or contracted for by Seller and all backup and archival media containing Buyer Information must be encrypted.
- g) **Penetration/Vulnerability Testing** – Seller will provide Buyer with an annual, third party Penetration Test report. During the term of this Order, Seller will engage, at its own expense and at least one time per year, a third party vendor reasonably acceptable to Buyer to perform penetration and vulnerability testing (“Penetration Tests”) with respect to Seller’s systems. The objective of such Penetration Tests is to identify design and/or functionality issues in infrastructure of Seller’s systems that could expose Buyer Information and its computer and network equipment and systems to risks from malicious activities. Penetration Tests will probe for weaknesses in network perimeters or other infrastructure elements as well as weaknesses in software, process or technical countermeasures relating to Seller’s systems that could be exploited by a malicious party. Penetration Tests will identify, at a minimum, any software, either as a product or integrated into a Service, that contains common security defects that have been listed by such entities as OWASP, SANS and MITRE. Within a reasonable period after the annual Penetration Test has been performed, Seller will provide to Buyer a report of any security issues that were revealed during such Penetration Test and subsequent certification in writing to Buyer that such high level and medium level security issues have been fully remediated. To the extent that high level and/or medium level security issues were revealed during a particular Penetration Test, Seller will subsequently engage, at its own expense, the third party vendor to perform an additional Penetration Test within a reasonable period thereafter to ensure continued resolution of identified security issues and will notify Buyer with the results thereof. All reports and results of Penetration tests will be considered Seller Confidential Information (defined herein).
- h) **Security Awareness Training** – Seller must conduct formal security awareness training, with a testing component, for all personnel and

contractors as soon as reasonably practicable after the time of hiring or prior to being appointed to work on Buyer information and annually recertified thereafter. Documentation of Security Awareness Training must be retained by Seller, confirming that this training and subsequent annual recertification process have been completed, and available for review by Buyer.

- i) **GDPR** – If the Order, and/or the activities contemplated thereby involve the Processing (as such term is defined under the Regulation (EU) 2016/679 (General Data Protection Regulation, or “GDPR”)) by the Seller of Personal Data (as defined in the GDPR) of which Buyer is the Controller (as defined in the GDPR), regardless of whether such Personal Data constitutes Buyer Data, then Buyer and the Seller agree to complete/execute a Personal Data Processing Agreement (PDPA) to the extent to which the GDPR applies to such processing (in addition to the provisions of the Order).
- 6) **ATTORNEY FEES** – If either party commences or is made a party to an action or proceeding to enforce or interpret this Order, the prevailing party in such action or proceeding shall be entitled to recover from the other party all reasonable attorneys’ fees, costs and expenses incurred in connection with such action or proceeding or any appeal or enforcement of any judgment obtained in any such action or proceeding.
- 7) **BUYER’S PROPERTY** – Unless otherwise agreed in writing, all tools, equipment or Goods and Services of every description furnished to Seller by or on behalf of Buyer or specifically paid for by Buyer or prepared by Seller for Buyer or at Buyer’s request and any replacement thereof or modification thereto, or any Goods affixed or attached thereto, shall be and remain the sole property of Buyer. Such property (a) shall be clearly marked “Property of Buyer”, (b) shall not be used except in filling Buyer’s Orders; (c) shall be held at Seller’s risk; and (d) shall be promptly delivered without cost to Buyer at its written request. Seller shall supply Buyer with an inventory of such property quarterly. Any specifications, drawings, sketches, models, samples, tools, technical information or data, and any other confidential or proprietary information, written, oral or otherwise (all hereinafter designated “information”) furnished to Seller thereunder or in contemplation hereof shall remain Buyer’s property. All copies of such information in written, graphic or other tangible form shall be immediately returned to Buyer without cost upon its request. The information shall be kept confidential by Seller, shall be used only in the filling of Buyer Orders, or in performing obligations thereunder and may be disclosed or used for other purposes only upon such terms as may be agreed upon between Buyer and Seller in writing. No information furnished by Seller to Buyer or in contemplation hereof shall be considered by Seller to be confidential or proprietary except as specifically agreed to in writing by an authorized agent of Buyer.
- 8) **CANCELLATION** – Buyer may cancel this Order at any time for any reason upon written notice to Seller. Upon cancellation of this Order, Seller will be paid for the Goods received and Services performed, and accepted by Buyer through the effective date of cancellation. In addition, in the event that (i) any Goods fail to conform to any applicable warranties, (ii) Seller fails to make any required deliveries, (iii) Seller breaches any terms or conditions of this Order, (iv) Seller becomes insolvent, (v) a voluntary petition in bankruptcy is filed by Seller, (vi) an involuntary petition to have Seller declared bankrupt is filed, (vii) a receiver or trustee for Seller is appointed, or (viii) an assignment for the benefit of creditors is executed by Seller, Buyer shall have the right to immediately cancel this Order without any liability whatsoever to Seller or any other person or entity. In the event of such cancellation, Buyer, without prejudice to any other rights available to Buyer for breach of contract, shall have the right to: (a) refuse to accept delivery of the Goods or performance of the Services, (b) return to Seller any Goods already accepted and recover from Seller all payments made therefor and for freight, storage, handling and other expenses incurred by Buyer and be relieved from liability for any future payments to Seller, (c) recover any advance payments to Seller for undelivered or returned Goods or Services to be performed, and (d) purchase Goods or Services elsewhere and require Seller to immediately reimburse Buyer for any resulting losses.
- 9) **CODE OF CONDUCT** – A commitment to integrity and high ethical standards in all of our business operations is at the core of Buyer’s corporate culture. Therefore, Buyer has implemented a Code of Business Conduct and expects its employees to adhere to it when dealing with suppliers. Buyer requires the same high ethical standards of its suppliers and requires that they not conceal or facilitate any illegal or improper payments or receipts, or support an inference or appearance of wrongdoing. Seller’s employees must not involve themselves, directly or indirectly, in any improper payments or promises (for example, promise of future employment) to any Buyer employees, officials, or other representatives of any governments to secure any business or favor, or to influence any official act. In addition, Seller should not offer Buyer employees any gifts of significant value, including free travel or lodging.
- 10) **COMPLIANCE WITH LAWS** – Seller warrants that Goods manufactured or Services performed pursuant to this Order are manufactured and shipped or performed in compliance with all applicable federal, state, local laws, rules and regulations, including, but not limited to, the Toxic Substance Control Act, the Occupational Safety and Health Act, the Clean Air Act, the Federal Water Pollution Control Act, the Solid Waste Disposal Act, the Resource Conservation and Recovery Act, Fair Labor Standards Act of 1938, and the Hazardous Goods and Services Transportation Act.
- 11) **CONFIDENTIALITY** – In connection with the negotiation and performance of this Order, Seller may receive information from Buyer which is confidential or proprietary in nature. “Confidential Information” means any and all: (i) trade secrets, inventions, ideas, processes, computer source and object code, formulae, data, programs, other works of authorship, know-how, improvements, discoveries, developments, designs, and techniques; (ii) information regarding products, plans for research and development, marketing and business plans, budgets, financial statements, contracts, prices, suppliers, and customers; (iii) information regarding the skills of Buyer’s employees, contractors, and other agents; (iv) the existence of any business discussions, negotiations, or agreements between Buyer and Seller or any third party, and (v) and all other information that the Seller knew, or reasonably should have known, was the Confidential Information of Buyer or Buyer’s customer, whether or not 1) identified as confidential if disclosed orally or 2) labeled at the time of such disclosure as “Confidential”. Seller agrees that it will keep the Confidential Information in strictest confidence and, in addition, protect such Confidential Information by no less stringent security measures as it takes to protect its own Confidential Information. Seller also agrees that it will not use any Confidential Information for any purpose other than in connection with the performance of its obligations under this Order, and shall limit disclosure of Confidential Information within its own organization to individuals whose duties justify the need to know such information, who have a clear understanding of the obligations of this Order and who are legally obligated to comply with the terms of this Order. The term “Confidential Information” shall not include information which (a) at the time of disclosure is available to the public; or (b) after disclosure becomes available to the public through no fault of Seller provided that the obligation of Seller shall cease only after the date on which such information has become available to the public; or (c) Seller can demonstrate through tangible evidence was in its possession before receipt from Buyer; or (d) is disclosed to Seller without restriction on disclosure by a third party who has the lawful right to disclose such information. At the expiration or termination of this Order, Seller shall return or destroy (if requested by Buyer) all copies, extracts or other reproductions in whole or in part of the Confidential Information disclosed to the Seller by Buyer. If Buyer requests destruction of the documents, Seller shall provide a certification of such destruction, by an officer of Seller. Seller shall retain no copies of any Buyer Confidential Information.

This Section shall survive the termination or expiration of this Order, for whatever reason.

- 12) **COUNTERPARTS** – This Order may be executed in any number of counterparts, and each such counterpart shall be deemed to be an original instrument.
- 13) **DELAYS IN DELIVERY** – Time is of the essence, but Seller will not be liable for damages for delays in delivery due to causes beyond its reasonable control and without its fault or negligence. If Seller does not comply with Buyer's delivery schedule, Buyer in addition to remedies provided by law, at its option, may either approve a revised delivery schedule or may terminate this Order and hold Seller accountable for all losses and damages arising therefrom. Buyer has the right, at any time, to change the place and/or time of delivery. Any claim by Seller for adjustment because of a change in place and/or time of delivery will be deemed waived unless asserted in writing within ten (10) days after receipt by Seller of the request for change.
- 14) **DELIVERY SCHEDULE** – Seller understands and agrees that if Seller makes any commitments or production arrangements in excess of the amounts set forth herein or in advance of the time necessary to meet Buyer's delivery schedule, it does so at its own risk, and Buyer shall have no liability to Seller or any other party relating to same. Goods shipped in advance of the time required in this Order may, at Buyer's option, be returned to Seller at Seller's expense. Buyer reserves the right to delay shipment of the Goods for up to thirty (30) days at no additional cost.
- 15) **DRAWINGS** – Buyer's review and approval of drawings submitted by Seller will be for and cover only general conformity to the specifications. Such approval will not constitute approval of any dimensions, quantities or details of the Goods shown by such drawings, and shall not relieve the Seller of its responsibility for meeting all specifications of this Order. Buyer retains the right of final approval for all finished Goods.
- 16) **ENVIRONMENTAL PERFORMANCE** – Buyer is committed to operating in an environmentally responsible manner and has established an Environmental Management System. As such, Seller warrants that Services performed will be done in accordance with local, state, and federal environmental regulatory requirements, and in conformance with accepted practice in the industry. This includes, but is not limited to Seller's obligation to not illegally dispose of or otherwise improperly manage hazardous wastes, not cause illegal discharges to grounds or waterways or discharges to air that exceed levels that would be considered environmentally unsafe. These requirements apply to subcontractors working under the direction of Seller. Additional site-specific environmental requirements may apply depending on the Buyer's site where the Services are provided.
- 17) **EQUAL EMPLOYMENT OPPORTUNITY** - Executive Order 11246, as amended; Section 402 of the Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended; Section 503 of the Rehabilitation Act of 1973, as amended; and Section 61-50.10 (VETS-100 Reporting); and Public Law 95-507 contain required contract clauses relative to equal employment opportunity.

Seller and its subcontractors shall abide by the requirements of 41 CFR 60-1.4(a), 60-300.5(a) and 60-741.5(a). These regulations prohibit discrimination against qualified individuals based on their status as protected veterans or individuals with disabilities, and prohibit discrimination against all individuals based on their race, color, religion, sex, or national origin. Moreover, these regulations require that covered prime contractors and subcontractors take affirmative action to employ and advance in employment individuals without regard to race, color, religion, sex, national origin, protected veteran status or disability.

- 18) **FAIR LABOR STANDARDS ACT** – In accepting this Order, Seller warrants that the Goods or the Services to be furnished hereunder were or will be produced in compliance with the requirements (on date of shipment or performing) of the Fair Labor Standards Act of 1938 as amended ("Act") and, unless otherwise agreed in writing Seller, shall insert a certification on all invoices submitted in connection with this Order stating that the Goods or Services covered by the invoice were produced or performed in compliance with the requirements of such Act, including without limitation, Sections 12(a) and (15a) thereof.
- 19) **GOVERNING LAW** – The contract resulting from acceptance of this Order by Seller shall be governed by and construed under the laws of the State of Delaware, and shall not be governed by or construed under the U.N. Convention On Contracts For International Sale Of Goods ("CIGS"), the parties agreeing that CIGS shall not apply to this Order or the enforcement or interpretation hereof.
- 20) **INDEMNIFICATION AND LIMITATION ON LIABILITY** - To the fullest extent permitted by law, Seller and its parent(s), subsidiaries and/or affiliates ("Indemnifying Parties") shall defend, indemnify and hold harmless Buyer and its parents, subsidiaries and affiliates and their respective officers, employees, agents, subcontractors and customers against all damages, claims, actions, liabilities, fines, assessments and expenses (including costs associated with recalling any Goods, reasonable attorneys' fees and costs) arising out of or resulting in any way from (i) any defect in the Goods or Services, (ii) any breach of any warranty or other term of this Order, (iii) the presence of Indemnifying Parties' agents, representatives, employees or subcontractors on Buyer's premises (including, without limitation, personal injury, illness or death of Indemnifying Parties' agents, representatives, employees or subcontractors; and property damage), regardless of the cause of such injury, illness or death, and even though caused in whole or in part by a pre-existing defect, the indemnified party's (or indemnified persons') negligence or any other actual or alleged legal fault, whether sole, joint or concurrent, and (iv) the negligent acts or omissions of Indemnifying Parties, its agents, representatives, employees or subcontractors related to the performance of the services under this Order, but in no event shall the indemnity obligation apply to liability caused by the willful misconduct or sole negligence of Buyer with regard to (i) and (ii) above. Indemnifying Parties will conduct the defense of a third party claim diligently and with counsel reasonably satisfactory to Buyer, and will not consent to the entry of a judgment or enter into any settlement with respect to the claim without the prior written consent of Buyer (not to be withheld unreasonably).

NOTHING IN THIS ORDER SHALL BE CONSTRUED TO SUBJECT BUYER TO LIABILITY FOR INCIDENTAL, INDIRECT, CONSEQUENTIAL, SPECIAL, PUNITIVE OR EXEMPLARY DAMAGES OF ANY KIND - INCLUDING LOST REVENUES OR PROFITS, LOSS OF BUSINESS OR LOSS OF DATA - ARISING OUT OF THIS ORDER OR ANY GOODS OR SERVICES PROVIDED HEREUNDER (INCLUDING WITHOUT LIMITATION AS A RESULT OF ANY BREACH OF THE TERMS AND CONDITIONS SET FORTH HEREIN), REGARDLESS OF WHETHER THE COMPANY WAS ADVISED, HAD OTHER REASON TO KNOW, OR IN FACT KNEW OF THE POSSIBILITY THEREOF.

In no event shall the aggregate liability of Buyer arising out of or relating to this Order exceed, in the aggregate, the fees paid by Buyer for the Goods and Services during the twelve (12) months preceding the event giving rise to the claim.

This Section shall survive the termination or expiration of this Order, for whatever reason.

- 21) INDEPENDENT CONTRACTOR** – Seller shall perform the Services as an independent contractor with exclusive control of the manner and means of performing the work in accordance with the requirements of this Order. Seller has no authority to act or make any agreements or representations on behalf of Buyer or Buyer's customer and no contractual relationship exists between Seller and Buyer's customer. This Order is not intended to create, and shall not be construed as creating, between Buyer and Seller, the relationship of principal and agent, joint venture, co-partners or any other such relationship, the existence of which is hereby expressly denied. No employee or agent engaged by Seller shall be, or shall be deemed to be, an employee or agent of Buyer or Buyer's customer.
- 22) INFRINGEMENT OF PATENTS, TRADEMARKS OR COPYRIGHTS** – The following terms apply to any infringement, or claim of infringement, on any patent, trademark or copyright based on the manufacture, normal use or sale of any Goods furnished to Buyer hereunder or in contemplation hereof. Seller shall indemnify Buyer and its customers for any loss, damage, expense or liability that may result by reason of such infringement or claim (including without limitation reasonable attorneys' fees, costs and expenses), except where such infringement or claim arises solely from Seller's adherence to Buyer's written instructions or directions which relate to the Goods other than (1) commercial material or equipment, or (2) items of Seller's origin, design or selection, and Buyer shall indemnify Seller in such excepted cases. Each party shall defend or settle, at its own expense, any action or suit against the other for which it is responsible hereunder. Each party shall notify the other promptly of any claim of infringement for which the other is or may be responsible hereunder, and shall cooperate with the other in every reasonable way to facilitate the defense of any such claim.
- 23) INSIGNIA** – Goods rejected or not purchased by Buyer which utilize or carry any Buyer name, trade name, trademark, insignia, symbol, decorative design or evidence of Buyer's inspection (all hereinafter designated ("Insignia")) shall have all such Insignia removed prior to any sale, use or disposition thereof. Seller agrees to indemnify and hold Buyer harmless from any claim, loss or damage arising out of Seller's failure so to do. This clause shall in no way modify the provisions hereof relating to the use of information.
- 24) INSPECTION** – Buyer and its customers reserve the right to expedite, inspect or witness the test of the Goods at any time and place including the Seller's and its subcontractor's facilities with prior notice.
- 25) INSURANCE** – Without in any way limiting Seller's liability hereunder, Seller shall maintain the following minimum limits of insurance with insurance companies rated A-VII or higher by A.M. Best's, to cover the risk of losses associated with this Order: (i) Workers' Compensation required by applicable law; (ii) Employer's Liability with limits of not less than \$1,000,000 each accident; \$1,000,000 each employee; \$1,000,000 policy limit; (iii) Commercial General Liability, written on ISO CG 00 01 coverage form or its equivalent. No limiting or exclusionary endorsements material to Seller's obligations in this Order may be attached. Coverage shall include: a) contractual liability; b) explosion, collapse & underground perils (XCU); c) third-party over action coverage; d) Riggers Liability endorsement for the use of cranes, booms or other rigging equipment, if applicable; and e) amendment of the aircraft exclusion to include coverage for the use of commercial UAVs (drones), if applicable, with combined limits of not less than \$2,000,000 per occurrence for property damage and bodily injury (PD/BI); \$2,000,000 general aggregate; and \$2,000,000 products/completed operations aggregate; (iv) Automobile Liability – covering all owned (if any), hired and non-owned autos with limits no less than \$2,000,000 combined single limit each accident. If Seller is performing any hauling, endorsements MCS-90 and/or CA 99 48 shall be attached; (v) Umbrella/Excess Liability – providing coverage at least as broad as the underlying policy(ies) may be utilized to meet minimum limits outlined above; (vi) Property – Seller shall be solely responsible for protecting and insuring all property owned, leased or used by Seller to provide Goods or Services during the term of this Order; and **[If Applicable]**: (vii) Professional Liability (Errors & Omissions), coverage shall not exclude Technology Errors & Omissions coverage if Seller will have any type of access to any Buyer systems, including, but not limited to, any Buyer-owned or managed IT asset (network, server or application) wherever it is hosted, with combined limits of not less than \$2,000,000 each claim; and \$2,000,000 annual aggregate; (viii) Contractor's Pollution Liability, with combined limits of not less than \$5,000,000 each claim; and \$5,000,000 annual aggregate; (ix) Valuable Papers, with combined limits of not less than \$1,000,000 covering "All Risk Perils" for damage to all drawings, specifications, plans, computations, sketches, test data, survey results, photographs, renderings, or other paper or reproductions; (x) Cyber Liability, with combined limits of not less than \$1,000,000 each claim; and \$2,000,000 policy limit; and (xi) Crime Insurance or Employee Dishonesty Bond, in the amount of \$2,000,000 each claim; and \$2,000,000 policy limit.

Contractor's pollution liability policy above shall provide coverage for:

- (i) Bodily injury, sickness, disease, sustained by any person, including death;
- (ii) Property damage, including physical injury to or destruction of tangible property including the resulting loss of use thereof;
- (iii) Cleanup costs, and the loss of use of tangible property that has not been physically injured or destroyed including diminution of value and natural resources damages;
- (iv) Defense costs, including costs, charges, and expenses incurred in the investigation, adjustment, or defense of claims; (e) Contractual liability coverage, e.g., coverage for liability assumed by Seller under this Order; and (f) the full scope of the Seller's operations as described within the scope of work for this Order.

Contractor's pollution liability coverage may not contain separate restrictions for:

- (i) Insured versus insured actions (however, exclusions for claims made between insureds within the same economic family are acceptable);
- (ii) Completed operations in any coverage part of the policy for either the insured or additional insured; (c) Damage to property that cannot be used or is less useful because of operations of Seller; or
- (iv) Work performed by subcontractors.

In the event that the state where Goods or Services are to be provided allows an employer to opt out of Workers Compensation coverage, Seller shall nevertheless obtain a Workers Compensation policy complying in all respects with this provision.

Prior to providing any Goods or Services under this Order and prior to expiration of any policy required under this Order, Seller will provide Buyer with an ACORD certificate of insurance evidencing that the above described coverages are in full force and effect. Seller will include Buyer, its parent companies, subsidiaries, affiliates, and each of their officers, directors, employees, agents, representatives and Buyer's customer (if applicable), (collectively "Buyer Additional Insured") as additional insured with respect to the Commercial General Liability, Automobile Liability, Umbrella/Excess Liability and Contractor's Pollution Liability coverages. All policies shall be primary and non-contributory, provide a full waiver of the insurer's right of subrogation in favor of Buyer Additional Insured and/or any subcontractor with respect to claims that are covered or should have been covered by valid and collectible insurance provided hereunder and said waiver will extend to any deductibles, co-insurance or other forms of retentions. Seller will not permit any cancellation or non-renewal in the insurance coverage to be

provided hereunder without thirty (30) days' written notice to Buyer.

Cyber liability coverage shall cover network security and privacy risks including, but not limited to 1) liability arising out the failure of network security, including unauthorized access or unauthorized use of corporate systems, a denial of service attack or transmission of virus malicious code, and 2) failure to protect sensitive personal or corporate information in any format, including but not limited to data exposed by a hacker, lost device, employee, or physical records.

All policies shall be issued on occurrence-based forms, except for Professional Liability, Contractor's Pollution Liability, Cyber Liability, and Crime Insurance, which may be issued on a claims-made form. All claims-made policies will be at least retroactive to the earlier of the date of this Order or the commencement of Seller's Services in relation to this Order, and shall be maintained for three (3) years after the expiration or termination of this Order.

These insurance requirements will not be construed in any matter as waiving, restricting or limiting Buyer's rights or Seller's obligations under this Order. Buyer does not represent that coverage or limits herein will be adequate to protect Seller. Seller remains responsible for any liability not paid by insurance including deductibles and retentions.

- 26) NON-WAIVER** – The failure by Buyer to enforce at any time, or for any period of time, any of the provisions hereof shall not be a waiver of such provisions nor the right of Buyer thereafter to enforce each and every such provision.
- 27) NOTICES** – Any notice given under this Order shall be in writing and sent (i) by registered or certified mail, postage prepaid, return receipt requested, or (ii) by any other commercial delivery service which delivers to the noticed destination and provides proof of delivery to the sender. Notice may also be sent by email provided that confirming notice according to one of the methods of the preceding sentence is sent within three (3) business days after the email transmission. All notices will be effective when first received at the address of Seller on the Order or to Buyer at Veolia North America, LLC, 53 State Street, 14th Floor, Boston, MA 02109, Attn: General Counsel, Email: general.counselNA@veolia.com and na.procurement.notice@veolia.com. Seller is required to provide notification to Buyer at na.information.security@veolia.com and general.counselNA@veolia.com of any suspected or actual breach of security or unauthorized use or disclosure of Buyer personally identifiable information or Confidential Information and/or Buyer's business systems which Seller becomes aware of in connection with the Services and/or deliverables provided under this Order ("data breach"). Notification shall be made in accordance with applicable laws or regulations, but no later than three (3) calendar days after Seller is made aware of a data breach.
- 28) PAYMENT TERMS** – Seller agrees to submit all invoices to us.apinvoices@veolia.com. Buyer's payment terms are 2% 15 or NET 60 (i.e., 2% discount will be taken on the undisputed amount if paid within fifteen (15) days from receipt of a correct invoice or the undisputed amount will be paid within sixty (60) days from receipt of a correct invoice) after receipt of the Goods (including all documents required in this Order), performance of the Services, verification that the quality of Goods or Services received meets Buyer's specifications. Each invoice must include the PO number and the site ID. If Seller fails to include the aforesaid information on each invoice, Buyer may reject the invoice and delay payment until a correct invoice is received. If Seller fails to ship the Goods or perform the Services in accordance with the times stipulated in this Order, Buyer may delay payment equal to the number of days the Goods or Services were delayed by the Seller, as an equitable adjustment. Buyer shall be entitled at all times to set off any amount owing at any time from Seller or any of its affiliates to Buyer. Payment of any invoice by Buyer shall not imply inspection, approval, or acceptance of the Goods or Services by Buyer. Payment to Seller shall be by electronic funds transfer to a Canadian based bank designated by Seller.
- 29) PRICES** – All prices are firm, fixed and not subject to escalation. Prices include all applicable federal, state and local taxes or charges (for which Seller shall be solely responsible) except state sales tax may be invoiced if applicable. All costs and expenses relating to boxing, packing, loading, bracing, cartage or extra insurance are included in the price, and no additional charges of any kind will be allowed relating to same.
- 30) PUBLICITY** – No news release, public announcement, public disclosure or denial or confirmation of the foregoing, regarding purchase of the Goods or any phase of the Services hereunder will be made by Seller and under no circumstances shall Seller issue, or permit to be issued, any advertisement or literature of any kind, or list Buyer or Buyer's logo on Seller's website or any social media site, or conduct or permit to be conducted any interview or news conference referring to Buyer.
- 31) REJECTIONS** – If any Goods are found by Buyer within a reasonable time after delivery to Buyer's destination to be defective in material or workmanship, or otherwise not in conformity with the requirements of this Order. Buyer, in addition to any other rights which it may have under warranties or otherwise, shall have the right to reject and return such Goods at Seller's expense, which Goods shall not be replaced by Seller, without prior written authorization from an authorized agent of Buyer.
- 32) REMEDIES** – Remedies herein reserved to Buyer shall be cumulative, and in addition to any other or further remedies provided in law or equity.
- 33) SEVERABILITY** – Nothing contained herein shall be construed so as to require the commission of any acts contrary to law, and wherever there is a conflict between any provisions of this Order and any present or future statute, law, ordinance or regulation, the former shall be curtailed and limited only to the extent necessary to make it comply with such statute, law, ordinance or regulation.
- 34) SPECIFICATIONS** – Seller expressly warrants that all Goods and Services covered by this Order will conform to the specifications, drawings, samples or other description(s) furnished or adopted by Buyer and will be of good quality and workmanship and free from defects. Goods furnished to Buyer's patterns, specifications, drawings, or fabricated with its tools shall not be furnished or quoted to any other person or entity. Specification Section 00700 - General Conditions is specifically included as an attachment to this Purchase Order.
- 35) SUBCONTRACTING & ASSIGNMENT** – Except as to raw material purchases or standard commercial articles or parts, Seller may not subcontract any portion of the work without prior written consent of Buyer. Assignment of this Order or any interest herein or any payment due or to become due thereunder without the prior written consent of Buyer shall be void and of no effect and may at the option of Buyer, render this Order void.
- 36) TRANSPORTATION** – Unless otherwise specified, all deliveries to Buyer by Seller shall be F.O.B. destination, freight prepaid. Seller shall make no provision for transportation insurance when Buyer is in control of the shipment and responsible for the freight charges, unless specifically authorized to do so in writing. No insurance charges will be allowed unless authorized in writing by Buyer. Irrespective of F.O.B. point, during the period that the Goods are in possession of Seller, all risk of loss or damage to the Goods shall be on Seller.

37) TRAVEL – All travel, together with estimated costs, must be pre-approved by Buyer and airfare, hotel, ground transportation, reasonable meals and other travel-related expenses will be invoiced separately from the fees at actual cost. Seller will make every effort to reduce travel costs when possible and stay in hotels with preferred rates with Buyer and comply with Buyer's travel policy.

38) WARRANTY – Seller warrants to Buyer and its customers that the Goods and Services furnished will be of good quality, free from defects in material, design and workmanship, will conform to the specifications, drawings, or samples and are suitable for their intended purpose(s) as represented to Buyer. All warranties shall succeed to Buyer, its successors, assigns, and all persons and entities, including affiliates of Buyer, to whom the Goods may be resold or leased.

Seller warrants it has not knowingly included any known viruses (including, but not limited to Trojan horses, or worms, or other software code designed to permit unauthorized access to, or to erase or otherwise harm, Buyer software, hardware, or data) with the software and the medium on which it was originally provided to Buyer.

39) WORK OF THE SELLER – All work shall be performed in accordance with sound and generally accepted trade and industry practices and standards by competent practitioners fully qualified (and licensed, if required by law) in their respective disciplines. If Seller's performance under this Order involves operations by Seller on the premises of Buyer or one of its customers, Seller shall comply with all applicable provisions of federal, state and local laws and regulations including rules, safety requirements and regulations established for such premises. Seller shall take all necessary precautions to prevent the occurrence of any injury to persons or property during the progress of such performance.

CERTIFICATION STATEMENT

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

City of Taunton, Massachusetts
City Auditor

Contract Approved As To Form:

City of Taunton Massachusetts
City Solicitor

SECTION 00700

GENERAL CONDITIONS

1.01 GENERAL PROVISIONS

A. The duties and obligations imposed by these General Conditions 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.

B. Sections of Division 1, General Requirements govern the execution of the Work of all sections of the specifications.

C. The Specifications are written in imperative and streamlined form. This imperative language is directed to the Contractor, unless stated otherwise.

1.02 MATERIALS AND EQUIPMENT

A. General

1. Unless otherwise provided in the Contract Documents, only new materials and equipment shall be incorporated in the Work.

2. As soon as possible after execution of the AGREEMENT, submit to the Engineer the names and addresses of the manufacturers and suppliers of all materials and equipment proposed to be incorporated into the Work.

3. When shop and working drawings are required as specified below, submit, prior to the submission of such drawings, data in sufficient detail to enable the Engineer to determine whether the manufacturer and/or the supplier have the ability to furnish a product meeting the Specifications.

4. Submit data relating to the materials and equipment proposed to be incorporated into the Work in sufficient detail to enable the Engineer to identify and evaluate the particular product and to determine whether it conforms to the Contract requirements. Such data shall be submitted in a manner similar to that specified for submission of shop and working drawings.

B. Handling

1. Handle, haul, and distribute materials and all surplus materials on the different portions of the Work, required to complete the Work in accordance with the Contract Documents.

2. Provide suitable storage room for materials and equipment during the progress of the Work, and be responsible for the protection, loss of, or damage to materials and equipment furnished under this Contract, until the final completion and acceptance of the Work.

3. Pay all storage and demurrage charges by transportation companies and vendors.

C. Inspection

1. All materials and equipment furnished by the Contractor to be incorporated in the Work shall be subject to the inspection of the Engineer.

2. No material shall be processed or fabricated for the Work or delivered to the work site without prior concurrence of the Engineer.

3. Facilities and labor for the storage, handling, and inspection of all materials and equipment shall be furnished by the Contractor.

4. Defective materials and equipment shall be removed immediately from the site of the Work.

D. Shop Testing

1. When required, furnish to the Engineer sworn copies of manufacturer's shop or mill tests (or reports from independent testing laboratories) relative to materials or equipment performance ratings.

1.03 CONTRACTOR'S SHOP AND WORKING DRAWINGS

A. Submit shop drawings to the Engineer for review and approval.

B. All submittals will be identified as the Engineer may require and in the number of copies also as required by the Engineer.

C. The data shown on the Shop Drawings will be complete regarding quantities, dimensions, specified performance and design criteria, materials and other data as particular to the Work that the Contractor proposes to provide.

1.04 CERTIFICATES OF CONFORMANCE

A. Furnish to the Engineer, in the manner as directed and prior to actual installation, notarized certificates of

conformance for all materials to be furnished under this Contract. The notarized certificates of conformance shall state that the material to be furnished meets or exceeds all requirements specified under the Contract Documents. When so directed, the manufacturer's notarized certificates of conformance, certifying that the materials meet the requirements specified shall accompany each shipment of material. Unless otherwise specifically specified and/or directed by the Engineer, all testing of materials required under this Contract shall be provided by the Contractor at no

1.05 Equal Employment Opportunity

A. During the performance of this contract, 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.

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.

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]

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.

The contractor will include the provisions of paragraphs 1 through 7 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"]

1.06 Unlawful Conduct and Participation In Boycott

A. 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 of 1954, as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Massachusetts General Laws

1.07 Suspension and Debarment

A. 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.

B. 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.

1.08 American Iron and Steel

The Contractor acknowledges to and for the benefit of the City of Taunton (Purchaser) and the Commonwealth of Massachusetts (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 that have statutory requirements commonly known as "American Iron and Steel"; that requires all of the iron and steel products used in this project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contractor 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 this 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.

1.08 PERFORMANCE PERIOD / SCHEDULE

Time is of the essence in the performance of this Work. Contractor shall make whatever adjustments in working hours, manpower, equipment, etc. deemed necessary to complete the Work in accordance with the terms of the Agreement and the specific schedule requirements hereof.

4 weeks engineering submittals

2 weeks engineering review

24 weeks delivery upon approval of submittals

The Contractor shall start promptly after the Effective Date of the Agreement. The Time for Completion of this Agreement is 365 calendar days or DATE. The Contractor shall prepare a Project schedule.

Liquidated damages specified in this contract are \$1,000 per day for each calendar day beyond the contract completion date that work remains uncompleted.

1.09 DIRECT LABOR MARKUP

As allowed in DEP's Policy Memorandum #10 - the agreed upon DIRECT LABOR MARKUP (percentage) for Change Orders on this Project shall be _____ on this project. The "direct labor markup" rate shall account for the cost of Worker's Compensation Insurance, Federal Social Security and State Unemployment Compensation.

1.10 DAVIS BACON WAGE RATES

Wage Rates as determined by the United States Department of Labor under the DavisBacon Act apply to this project. These wage rates are included in Attachment B to Specification Section 01067

1.11 D/MBE and D/WBE PARTICIPATION

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) 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 City. The contractor shall require similar reports from its subcontractors.

END OF SECTION

EXHIBIT D

INSURANCE REQUIREMENTS

Without in any way limiting Contractor's liability hereunder, Contractor shall maintain the following minimum limits of insurance at its own expense during the performance of the Work, with insurance companies rated A-VII or higher by A.M. Best's, to cover the risk of losses associated with this Agreement:

<u>Coverage</u>	<u>Limits</u>
(i) Workers' Compensation	Worker's Compensation \$100,000. Employer's Liability 500,000. Each accident 500,000. Disease per employee
(ii) Employers' Liability	\$1,000,000 each accident \$1,000,000 each employee \$1,000,000 policy limit
(iii) Commercial General Liability written on ISO CG 00 01 coverage form or its equivalent. No limiting or exclusionary endorsements material to Contractor's obligations in this Subcontract may be attached. Coverage shall include: a) contractual liability; b) explosion, collapse & underground perils (XCU); c) third-party over action coverage; d) Riggers Liability endorsement for the use of cranes, booms or other rigging equipment, if applicable; and e) amendment of the aircraft exclusion to include coverage for the use of commercial UAVs (drones), if applicable	\$5,000,000 each occurrence for property damage and bodily injury (PD/BI) \$5,000,000 general aggregate per project \$5,000,000 products/completed operations aggregate
(iv) Automobile Liability - covering all owned (if any), hired and non-owned autos. If Contractor is performing any hauling, endorsements MCS-90 and/or CA 99 48 shall be attached.	Bodily Injury & \$2,000,000. Each person Property Damage 2,000,000. Each accident
(v) Umbrella/Excess Liability providing coverage at least as broad as the underlying policy(ies)	May be utilized to meet limits outlined above
(vi) Property	Contractor shall be solely responsible for protecting and insuring all property owned or leased or used by Contractor in conjunction with the Work during the term of this Subcontract
(vii) Professional Liability (Errors & Omissions), if applicable to the Work - Coverage shall not exclude Technology Errors & Omissions coverage if Contractor will have any type of access to any Company systems, including, but not limited to, any Company-owned or managed IT asset (network, server or application) wherever it is hosted	\$1,000,000 each claim \$1,000,000 annual aggregate
(viii) Contractor's Pollution Liability, if applicable to the Work	\$1,000,000 each claim \$1,000,000 annual aggregate

Contractor's pollution liability policy in (viii) above shall provide coverage for:

1. Bodily injury, sickness, disease, sustained by any person, including death;

DIVISION 01

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work covered by the Contract, listing of Owner, Project location, Engineer. Sequence requirements, the Contractor's use of the premises Owner's occupancy requirements, State Sales and Use Tax, Non Discrimination in Employment, DCAM Certification Requirements, and Wetland and Waterways.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work includes, but is not necessarily limited to the construction of:

- Replacement of the Gravity Sludge Thickener mechanisms and covers
- Replacement of thickened sludge pumps and piping
- Replacement of sludge dewatering equipment and scum concentrator
- Associated electrical and instrumentation work

all as more particularly indicated, shown or described in the Drawings, Specifications, and other Contract Documents.

1.03 OWNER

- A. City of Taunton, Department of Public Works
90 Ingell Street
Taunton, MA 02708
Telephone: 508-821-1434
Contact: Fred Cornaglia, Commissioner

1.04 PROJECT LOCATION

- A. Taunton Wastewater Treatment Facility (WWTF)
825 West Water Street
Taunton, MA 02708

1.05 ENGINEER

- A. BETA Group, Inc.
701 George Washington Highway
Lincoln, Rhode Island 02865
Telephone: 401-333-2382

Contact: Michael Andrus, P.E.
Email: mandrus@beta-inc.com

1.06 WORK SEQUENCE

- A. In order that Work may be conducted with minimum inconvenience to the public and, work under this Contract may be coordinated with other work which may be under construction or contemplated, and that work under the Contract may conform to conditions which it has been undertaken or conditions attached to a right-of-way or particular location for this work, the Engineer may determine the point or points and time or times when portions of work will commence or be carried on and may issue orders pertaining to the work sequence, relative to the rate of progress on several portions of the work.

1.07 CONTRACTOR USE OF PREMISES

- A. The Contractor's use of premises shall be within the limits shown on the Drawings and as defined in Section 00500 – Contract Agreement, for the performance of the Work.
- B. The Contractor shall maintain access and utilities to the existing pumping station facilities at all times.
- C. The Contractor shall assume full responsibility for security of all materials and equipment on the site, including those of his subcontractor's.
- D. If directed by the Owner, the Contractor shall move any stored items that interfere with operations of the Owner.
- E. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

1.08 OWNER OCCUPANCY REQUIREMENTS

- A. The Main Lift Pumping Station conveys the City's wastewater to the Taunton Wastewater Treatment Facility. The existing collection systems and force mains servicing the Main Lift Pumping Station must remain in full service at all times, throughout the duration of the project.
- B. The Owner requires safe and unhindered access to be maintained to the existing Main Lift Pumping Station for the purpose of operating and maintaining the station, throughout the duration of the Contract.

1.09 STATE SALES AND USE TAX

- A. Materials and equipment purchased for installation under this Contract are exempt from Massachusetts Sales Tax. The Contractor shall file for exemption on behalf of the Owner with the Commonwealth of Massachusetts Department of Revenue as required by law. The exemption from the Sales Tax shall be taken into account by the Contractor during bidding.

1.10 NONDISCRIMINATION IN EMPLOYMENT

- A. Contracts for work will obligate the Contractors and subcontractors not to discriminate in employment practices.
- B. 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' representation 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.

- C. 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.
- D. 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]
- E. 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.
- F. The contractor will include the provisions of paragraphs (1) through (7) 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"
- G. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age, handicap, or national origin. The Contractor shall take affirmative action to ensure that applicants are employed and the employees are treated during employment without regard to their race, color, religion, sex, age, handicap, or national origin. Such actions shall include, but not be limited to, the following: employment, upgrading; demotions, or transfers; recruitment or recruitment advertising, layoffs, or terminations; rates of pay or other forms of compensation; selection for training including apprenticeship; and participation in recreational and education activities. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notice to be provided setting forth the provisions of this non-discrimination clause. The Contractor will in all solicitations or advertisements for employees placed by or on behalf on the Contractor state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age, handicap or national origin. The Contractor will cause the foregoing provisions to be inserted in all sub-contracts for any work covered by this Contract so that such provisions will be binding upon each sub-contractor and upon sub-contracts for standard commercial supplies or raw materials.
- H. The Contractor shall keep such records and submit such reports concerning the racial and ethnic origin of applicants for employment and employees as the Owner may require as

consistent with Federal and State law. The Contractor agrees to comply with such rules, regulations, or guidelines as the Commonwealth of Massachusetts may implement these requirements. The Contractor further warrants, that he will comply with the President's Executive Order No. 11246 or any preceding similar Executive Order relating thereto.

- I. Contractors must, if required, submit a compliance report (EPA Form 5720-4) concerning their employment practices and policies in order to maintain their eligibility to receive award of the Contract.
- J. Contractors must, submit a list of all Subcontractors who will perform work on the project, and written signed statements from authorized agents of labor pools with which they will or may deal with for employees on the work, together with any information to the effect that such labor pools' practices or policies are in conformity with said Executive Order that they will affirmatively cooperate in or offer no hindrance to the recruitment, employment, and equal treatment of employees seeking employment and performing work under this Contract; or a certification as to when such agents or labor pools have failed or refused to furnish them, prior to award of the Contract.
- K. Contractor will be required to comply with Equal Opportunity Requirements and to abide by the prevailing wage rates for Public Work Projects for all employees on the job. It is the responsibility of Bidders to inform themselves as to the local labor conditions, overtime compensation, health and welfare contributions, labor supply and prospective changes or adjustment of wage rates. Information is available at the Department of Labor.

1.11 WETLANDS AND WATERWAYS

- A. The Contractor's attention is directed to the fact that a portion of the work is located within and/or immediately adjacent to wetlands and waterways. Work within these areas is subject to the jurisdiction of the Massachusetts Department of Environmental Protection. All requirements and/or control measures deemed necessary by the Department shall be strictly adhered to throughout the duration of this Contract.
- B. The Contractor shall not have or assert any claim for nor shall he be entitled to any additional compensation or damages on account of requirements set forth by the Department of Environmental Protection regarding wetlands and waterways encountered during construction.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Measurement and payment criteria applicable to the Work performed under a unit price and/or lump sum payment method of Items listed in the BID.

1.02 LUMP SUM PRICES

- ###### A. Payment will be computed on the basis of the percentage of work completed on each Item in the contract BID as determined by the Engineer. Lump sum prices are to include the cost of all necessary materials, labor, equipment, overhead, profit and other applicable costs. (See Par. 1.03, this Section.)

1.03 PRICES INCLUDE

- ###### A. The prices stated in the Proposal include full compensation not only for furnishing all the labor, equipment and material needed for the Contract, and the Contractor shall receive the prices stipulated in the BID made a part hereof as full compensation for everything performed and for all risks and obligations undertaken by the Contractor under and as required by the Contract.

1.04 SLUDGE DEWATERING CENTRIFUGES BID

BID ITEM NO. 1 SLUDGE DEWATERING CENTRIFUGES

- ###### A. Payment of the lump-sum price bid in the Bid Form for Item No. 1 shall constitute full compensation for supplying the Sludge Dewatering Centrifuges for the WWTF Solids Handling Improvements, Contract S-2020-3, complete, as indicated on the Drawings and as specified in the Bidding and Contract Requirements and Specification Section 11350.

1.05 PAYMENT

- ###### A. Payment of the total price bid in the Bid shall fully compensate the Supplier for furnishing all submittals, equipment and incidentals required to complete the work as outlined above and under Section 01300. Payment shall also include compensation for all other work required to complete the Project as described in the Contract Documents, including Operation and Maintenance Manuals and Spare Parts.

END OF SECTION

SECTION 01026

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for breakdown of lump sum bid.

B. Related Sections

1. Section 01300 - Submittals

1.02 BREAKDOWN OF LUMP SUM BID

A. Within 20 business days of the date of the executed Contract, a list detailing the breakdown of the lump sums bid by the appropriate Divisions of these Specifications or as otherwise directed by the Engineer, shall be submitted for review and concurrence by the Engineer. This list will be used by the Engineer as a guide in preparing estimates for payment. The list shall be an accurate representation of costs required to complete the Work in accordance with the Contract Documents.

B. A schedule of the monthly value of work done based on the Progress Schedule submitted under Section 01300 - Submittals shall be submitted within 20 business days of the date of the executed Contract. The schedule shall show the total sum of work done for each month of the projected construction period and shall be updated monthly to reflect the actual amount requisitioned for payment.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01035

MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Procedures for making modifications to the Contract by change orders or other means.

B. Related Sections

1. Document 00500 - Agreement

1.02 CHANGE ORDERS

A. In general Change Orders will be issued for modification of Contract documents which will incorporate changes in the Contract requirements, including additions or deletions in the Work; for unforeseen field conditions which will necessitate changes in the Work; changes in code provisions or other requirements of federal, state or local authority requiring changes in the Work; changes in the availability of products or for incorporating new products into the work and for changes directed by the Engineer for the benefit of the Owner.

B. Authority to execute Change Orders shall be that of the Owner and not of the Contractor. Changes Orders will, in general, originate by a "Change Order Proposal Request" or by issuance of a "Construction Change Authorization".

C. Unless authorized by the Owner, no work shall be performed that is involved in the change until a formal Change Order is issued.

D. To initiate a Change Order, the Owner will forward a Change Order proposal request describing the proposed changes and if required, include additional or revised drawings and specifications soliciting a formal quotation of cost and time to complete the proposed Change Order work. Upon reaching mutual agreement on the cost and time, the Engineer will sign his approval of the Change Order and submit it to the Contractor for his full signature of acceptance.

1.03 FIELD ORDERS

A. The Owner may, to avoid costly removal of, or alterations to, present on-going work, issue a Work Directive Change authorizing the Contractor to proceed, subject to later negotiation of the price of the change.

1.04 PRICE AGREEMENTS

A. Prices agreed upon to cover the Change Orders may be either by mutual acceptance of a lump sum or by unit prices as stated in the Contract bid proposal or actual direct cost plus a percentage for overhead, profit and other expenses consistent with Section 00500 – Contract Agreement.

- B. Work done by a subcontractor entitles the General Contractor a percentage of the sum of the actual direct cost, not including the subcontractor's overhead and profit, consistent with Section 00500 – Contract Agreement.
- C. Method for computing the cost of the change shall be based on the net additional increase. No overhead and profit shall be deducted from prices for changes deleting work.
- D. The Change Order form document shall indicate the net adjustment (+/-) to the total Contract price as a result thereof including extension or reduction of time when applicable.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01040

COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for coordinating the various parts of Work under this Contract.

1.02 REQUIREMENTS

- A. Coordinate scheduling, submittals, and Work of the various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements and installation of mechanical, instrumentation and electrical work, which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean up of Work of separate Sections in preparation for Substantial Completion.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- G. Coordinate work with all utility companies necessary for completion of work under this contract.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01045

CUTTING, CORING AND PATCHING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements and limitations for cutting, coring and patching of Work.

B. Related Sections

1. Section 01300-Submittals

1.02 SUBMITTALS

A. In accordance with Section 01300 submit written request in advance of cutting or alteration which affects the following:

1. Structural integrity of any element of Project.
2. Integrity of weather-exposed or moisture-resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate contractor.

B. Include in request:

1. Identification of Project.
2. Location and description of affected work.
3. Necessity for cutting or alteration.
4. Description of proposed work, and products to be used.
5. Alternatives to cutting and patching.
6. Effect on work of Owner or separate contractor.
7. Written permission of affected separate contractor.
8. Date and time work will be executed.

C. Should conditions of the Work, or schedule, indicate a required change of materials or methods for cutting and patching, notify the Engineer and secure his written permission and the required Change Order prior to proceeding.

1.03 RELATED SECTIONS

A. Section 15050 – Pipe Sleeves

PART 2 PRODUCTS

2.01 MATERIALS

A. For replacement of items removed, use materials complying with pertinent sections of these specifications.

- B. Sealing materials to be used to seal annular space between cored hole in walls and related pipes to be in accordance with Section 15050.
- C. Sealing cored holes in sewer manholes to be with a resilient seal similar to Kor-N-Seal made by National Pollution Control Systems, Inc., Nashua, NH or similar product, as indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions

1. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, patching, and backfilling.
2. After uncovering the work, inspect conditions affecting installation of new work.
3. If uncovered conditions are not as anticipated, immediately notify the Engineer.
4. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Protection

1. Provide required protection including, but not necessarily limited to, shoring, bracing, and support to maintain structural integrity of the Work.
2. Perform cutting and demolition by methods which will prevent damage to portions of the Work.

B. Surface Preparation

1. Provide proper surfaces to receive installation of repair and new work.

3.03 INSTALLATION

- A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are familiar with the specified requirements and the methods needed for proper performance of the Work.
- B. Execute cutting, fitting, and patching (including excavation and fill) to complete work.
- C. Installation of materials shall be in accordance with manufacturer's instructions.
- D. Installations, repair or replacement of items provided under this Contract shall be in accordance with the Contract Documents.

3.04 FIELD QUALITY CONTROL

- A. In addition to other requirements specified, upon the Engineer's request uncover work to provide for inspection by the Engineer of covered work, and remove samples of installed materials for testing.
- B. Do not cut or alter work performed under separate contracts without the Engineer's written permission.

3.05 ADJUSTING

- A. Perform fitting and adjusting of products to provide finished installation complying with the specified tolerances and finishes.

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Survey work and other field engineering responsibilities of the Contractor.

1.02 REQUIREMENTS

- A. The Contractor shall be responsible for layout of the work and the establishing of lines and grades.
- B. Establish elevations, lines, levels, reference marks, batter boards, etc., required during the progress of the Work. Verify such marks by instrument to confirm accuracy.
- C. Locate and protect survey control and reference points.
- D. Make, check, and be responsible for all measurements and dimensions necessary for the proper construction of the Work.
- E. The Engineer will be permitted to check the lines, elevations, reference marks, batter boards, etc., set by the Contractor. The Contractor shall correct any errors found in lines, elevations, reference marks, batter boards, etc.. Such a check shall not be construed as approval of the Contractor's work and shall not relieve or diminish the responsibility of the Contractor for the accurate construction and completion of the Work.
- F. Control datum for survey as shown on Drawings.

1.03 QUALITY ASSURANCE

- A. Qualifications
 - 1. Employ a Civil Engineer or Land Surveyor registered within the Commonwealth of Massachusetts, acceptable to the Engineer.
- B. Certifications
 - 1. Submit certificate signed by the Contractor's Engineer or Land Surveyor stating elevations and locations of the Work are in conformance with the Contract Documents.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01060

PERMITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building codes, Mechanical codes, and Electrical codes, Regulations, Permits and Fees applicable to the project.

1.02 PERMITS BY CONTRACTOR

- A. The Contractor shall secure all necessary permits from the state, city or town authorities having jurisdiction, for digging of trenches in the streets or highways and all other building and construction operations requiring permits.
- B. As a minimum the following permits are required:
 - 1. Building Permit – City of Taunton
 - 2. City of Taunton Contractor’s License
 - a. Contractor’s License Requirements and Application is attached to this specification section.

1.03 PERMITS BY OWNER

- A. The Owner has obtained or will obtain and pay all fees for the permits listed here:
 - 1. Order of Conditions – Local Conservation Commission
 - 2. WM 16 Treatment Works Plan Approval, without Permit Modification - MassDEP

1.04 CODES

- A. The Contractor shall conform to the requirements of and pay all fees imposed by local and State Building Authorities having jurisdiction over the Work. The Contractor is responsible to conform to all building, mechanical, electrical and plumbing code requirements.
- B. The Contractor shall conform to the latest requirements of the following codes:
 - 1. Federal, State and Municipal Laws
 - 2. 2009 International Building Code (IBC)
 - 3. 2009 International Energy Conservation Code (IECC)
 - 4. Commonwealth of Massachusetts State Building Code, 780 CMR
 - 5. Commonwealth of Massachusetts State Plumbing Code 248 CMR 10.00
 - 6. Commonwealth of Massachusetts Electrical Code 527 CMR 12.00
 - 7. Massachusetts Architectural Access Board (521 CMR)
 - 8. Massachusetts Board of Fire Prevention Regulations (527 CMR)
 - 9. OSHA
 - 10. Any prevailing rules and regulations pertaining to adequate protection and/or guarding of any moving parts or otherwise hazardous locations.

1.04 FEES

- A. The cost of all permits secured by the Contractor shall be borne by him and shall be considered as having been included in the price or prices stated in the Bid. Copies of all required permits shall be filed with the Engineer prior to starting work for which a permit is required.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01067

COMMONWEALTH OF MASSACHUSETTS AND FEDERAL REQUIREMENTS

PART 1 - GENERAL

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- 1.01 American Iron and Steel
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LIST OF ATTACHMENTS

- A - Excerpts from Massachusetts General Laws
- B - Massachusetts Prevailing Wage Rates & Federal Davis-Bacon Wage Rates
- C - Massachusetts Equal Employment Opportunity Package
- D - Massachusetts Diesel Retrofit Forms

1.01 AMERICAN IRON AND STEEL

A. The Contractor acknowledges to and for the benefit of the City of Taunton (“Owner”) 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 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 Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Owner 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 Owner or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor

shall permit the Owner or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Owner 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 Owner). While the Contractor has no direct contractual privity with the State, as a lender to the Owner for the funding of its project, the Owner 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.

1.02 SUSPENSION AND DEBARMENT

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.

1.03 EXCERPTS FROM MASSACHUSETTS STATUTES

A. In addition to the requirements as set forth under "Compliance with Laws" in the AGREEMENT, particular attention is directed to certain stipulations of Chapter 149 of the General Laws of Massachusetts, as amended to date as follows:

Section 25. "Every employee in public work shall lodge, board, and trade where and with whom he elects; and no person or his agents or employees under contract with the commonwealth, a county, city or town, or with a department, board, commission or officer acting therefore, for the doing of public work shall directly or indirectly require, as a condition of employment therein, that the employee shall lodge, board or trade at a particular place or with a particular person. This section shall be made a part of the contract for such employment."

Section 26. "In the employment of mechanics and apprentices, teamsters, chauffeurs and laborers in the construction of public works by the commonwealth, or by a county, town, authority or district, or by persons contracting or subcontracting for such works, preference shall first be given to citizens of the commonwealth who have been residents of the commonwealth for at least six months at the commencement of their employment who are male veterans as defined in clause Forty-third of section seven of chapter four, and who are qualified to perform the work to which the employment relates; and secondly, to citizens of the commonwealth generally who have been residents of the commonwealth for at least six months at the commencement of their employment, and if they cannot be obtained in sufficient numbers, then to citizens of the United States, and every contract for such work shall contain a provision to this effect.

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, subcontractor 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 48 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..."

Section 34A. "Every contract for the construction, alteration, maintenance, repair or demolition of or addition to, any public building or other public works for the commonwealth or any political subdivision thereof shall contain stipulations requiring that the contractor shall, before commencing performance of such contract, provide by insurance for the payment of compensation and the furnishing of other benefits under chapter one hundred and fifty-two to all persons to be employed under the contract, and that the contractor shall continue such insurance in full force and effect during the term of the contract. No officer or agent contracting in behalf of the commonwealth or any political subdivision thereof shall award such a contract until he has been furnished with sufficient proof of compliance with the aforesaid stipulations. Failure to provide and continue in force such insurance as aforesaid shall be deemed a material breach of contract and shall operate as an immediate termination thereof. No cancellation of such insurance, whether by the insurer or by the insured, shall be valid unless written notice thereof is given by the party proposing cancellation to the other party and to the officer or agent who awarded the contract at least fifteen days prior to the intended effective date thereof, which date shall be expressed in said notice. Notice of cancellation sent by the party proposing receipt of the addressee requested, shall be a sufficient notice..."

Section 34B. "Every contract for the construction, alteration, maintenance, repair or demolition of, or addition to, any public works for the commonwealth or any political subdivision thereof shall contain stipulations requiring that the contractor shall pay to any reserve police officer employed by him in any city or town the prevailing rate of wage paid to regular police officers employed by him in such city or town."

Attention is directed to Chapter 774 of the Acts of 1972 amending Section 39F of Chapter 30 to read as follows:

Section 39F. "(1) Every contract awarded shall contain the following subparagraphs 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 sub-paragraphs (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 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 subcontractor 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 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 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 for 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."

Attention is also directed to Chapter 774 of the Acts of 1972 further amending Chapter 30 by adding after Section 39M the following section:

Section 39M. (b) Specifications for such contracts, and specification 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 therefore, 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 (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 named or described materials.

Section 39N. "Every contract subject to section forty-four A of chapter one hundred 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 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."

Attention is also directed to Chapter 1164 of the Acts of 1973 further amending Chapter 30 by adding after Section 39N the following two sections:

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...

(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 due to a failure of the awarding authority shall make an adjustment in the contract but shall not include any profit

to the general contractor on such increase; and provide 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 20 days before the general contractor notified the awarding authority of the act or failure to act involved in the claim."

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 required 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."

Attention is also directed to Chapter 30, Section 39R of the General Laws of Massachusetts as amended to date as follows:

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 section thirty-nine M of chapter thirty, sections forty-four A through forty-four H, inclusive, of chapter one hundred forty-nine and sections thirty B through thirty P, inclusive, of chapter seven.

(2) "Contract" means any contract awarded or executed pursuant to sections thirty B through thirty P, inclusive, of chapter seven and any contract awarded or executed pursuant to section thirty-nine M of chapter thirty, or sections forty-four A through forty-four H, inclusive, of chapter one hundred forty-nine, which is for an 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, memorandum invoices, computer printouts, tapes, discs, papers and other documents 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/her 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 delineation 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 she/he has made and sets forth his/her 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 a 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 principals and auditing standards.

(b) Subsection (a) (2) hereof notwithstanding, every agreement or contract awarded or executed pursuant to sections 30B through 30P, inclusive, of chapter seven, and pursuant to section 39M of chapter 30 or to section 44A through 44H, inclusive, of chapter 149, 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 awarding authority, office of inspector general, and the deputy commissioner of capital planning and operations shall have the right to examine any books, documents, papers or records of the contractor or of

his/her subcontractors that directly pertain to, and involve transactions relating to, the contractor or his/her 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/her description the date of the change and reasons therefore, 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 she/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 awarding authority during the term of the contract a financial statement prepared by an independent certified public accountant on

the basis of an audit by sub accountant. The final statement filed shall include the date of final payment. All statements shall be accompanied by an accountant's report.

(e) The office of inspector general, the deputy commissioner for capital planning and operations and any other awarding authority shall enforce the provisions of this section. The deputy commissioner of capital planning and operations 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 disqualification pursuant to section forty-four C of Chapter one hundred forty-nine.

1.04 MINIMUM WAGE RATES

- A. Minimum Wage Rates as determined by the Commissioner of Department of Labor and Industries 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 of Minimum Wage Rates for those trades-people who may be employed for the proposed work under this contract. Minimum wage rates are included at the end of this section.
- B. Minimum Wage Rates as determined by the United States Department of Labor under the Davis-Bacon Act also apply to this project.

1.05 SAFETY AND HEALTH

- A. This project is subject to the Safety and Health regulation of the U.S. Department of Labor set forth in 29 CFR Part 1926, Commonwealth of Massachusetts Regulations CMR 454, and to the Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction operations (Chapter 454 CMR 10.00 et. seq.)". Contractors shall be familiar with the requirements of these regulations.

1.06 MODIFIED SUPPLEMENTAL EQUAL EMPLOYMENT OPPORTUNITY NON-DISCRIMINATION AND AFFIRMATIVE ACTION PROGRAM

- A. See Attached pages EEO-AAO-MS Page 1 through EEO-AAO-MS Page 7.

1.07 SPECIAL PROVISIONS FOR DISADVANTAGED BUSINESS ENTERPRISES

- A. See Attached pages EEO-DEP-SP Page 1 through EEO-DEP-SP Page 9 AND EEO-DEP Forms.

1.08 STATUTES REGULATING CONSTRUCTION CONTRACTS FOR PUBLIC BUILDINGS AND PUBLIC WORKS PROJECTS

- A. The following statutes regulating construction contracts for public buildings and public works projects are incorporated into the specifications. Where indicated, statutory references are included as attachments.

1. M.G.L c.30 s 39F Payment to Subcontractor (attached)
2. M.G.L c.30 s 39I Deviation from Plans and Specifications
3. M.G.L c.30 s 39J No Arbitrary Decisions are Final
4. M.G.L c.30 s 39L Construction Work by Foreign Corporations
5. M.G.L c.30 s 39M(b) Substitution of Equal Products
6. M.G.L c.30 s 39N Differing Site Conditions (attached)
7. M.G.L c.30 s 39O Equitable Adjustments for Delays (attached)
8. M.G.L c.30 s 39P Decision on Interpretation of Specifications
9. M.G.L c.30 s 39R Contractor's Records
10. M.G.L c.149 s 34 Limitations on Hours of Work
11. M.G.L c.149 s 44J Advertising Invitations to Bid
12. M.G.L c.82 s 40 Excavations; Notice; Penalties
13. M.G.L c.30 s 39K Prompt Payment
14. M.G.L c.149 ss44F and 44G

END OF SECTION

ATTACHMENT A

Excerpts from the Massachusetts General Laws

**GENERAL LAWS OF MASSACHUSETTS
PART I.
ADMINISTRATION OF THE GOVERNMENT.**

**TITLE III.
LAWS RELATING TO STATE OFFICERS.**

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES.

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.

**GENERAL LAWS OF MASSACHUSETTS
PART I.
ADMINISTRATION OF THE GOVERNMENT.**

**TITLE III.
LAWS RELATING TO STATE OFFICERS.**

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES.

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.

**GENERAL LAWS OF MASSACHUSETTS
PART I.
ADMINISTRATION OF THE GOVERNMENT.**

**TITLE III.
LAWS RELATING TO STATE OFFICERS.**

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES.

Chapter 30: Section 39O. Contracts for construction and materials; suspension, delay or interruption due to order of awarding authority; adjustment in contract price; required provisions.

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.

ATTACHMENT B

Massachusetts Prevailing Wage Rates

And

Federal Davis-Bacon Wage Rates



**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

ROSALIN ACOSTA
Secretary

KARYN E. POLITO
Lt. Governor

MICHAEL FLANAGAN
Director

Awarding Authority: City of Taunton DPW
Contract Number: S-2020-3 **City/Town:** TAUNTON
Description of Work: Solids handling system improvements, including retrofit of gravity thickeners, replacement of thickened sludge pumps and piping, replacement of sludge dewatering equipment.
Job Location: 825 West Water St, Taunton, MA

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- 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 from the Department of Labor Standards (“DLS”) 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 any sub-contractor.
- All apprentices working on the project are required to be registered with the Massachusetts Department of Labor Standards, Division of Apprentice Standards (DLS/DAS). Apprentice must keep his/her apprentice identification card on his/her person 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 DLS/DAS regardless of whether or not they are registered with any other federal, state, local, or private agency must be paid the journeyworker's rate for the trade.**
- 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. Awarding authorities are required to request these updates 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, 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. Contractors are required to obtain the wage schedules from awarding authorities, and to pay no less than these rates to covered workers. The annual update requirement is not applicable to 27F “rental of equipment” contracts.
- Every contractor or subcontractor which performs construction work on the project is required to 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. A sample of a payroll reporting form may be obtained at <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.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may report the violation to the Fair Labor Division of the office of the Attorney General at (617) 727-3465.
- 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.

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
Construction						
(2 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2020	\$35.15	\$12.41	\$13.72	\$0.00	\$61.28
	08/01/2020	\$35.15	\$12.91	\$13.72	\$0.00	\$61.78
	12/01/2020	\$35.15	\$12.91	\$14.82	\$0.00	\$62.88
	06/01/2021	\$35.95	\$12.91	\$14.82	\$0.00	\$63.68
	08/01/2021	\$35.95	\$13.41	\$14.82	\$0.00	\$64.18
	12/01/2021	\$35.95	\$13.41	\$16.01	\$0.00	\$65.37
(3 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2020	\$35.22	\$12.41	\$13.72	\$0.00	\$61.35
	08/01/2020	\$35.22	\$12.91	\$13.72	\$0.00	\$61.85
	12/01/2020	\$35.22	\$12.91	\$14.82	\$0.00	\$62.95
	06/01/2021	\$36.02	\$12.91	\$14.82	\$0.00	\$63.75
	08/01/2021	\$36.02	\$13.41	\$14.82	\$0.00	\$64.25
	12/01/2021	\$36.02	\$13.41	\$16.01	\$0.00	\$65.44
(4 & 5 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2020	\$35.34	\$12.41	\$13.72	\$0.00	\$61.47
	08/01/2020	\$35.34	\$12.91	\$13.72	\$0.00	\$61.97
	12/01/2020	\$35.34	\$12.91	\$14.82	\$0.00	\$63.07
	06/01/2021	\$36.14	\$12.91	\$14.82	\$0.00	\$63.87
	08/01/2021	\$36.14	\$13.41	\$14.82	\$0.00	\$64.37
	12/01/2021	\$36.14	\$13.41	\$16.01	\$0.00	\$65.56
ADS/SUBMERSIBLE PILOT <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2019	\$102.78	\$9.90	\$21.15	\$0.00	\$133.83
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.81	\$8.60	\$15.77	\$0.00	\$59.18
	12/01/2020	\$35.70	\$8.60	\$15.77	\$0.00	\$60.07
	06/01/2021	\$36.62	\$8.60	\$15.77	\$0.00	\$60.99
	12/01/2021	\$37.53	\$8.60	\$15.77	\$0.00	\$61.90
For apprentice rates see "Apprentice- LABORER"						
ASBESTOS WORKER (PIPES & TANKS) <i>HEAT & FROST INSULATORS LOCAL 6 (SOUTHERN MASS)</i>	06/01/2020	\$38.00	\$12.50	\$8.85	\$0.00	\$59.35
	12/01/2020	\$39.00	\$12.50	\$8.85	\$0.00	\$60.35
ASPHALT RAKER <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40
For apprentice rates see "Apprentice- LABORER"						
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$49.33	\$13.00	\$15.70	\$0.00	\$78.03
	12/01/2020	\$50.48	\$13.00	\$15.70	\$0.00	\$79.18
	06/01/2021	\$51.58	\$13.00	\$15.70	\$0.00	\$80.28
	12/01/2021	\$52.73	\$13.00	\$15.70	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$49.33	\$13.00	\$15.70	\$0.00	\$78.03
	12/01/2020	\$50.48	\$13.00	\$15.70	\$0.00	\$79.18
	06/01/2021	\$51.58	\$13.00	\$15.70	\$0.00	\$80.28
	12/01/2021	\$52.73	\$13.00	\$15.70	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
BARCO-TYPE JUMPING TAMPER <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.81	\$8.60	\$15.77	\$0.00	\$59.18
	12/01/2020	\$35.70	\$8.60	\$15.77	\$0.00	\$60.07
	06/01/2021	\$36.62	\$8.60	\$15.77	\$0.00	\$60.99
	12/01/2021	\$37.53	\$8.60	\$15.77	\$0.00	\$61.90
For apprentice rates see "Apprentice- LABORER"						
BOILER MAKER <i>BOILERMAKERS LOCAL 29</i>	01/01/2020	\$46.10	\$7.07	\$17.98	\$0.00	\$71.15

Apprentice - BOILERMAKER - Local 29

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	\$29.97	\$7.07	\$11.69	\$0.00	\$48.73
2	65	\$29.97	\$7.07	\$11.69	\$0.00	\$48.73
3	70	\$32.27	\$7.07	\$12.59	\$0.00	\$51.93
4	75	\$34.58	\$7.07	\$13.49	\$0.00	\$55.14
5	80	\$36.88	\$7.07	\$14.38	\$0.00	\$58.33
6	85	\$39.19	\$7.07	\$15.29	\$0.00	\$61.55
7	90	\$41.49	\$7.07	\$16.18	\$0.00	\$64.74
8	95	\$43.80	\$7.07	\$17.09	\$0.00	\$67.96

Notes:

Apprentice to Journeyworker Ratio:1:4

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING) <i>BRICKLAYERS LOCAL 3 (FOXBORO)</i>	02/01/2020	\$52.26	\$10.75	\$21.30	\$0.00	\$84.31
	08/01/2020	\$53.61	\$10.75	\$21.45	\$0.00	\$85.81
	02/01/2021	\$54.21	\$10.75	\$21.45	\$0.00	\$86.41
	08/01/2021	\$55.61	\$10.75	\$21.61	\$0.00	\$87.97
	02/01/2022	\$56.19	\$10.75	\$21.61	\$0.00	\$88.55

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - BRICK/PLASTER/CEMENT MASON - Local 3 Foxboro

Effective Date - 02/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.13	\$10.75	\$21.30	\$0.00	\$58.18
2	60	\$31.36	\$10.75	\$21.30	\$0.00	\$63.41
3	70	\$36.58	\$10.75	\$21.30	\$0.00	\$68.63
4	80	\$41.81	\$10.75	\$21.30	\$0.00	\$73.86
5	90	\$47.03	\$10.75	\$21.30	\$0.00	\$79.08

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.81	\$10.75	\$21.45	\$0.00	\$59.01
2	60	\$32.17	\$10.75	\$21.45	\$0.00	\$64.37
3	70	\$37.53	\$10.75	\$21.45	\$0.00	\$69.73
4	80	\$42.89	\$10.75	\$21.45	\$0.00	\$75.09
5	90	\$48.25	\$10.75	\$21.45	\$0.00	\$80.45

Notes:

Apprentice to Journeyworker Ratio:1:5

BULLDOZER/GRADER/SCRAPER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

CAISSON & UNDERPINNING BOTTOM MAN <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2020	\$40.30	\$8.60	\$17.24	\$0.00	\$66.14
	12/01/2020	\$41.28	\$8.60	\$17.24	\$0.00	\$67.12
	06/01/2021	\$42.30	\$8.60	\$17.24	\$0.00	\$68.14
	12/01/2021	\$43.31	\$8.60	\$17.24	\$0.00	\$69.15

For apprentice rates see "Apprentice- LABORER"

CAISSON & UNDERPINNING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2020	\$39.15	\$8.60	\$17.24	\$0.00	\$64.99
	12/01/2020	\$40.13	\$8.60	\$17.24	\$0.00	\$65.97
	06/01/2021	\$41.15	\$8.60	\$17.24	\$0.00	\$66.99
	12/01/2021	\$42.16	\$8.60	\$17.24	\$0.00	\$68.00

For apprentice rates see "Apprentice- LABORER"

CAISSON & UNDERPINNING TOP MAN <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2020	\$39.15	\$8.60	\$17.24	\$0.00	\$64.99
	12/01/2020	\$40.13	\$8.60	\$17.24	\$0.00	\$65.97
	06/01/2021	\$41.15	\$8.60	\$17.24	\$0.00	\$66.99
	12/01/2021	\$42.16	\$8.60	\$17.24	\$0.00	\$68.00

For apprentice rates see "Apprentice- LABORER"

CARBIDE CORE DRILL OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CARPENTER	03/01/2020	\$42.50	\$9.40	\$18.95	\$0.00	\$70.85
CARPENTERS -ZONE 2 (Eastern Massachusetts)	09/01/2020	\$43.15	\$9.40	\$18.95	\$0.00	\$71.50
	03/01/2021	\$43.75	\$9.40	\$18.95	\$0.00	\$72.10
	09/01/2021	\$44.40	\$9.40	\$18.95	\$0.00	\$72.75
	03/01/2022	\$45.00	\$9.40	\$18.95	\$0.00	\$73.35
	09/01/2022	\$45.65	\$9.40	\$18.95	\$0.00	\$74.00
	03/01/2023	\$46.25	\$9.40	\$18.95	\$0.00	\$74.60

Apprentice - CARPENTER - Zone 2 Eastern MA

Effective Date - 03/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.25	\$9.40	\$1.73	\$0.00	\$32.38
2	60	\$25.50	\$9.40	\$1.73	\$0.00	\$36.63
3	70	\$29.75	\$9.40	\$13.76	\$0.00	\$52.91
4	75	\$31.88	\$9.40	\$13.76	\$0.00	\$55.04
5	80	\$34.00	\$9.40	\$15.49	\$0.00	\$58.89
6	80	\$34.00	\$9.40	\$15.49	\$0.00	\$58.89
7	90	\$38.25	\$9.40	\$17.22	\$0.00	\$64.87
8	90	\$38.25	\$9.40	\$17.22	\$0.00	\$64.87

Effective Date - 09/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.58	\$9.40	\$1.73	\$0.00	\$32.71
2	60	\$25.89	\$9.40	\$1.73	\$0.00	\$37.02
3	70	\$30.21	\$9.40	\$13.76	\$0.00	\$53.37
4	75	\$32.36	\$9.40	\$13.76	\$0.00	\$55.52
5	80	\$34.52	\$9.40	\$15.49	\$0.00	\$59.41
6	80	\$34.52	\$9.40	\$15.49	\$0.00	\$59.41
7	90	\$38.84	\$9.40	\$17.22	\$0.00	\$65.46
8	90	\$38.84	\$9.40	\$17.22	\$0.00	\$65.46

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
 Step 1&2 \$30.26/ 3&4 \$36.18/ 5&6 \$54.64/ 7&8 \$60.62

Apprentice to Journeyworker Ratio:1:5

CARPENTER WOOD FRAME	10/01/2019	\$27.95	\$7.07	\$7.86	\$0.00	\$42.88
CARPENTERS -ZONE 2 (Wood Frame)						

All Aspects of New Wood Frame Work

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - CARPENTER (Wood Frame) - Zone 2

Effective Date - 10/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$16.77	\$7.07	\$0.00	\$0.00	\$23.84
2	60	\$16.77	\$7.07	\$0.00	\$0.00	\$23.84
3	65	\$18.17	\$7.07	\$7.86	\$0.00	\$33.10
4	70	\$19.57	\$7.07	\$7.86	\$0.00	\$34.50
5	75	\$20.96	\$7.07	\$7.86	\$0.00	\$35.89
6	80	\$22.36	\$7.07	\$7.86	\$0.00	\$37.29
7	85	\$23.76	\$7.07	\$7.86	\$0.00	\$38.69
8	90	\$25.16	\$7.07	\$7.86	\$0.00	\$40.09

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 \$19.65/ 3&4 \$27.19/ 5&6 \$34.50/ 7&8 \$37.29

Apprentice to Journeyworker Ratio:1:5

CEMENT MASONRY/PLASTERING BRICKLAYERS LOCAL 3 (FOXBORO)	01/01/2020	\$44.67	\$12.75	\$22.41	\$0.62	\$80.45
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Apprentice - CEMENT MASONRY/PLASTERING - Foxboro

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.34	\$12.75	\$15.41	\$0.00	\$50.50
2	60	\$26.80	\$12.75	\$17.41	\$0.62	\$57.58
3	65	\$29.04	\$12.75	\$18.41	\$0.62	\$60.82
4	70	\$31.27	\$12.75	\$19.41	\$0.62	\$64.05
5	75	\$33.50	\$12.75	\$20.41	\$0.62	\$67.28
6	80	\$35.74	\$12.75	\$21.41	\$0.62	\$70.52
7	90	\$40.20	\$12.75	\$22.41	\$0.62	\$75.98

Notes:

Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.

Apprentice to Journeyworker Ratio:1:3

CHAIN SAW OPERATOR LABORERS - ZONE 2	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES OPERATING ENGINEERS LOCAL 4	06/01/2020	\$50.33	\$13.00	\$15.70	\$0.00	\$79.03
	12/01/2020	\$51.48	\$13.00	\$15.70	\$0.00	\$80.18
	06/01/2021	\$52.58	\$13.00	\$15.70	\$0.00	\$81.28
	12/01/2021	\$53.73	\$13.00	\$15.70	\$0.00	\$82.43

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
COMPRESSOR OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$32.72	\$13.00	\$15.70	\$0.00	\$61.42
	12/01/2020	\$33.50	\$13.00	\$15.70	\$0.00	\$62.20
	06/01/2021	\$34.25	\$13.00	\$15.70	\$0.00	\$62.95
	12/01/2021	\$35.04	\$13.00	\$15.70	\$0.00	\$63.74

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

DELEADER (BRIDGE) <i>PAINTERS LOCAL 35 - ZONE 2</i>	01/01/2020	\$50.96	\$8.20	\$22.10	\$0.00	\$81.26
	07/01/2020	\$51.51	\$8.25	\$22.40	\$0.00	\$82.16
	01/01/2021	\$52.06	\$8.25	\$22.75	\$0.00	\$83.06

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.48	\$8.20	\$0.00	\$0.00	\$33.68
2	55	\$28.03	\$8.20	\$5.94	\$0.00	\$42.17
3	60	\$30.58	\$8.20	\$6.48	\$0.00	\$45.26
4	65	\$33.12	\$8.20	\$7.02	\$0.00	\$48.34
5	70	\$35.67	\$8.20	\$18.86	\$0.00	\$62.73
6	75	\$38.22	\$8.20	\$19.40	\$0.00	\$65.82
7	80	\$40.77	\$8.20	\$19.94	\$0.00	\$68.91
8	90	\$45.86	\$8.20	\$21.02	\$0.00	\$75.08

Effective Date - 07/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.76	\$8.25	\$0.00	\$0.00	\$34.01
2	55	\$28.33	\$8.25	\$6.05	\$0.00	\$42.63
3	60	\$30.91	\$8.25	\$6.60	\$0.00	\$45.76
4	65	\$33.48	\$8.25	\$7.15	\$0.00	\$48.88
5	70	\$36.06	\$8.25	\$19.10	\$0.00	\$63.41
6	75	\$38.63	\$8.25	\$19.65	\$0.00	\$66.53
7	80	\$41.21	\$8.25	\$20.20	\$0.00	\$69.66
8	90	\$46.36	\$8.25	\$21.30	\$0.00	\$75.91

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

DEMO: ADZEMAN <i>LABORERS - ZONE 2</i>	12/01/2019	\$39.30	\$8.10	\$16.60	\$0.00	\$64.00
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For apprentice rates see "Apprentice- LABORER"

DEMO: BACKHOE/LOADER/HAMMER OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2019	\$40.30	\$8.10	\$16.60	\$0.00	\$65.00
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For apprentice rates see "Apprentice- LABORER"

DEMO: BURNERS <i>LABORERS - ZONE 2</i>	12/01/2019	\$40.05	\$8.10	\$16.60	\$0.00	\$64.75
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For apprentice rates see "Apprentice- LABORER"

DEMO: CONCRETE CUTTER/SAWYER <i>LABORERS - ZONE 2</i>	12/01/2019	\$40.30	\$8.10	\$16.60	\$0.00	\$65.00
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Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER"						
DEMO: JACKHAMMER OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2019	\$40.05	\$8.10	\$16.60	\$0.00	\$64.75
For apprentice rates see "Apprentice- LABORER"						
DEMO: WRECKING LABORER <i>LABORERS - ZONE 2</i>	12/01/2019	\$39.30	\$8.10	\$16.60	\$0.00	\$64.00
For apprentice rates see "Apprentice- LABORER"						
DIRECTIONAL DRILL MACHINE OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2019	\$68.52	\$9.90	\$21.15	\$0.00	\$99.57
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2019	\$48.94	\$9.90	\$21.15	\$0.00	\$79.99
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2019	\$73.41	\$9.90	\$21.15	\$0.00	\$104.46
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER/SLURRY (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2019	\$102.78	\$9.90	\$21.15	\$0.00	\$133.83
For apprentice rates see "Apprentice- PILE DRIVER"						
ELECTRICIAN <i>ELECTRICIANS LOCAL 223</i>	03/01/2020	\$42.87	\$10.40	\$13.94	\$0.00	\$67.21

Apprentice - ELECTRICIAN - Local 223

Effective Date - 03/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$17.15	\$10.40	\$0.51	\$0.00	\$28.06
2	42	\$18.01	\$10.40	\$0.54	\$0.00	\$28.95
3	45	\$19.29	\$10.40	\$0.58	\$0.00	\$30.27
4	48	\$20.58	\$10.40	\$5.22	\$0.00	\$36.20
5	50	\$21.44	\$10.40	\$5.26	\$0.00	\$37.10
6	55	\$23.58	\$10.40	\$5.63	\$0.00	\$39.61
7	60	\$25.72	\$10.40	\$5.93	\$0.00	\$42.05
8	65	\$27.87	\$10.40	\$6.25	\$0.00	\$44.52
9	70	\$30.01	\$10.40	\$6.54	\$0.00	\$46.95
10	75	\$32.15	\$10.40	\$6.79	\$0.00	\$49.34

Notes:

Steps are 750 hours

Apprentice to Journeyworker Ratio:2:3***

ELEVATOR CONSTRUCTOR <i>ELEVATOR CONSTRUCTORS LOCAL 4</i>	01/01/2020	\$61.42	\$15.73	\$18.41	\$0.00	\$95.56
	01/01/2021	\$63.47	\$15.88	\$19.31	\$0.00	\$98.66
	01/01/2022	\$65.62	\$16.03	\$20.21	\$0.00	\$101.86

Apprentice - ELEVATOR CONSTRUCTOR - Local 4

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.71	\$15.73	\$0.00	\$0.00	\$46.44
2	55	\$33.78	\$15.73	\$18.41	\$0.00	\$67.92
3	65	\$39.92	\$15.73	\$18.41	\$0.00	\$74.06
4	70	\$42.99	\$15.73	\$18.41	\$0.00	\$77.13
5	80	\$49.14	\$15.73	\$18.41	\$0.00	\$83.28

Effective Date - 01/01/2021

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.74	\$15.88	\$0.00	\$0.00	\$47.62
2	55	\$34.91	\$15.88	\$19.31	\$0.00	\$70.10
3	65	\$41.26	\$15.88	\$19.31	\$0.00	\$76.45
4	70	\$44.43	\$15.88	\$19.31	\$0.00	\$79.62
5	80	\$50.78	\$15.88	\$19.31	\$0.00	\$85.97

Notes:

Steps 1-2 are 6 mos.; Steps 3-5 are 1 year

Apprentice to Journeyworker Ratio:1:1

ELEVATOR CONSTRUCTOR HELPER <i>ELEVATOR CONSTRUCTORS LOCAL 4</i>	01/01/2020	\$42.99	\$15.73	\$18.41	\$0.00	\$77.13
	01/01/2021	\$44.43	\$15.88	\$19.31	\$0.00	\$79.62
	01/01/2022	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17

For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"

FENCE & GUARD RAIL ERECTOR <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2020	\$44.73	\$12.50	\$15.70	\$0.00	\$72.93
	11/01/2020	\$45.73	\$12.50	\$15.70	\$0.00	\$73.93
	05/01/2021	\$46.88	\$12.50	\$15.70	\$0.00	\$75.08
	11/01/2021	\$47.88	\$12.50	\$15.70	\$0.00	\$76.08
	05/01/2022	\$49.03	\$12.50	\$15.70	\$0.00	\$77.23

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2020	\$46.23	\$12.50	\$15.70	\$0.00	\$74.43
	11/01/2020	\$47.24	\$12.50	\$15.70	\$0.00	\$75.44
	05/01/2021	\$48.40	\$12.50	\$15.70	\$0.00	\$76.60
	11/01/2021	\$49.41	\$12.50	\$15.70	\$0.00	\$77.61
	05/01/2022	\$50.57	\$12.50	\$15.70	\$0.00	\$78.77

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	05/01/2020	\$22.64	\$12.50	\$15.70	\$0.00	\$50.84
	11/01/2020	\$23.23	\$12.50	\$15.70	\$0.00	\$51.43
	05/01/2021	\$23.91	\$12.50	\$15.70	\$0.00	\$52.11
	11/01/2021	\$24.51	\$12.50	\$15.70	\$0.00	\$52.71
	05/01/2022	\$25.18	\$12.50	\$15.70	\$0.00	\$53.38
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIRE ALARM INSTALLER <i>ELECTRICIANS LOCAL 223</i>	03/01/2020	\$42.87	\$10.40	\$13.94	\$0.00	\$67.21
For apprentice rates see "Apprentice- ELECTRICIAN"						
FIRE ALARM REPAIR / MAINTENANCE / COMMISSIONING <i>ELECTRICIANS LOCAL 223</i>	03/01/2020	\$36.27	\$10.40	\$11.78	\$0.00	\$58.45
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"						
FIREMAN (ASST. ENGINEER) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$40.30	\$13.00	\$15.70	\$0.00	\$69.00
	12/01/2020	\$41.25	\$13.00	\$15.70	\$0.00	\$69.95
	06/01/2021	\$42.16	\$13.00	\$15.70	\$0.00	\$70.86
	12/01/2021	\$43.11	\$13.00	\$15.70	\$0.00	\$71.81
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FLAGGER & SIGNALER <i>LABORERS - ZONE 2</i>	06/01/2020	\$23.50	\$8.60	\$15.77	\$0.00	\$47.87
	12/01/2020	\$24.50	\$8.60	\$15.77	\$0.00	\$48.87
	06/01/2021	\$24.50	\$8.60	\$15.77	\$0.00	\$48.87
	12/01/2021	\$24.50	\$8.60	\$15.77	\$0.00	\$48.87
For apprentice rates see "Apprentice- LABORER"						
FLOORCOVERER <i>FLOORCOVERERS LOCAL 2168 ZONE 1</i>	03/01/2020	\$47.05	\$9.40	\$19.25	\$0.00	\$75.70
	09/01/2020	\$47.85	\$9.40	\$19.25	\$0.00	\$76.50
	03/01/2021	\$48.65	\$9.40	\$19.25	\$0.00	\$77.30
	09/01/2021	\$49.45	\$9.40	\$19.25	\$0.00	\$78.10
	03/01/2022	\$50.25	\$9.40	\$19.25	\$0.00	\$78.90

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - FLOORCOVERER - Local 2168 Zone I

Effective Date - 03/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.53	\$9.40	\$1.79	\$0.00	\$34.72
2	55	\$25.88	\$9.40	\$1.79	\$0.00	\$37.07
3	60	\$28.23	\$9.40	\$13.88	\$0.00	\$51.51
4	65	\$30.58	\$9.40	\$13.88	\$0.00	\$53.86
5	70	\$32.94	\$9.40	\$15.67	\$0.00	\$58.01
6	75	\$35.29	\$9.40	\$15.67	\$0.00	\$60.36
7	80	\$37.64	\$9.40	\$17.46	\$0.00	\$64.50
8	85	\$39.99	\$9.40	\$17.46	\$0.00	\$66.85

Effective Date - 09/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.93	\$9.40	\$1.79	\$0.00	\$35.12
2	55	\$26.32	\$9.40	\$1.79	\$0.00	\$37.51
3	60	\$28.71	\$9.40	\$13.88	\$0.00	\$51.99
4	65	\$31.10	\$9.40	\$13.88	\$0.00	\$54.38
5	70	\$33.50	\$9.40	\$15.67	\$0.00	\$58.57
6	75	\$35.89	\$9.40	\$15.67	\$0.00	\$60.96
7	80	\$38.28	\$9.40	\$17.46	\$0.00	\$65.14
8	85	\$40.67	\$9.40	\$17.46	\$0.00	\$67.53

Notes: Steps are 750 hrs.
 % After 09/1/17; 45/45/55/55/70/70/80/80 (1500hr Steps)
 Step 1&2 \$32.36/ 3&4 \$38.80/ 5&6 \$58.01/ 7&8 \$64.50

Apprentice to Journeyworker Ratio:1:1

FORK LIFT/CHERRY PICKER <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$49.33	\$13.00	\$15.70	\$0.00	\$78.03
	12/01/2020	\$50.48	\$13.00	\$15.70	\$0.00	\$79.18
	06/01/2021	\$51.58	\$13.00	\$15.70	\$0.00	\$80.28
	12/01/2021	\$52.73	\$13.00	\$15.70	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GENERATOR/LIGHTING PLANT/HEATERS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$32.72	\$13.00	\$15.70	\$0.00	\$61.42
	12/01/2020	\$33.50	\$13.00	\$15.70	\$0.00	\$62.20
	06/01/2021	\$34.25	\$13.00	\$15.70	\$0.00	\$62.95
	12/01/2021	\$35.04	\$13.00	\$15.70	\$0.00	\$63.74
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) <i>GLAZIERS LOCAL 1333</i>	06/01/2020	\$39.18	\$10.80	\$10.45	\$0.00	\$60.43

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

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

HOISTING ENGINEER/CRANES/GRADALLS	06/01/2020	\$49.33	\$13.00	\$15.70	\$0.00	\$78.03
OPERATING ENGINEERS LOCAL 4	12/01/2020	\$50.48	\$13.00	\$15.70	\$0.00	\$79.18
	06/01/2021	\$51.58	\$13.00	\$15.70	\$0.00	\$80.28
	12/01/2021	\$52.73	\$13.00	\$15.70	\$0.00	\$81.43

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - OPERATING ENGINEERS - Local 4

Effective Date - 06/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$27.13	\$13.00	\$0.00	\$0.00	\$40.13
2	60	\$29.60	\$13.00	\$15.70	\$0.00	\$58.30
3	65	\$32.06	\$13.00	\$15.70	\$0.00	\$60.76
4	70	\$34.53	\$13.00	\$15.70	\$0.00	\$63.23
5	75	\$37.00	\$13.00	\$15.70	\$0.00	\$65.70
6	80	\$39.46	\$13.00	\$15.70	\$0.00	\$68.16
7	85	\$41.93	\$13.00	\$15.70	\$0.00	\$70.63
8	90	\$44.40	\$13.00	\$15.70	\$0.00	\$73.10

Effective Date - 12/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$27.76	\$13.00	\$0.00	\$0.00	\$40.76
2	60	\$30.29	\$13.00	\$15.70	\$0.00	\$58.99
3	65	\$32.81	\$13.00	\$15.70	\$0.00	\$61.51
4	70	\$35.34	\$13.00	\$15.70	\$0.00	\$64.04
5	75	\$37.86	\$13.00	\$15.70	\$0.00	\$66.56
6	80	\$40.38	\$13.00	\$15.70	\$0.00	\$69.08
7	85	\$42.91	\$13.00	\$15.70	\$0.00	\$71.61
8	90	\$45.43	\$13.00	\$15.70	\$0.00	\$74.13

Notes:

Apprentice to Journeyworker Ratio:1:6

HVAC (DUCTWORK) SHEETMETAL WORKERS LOCAL 17 - A	02/01/2020	\$49.36	\$13.35	\$24.12	\$2.61	\$89.44
	08/01/2020	\$50.96	\$13.35	\$24.12	\$2.66	\$91.09
	02/01/2021	\$52.61	\$13.35	\$24.12	\$2.71	\$92.79
	08/01/2021	\$54.36	\$13.35	\$24.12	\$2.76	\$94.59
	02/01/2022	\$56.11	\$13.35	\$24.12	\$2.81	\$96.39

For apprentice rates see "Apprentice- SHEET METAL WORKER"

HVAC (ELECTRICAL CONTROLS) ELECTRICIANS LOCAL 223	03/01/2020	\$42.87	\$10.40	\$13.94	\$0.00	\$67.21
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For apprentice rates see "Apprentice- ELECTRICIAN"

HVAC (TESTING AND BALANCING - AIR) SHEETMETAL WORKERS LOCAL 17 - A	02/01/2020	\$49.36	\$13.35	\$24.12	\$2.61	\$89.44
	08/01/2020	\$50.96	\$13.35	\$24.12	\$2.66	\$91.09
	02/01/2021	\$52.61	\$13.35	\$24.12	\$2.71	\$92.79
	08/01/2021	\$54.36	\$13.35	\$24.12	\$2.76	\$94.59
	02/01/2022	\$56.11	\$13.35	\$24.12	\$2.81	\$96.39

For apprentice rates see "Apprentice- SHEET METAL WORKER"

HVAC (TESTING AND BALANCING - WATER) PLUMBERS & PIPEFITTERS LOCAL 51	03/02/2020	\$43.69	\$10.00	\$18.80	\$0.00	\$72.49
	08/31/2020	\$45.84	\$10.00	\$18.80	\$0.00	\$74.64
	08/30/2021	\$47.84	\$10.00	\$18.80	\$0.00	\$76.64

For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
HVAC MECHANIC <i>PLUMBERS & PIPEFITTERS LOCAL 51</i>	03/02/2020	\$43.69	\$10.00	\$18.80	\$0.00	\$72.49
	08/31/2020	\$45.84	\$10.00	\$18.80	\$0.00	\$74.64
	08/30/2021	\$47.84	\$10.00	\$18.80	\$0.00	\$76.64
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HYDRAULIC DRILLS <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.81	\$8.60	\$15.77	\$0.00	\$59.18
	12/01/2020	\$35.70	\$8.60	\$15.77	\$0.00	\$60.07
	06/01/2021	\$36.62	\$8.60	\$15.77	\$0.00	\$60.99
	12/01/2021	\$37.53	\$8.60	\$15.77	\$0.00	\$61.90
For apprentice rates see "Apprentice- LABORER"						
INSULATOR (PIPES & TANKS) <i>HEAT & FROST INSULATORS LOCAL 6 (SOUTHERN MASS)</i>	09/01/2019	\$43.60	\$12.80	\$16.40	\$0.00	\$72.80

Apprentice - ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Southern MA

Effective Date - 09/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.80	\$12.80	\$11.90	\$0.00	\$46.50
2	60	\$26.16	\$12.80	\$12.80	\$0.00	\$51.76
3	70	\$30.52	\$12.80	\$13.70	\$0.00	\$57.02
4	80	\$34.88	\$12.80	\$14.60	\$0.00	\$62.28

Notes:

Steps are 1 year

Apprentice to Journeyworker Ratio:1:4

IRONWORKER/WELDER <i>IRONWORKERS LOCAL 37</i>	03/16/2020	\$40.61	\$7.70	\$17.10	\$0.00	\$65.41
	09/16/2020	\$41.51	\$7.70	\$17.10	\$0.00	\$66.31
	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 - 03/16/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	70	\$28.43	\$7.70	\$17.10	\$0.00	\$53.23
2	75	\$30.46	\$7.70	\$17.10	\$0.00	\$55.26
3	80	\$32.49	\$7.70	\$17.10	\$0.00	\$57.29
4	85	\$34.52	\$7.70	\$17.10	\$0.00	\$59.32
5	90	\$36.55	\$7.70	\$17.10	\$0.00	\$61.35
6	95	\$38.58	\$7.70	\$17.10	\$0.00	\$63.38

Effective Date - 09/16/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	70	\$29.06	\$7.70	\$17.10	\$0.00	\$53.86
2	75	\$31.13	\$7.70	\$17.10	\$0.00	\$55.93
3	80	\$33.21	\$7.70	\$17.10	\$0.00	\$58.01
4	85	\$35.28	\$7.70	\$17.10	\$0.00	\$60.08
5	90	\$37.36	\$7.70	\$17.10	\$0.00	\$62.16
6	95	\$39.43	\$7.70	\$17.10	\$0.00	\$64.23

Notes:

Apprentice to Journeyworker Ratio:1:4

JACKHAMMER & PAVING BREAKER OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

LABORER <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.06	\$8.60	\$15.77	\$0.00	\$58.43
	12/01/2020	\$34.95	\$8.60	\$15.77	\$0.00	\$59.32
	06/01/2021	\$35.87	\$8.60	\$15.77	\$0.00	\$60.24
	12/01/2021	\$36.78	\$8.60	\$15.77	\$0.00	\$61.15

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - LABORER - Zone 2

Effective Date - 06/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$20.44	\$8.60	\$15.77	\$0.00	\$44.81
2	70	\$23.84	\$8.60	\$15.77	\$0.00	\$48.21
3	80	\$27.25	\$8.60	\$15.77	\$0.00	\$51.62
4	90	\$30.65	\$8.60	\$15.77	\$0.00	\$55.02

Effective Date - 12/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$20.97	\$8.60	\$15.77	\$0.00	\$45.34
2	70	\$24.47	\$8.60	\$15.77	\$0.00	\$48.84
3	80	\$27.96	\$8.60	\$15.77	\$0.00	\$52.33
4	90	\$31.46	\$8.60	\$15.77	\$0.00	\$55.83

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER: CARPENTER TENDER LABORERS - ZONE 2	06/01/2020	\$34.06	\$8.60	\$15.77	\$0.00	\$58.43
	12/01/2020	\$34.95	\$8.60	\$15.77	\$0.00	\$59.32
	06/01/2021	\$35.87	\$8.60	\$15.77	\$0.00	\$60.24
	12/01/2021	\$36.78	\$8.60	\$15.77	\$0.00	\$61.15

For apprentice rates see "Apprentice- LABORER"

LABORER: CEMENT FINISHER TENDER LABORERS - ZONE 2	06/01/2020	\$34.06	\$8.60	\$15.77	\$0.00	\$58.43
	12/01/2020	\$34.95	\$8.60	\$15.77	\$0.00	\$59.32
	06/01/2021	\$35.87	\$8.60	\$15.77	\$0.00	\$60.24
	12/01/2021	\$36.78	\$8.60	\$15.77	\$0.00	\$61.15

For apprentice rates see "Apprentice- LABORER"

LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER LABORERS - ZONE 2	06/01/2020	\$34.15	\$8.60	\$15.83	\$0.00	\$58.58
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For apprentice rates see "Apprentice- LABORER"

LABORER: MASON TENDER LABORERS - ZONE 2	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

LABORER: MULTI-TRADE TENDER LABORERS - ZONE 2	06/01/2020	\$34.06	\$8.60	\$15.77	\$0.00	\$58.43
	12/01/2020	\$34.95	\$8.60	\$15.77	\$0.00	\$59.32
	06/01/2021	\$35.87	\$8.60	\$15.77	\$0.00	\$60.24
	12/01/2021	\$36.78	\$8.60	\$15.77	\$0.00	\$61.15

For apprentice rates see "Apprentice- LABORER"

LABORER: TREE REMOVER LABORERS - ZONE 2	06/01/2020	\$34.06	\$8.60	\$15.77	\$0.00	\$58.43
	12/01/2020	\$34.95	\$8.60	\$15.77	\$0.00	\$59.32
	06/01/2021	\$35.87	\$8.60	\$15.77	\$0.00	\$60.24
	12/01/2021	\$36.78	\$8.60	\$15.77	\$0.00	\$61.15

Classification Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate
 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"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
LASER BEAM OPERATOR LABORERS - ZONE 2	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
MARBLE & TILE FINISHERS BRICKLAYERS LOCAL 3 - MARBLE & TILE	02/01/2020	\$41.49	\$10.75	\$20.12	\$0.00	\$72.36
	08/01/2020	\$42.57	\$10.75	\$20.27	\$0.00	\$73.59
	02/01/2021	\$43.08	\$10.75	\$20.27	\$0.00	\$74.10
	08/01/2021	\$44.20	\$10.75	\$20.43	\$0.00	\$75.38
	02/01/2022	\$44.67	\$10.75	\$20.43	\$0.00	\$75.85

Apprentice - MARBLE & TILE FINISHER - Local 3 Marble & Tile

Effective Date - 02/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.75	\$10.75	\$20.12	\$0.00	\$51.62
2	60	\$24.89	\$10.75	\$20.12	\$0.00	\$55.76
3	70	\$29.04	\$10.75	\$20.12	\$0.00	\$59.91
4	80	\$33.19	\$10.75	\$20.12	\$0.00	\$64.06
5	90	\$37.34	\$10.75	\$20.12	\$0.00	\$68.21

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.29	\$10.75	\$20.27	\$0.00	\$52.31
2	60	\$25.54	\$10.75	\$20.27	\$0.00	\$56.56
3	70	\$29.80	\$10.75	\$20.27	\$0.00	\$60.82
4	80	\$34.06	\$10.75	\$20.27	\$0.00	\$65.08
5	90	\$38.31	\$10.75	\$20.27	\$0.00	\$69.33

Notes:

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
MARBLE MASONS, TILELAYERS & TERRAZZO MECH BRICKLAYERS LOCAL 3 - MARBLE & TILE	02/01/2020	\$54.42	\$10.75	\$21.93	\$0.00	\$87.10
	08/01/2020	\$55.77	\$10.75	\$22.08	\$0.00	\$88.60
	02/01/2021	\$56.41	\$10.75	\$22.08	\$0.00	\$89.24
	08/01/2021	\$57.81	\$10.75	\$22.24	\$0.00	\$90.80
	02/01/2022	\$58.38	\$10.75	\$22.24	\$0.00	\$91.37

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - MARBLE-TILE-TERRAZZO MECHANIC - Local 3 Marble & Tile

Effective Date - 02/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.21	\$10.75	\$21.93	\$0.00	\$59.89
2	60	\$32.65	\$10.75	\$21.93	\$0.00	\$65.33
3	70	\$38.09	\$10.75	\$21.93	\$0.00	\$70.77
4	80	\$43.54	\$10.75	\$21.93	\$0.00	\$76.22
5	90	\$48.98	\$10.75	\$21.93	\$0.00	\$81.66

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.89	\$10.75	\$22.08	\$0.00	\$60.72
2	60	\$33.46	\$10.75	\$22.08	\$0.00	\$66.29
3	70	\$39.04	\$10.75	\$22.08	\$0.00	\$71.87
4	80	\$44.62	\$10.75	\$22.08	\$0.00	\$77.45
5	90	\$50.19	\$10.75	\$22.08	\$0.00	\$83.02

Notes:

Apprentice to Journeyworker Ratio:1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MECHANICS MAINTENANCE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MILLWRIGHT (Zone 2) <i>MILLWRIGHTS LOCAL 1121 - Zone 2</i>	04/01/2019	\$38.87	\$9.90	\$18.50	\$0.00	\$67.27
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Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - MILLWRIGHT - Local 1121 Zone 2

Effective Date - 04/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$21.38	\$9.90	\$5.31	\$0.00	\$36.59
2	65	\$25.27	\$9.90	\$15.13	\$0.00	\$50.30
3	75	\$29.15	\$9.90	\$16.10	\$0.00	\$55.15
4	85	\$33.04	\$9.90	\$17.06	\$0.00	\$60.00

Notes:

Steps are 2,000 hours

Apprentice to Journeyworker Ratio:1:5

MORTAR MIXER <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

OILER (OTHER THAN TRUCK CRANES,GRADALLS) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$23.13	\$13.00	\$15.70	\$0.00	\$51.83
	12/01/2020	\$23.70	\$13.00	\$15.70	\$0.00	\$52.40
	06/01/2021	\$24.25	\$13.00	\$15.70	\$0.00	\$52.95
	12/01/2021	\$24.83	\$13.00	\$15.70	\$0.00	\$53.53

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

OILER (TRUCK CRANES, GRADALLS) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$27.79	\$13.00	\$15.70	\$0.00	\$56.49
	12/01/2020	\$28.47	\$13.00	\$15.70	\$0.00	\$57.17
	06/01/2021	\$29.11	\$13.00	\$15.70	\$0.00	\$57.81
	12/01/2021	\$29.79	\$13.00	\$15.70	\$0.00	\$58.49

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

OTHER POWER DRIVEN EQUIPMENT - CLASS II <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

PAINTER (BRIDGES/TANKS) <i>PAINTERS LOCAL 35 - ZONE 2</i>	01/01/2020	\$50.96	\$8.20	\$22.10	\$0.00	\$81.26
	07/01/2020	\$51.51	\$8.25	\$22.40	\$0.00	\$82.16
	01/01/2021	\$52.06	\$8.25	\$22.75	\$0.00	\$83.06

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.48	\$8.20	\$0.00	\$0.00	\$33.68
2	55	\$28.03	\$8.20	\$5.94	\$0.00	\$42.17
3	60	\$30.58	\$8.20	\$6.48	\$0.00	\$45.26
4	65	\$33.12	\$8.20	\$7.02	\$0.00	\$48.34
5	70	\$35.67	\$8.20	\$18.86	\$0.00	\$62.73
6	75	\$38.22	\$8.20	\$19.40	\$0.00	\$65.82
7	80	\$40.77	\$8.20	\$19.94	\$0.00	\$68.91
8	90	\$45.86	\$8.20	\$21.02	\$0.00	\$75.08

Effective Date - 07/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.76	\$8.25	\$0.00	\$0.00	\$34.01
2	55	\$28.33	\$8.25	\$6.05	\$0.00	\$42.63
3	60	\$30.91	\$8.25	\$6.60	\$0.00	\$45.76
4	65	\$33.48	\$8.25	\$7.15	\$0.00	\$48.88
5	70	\$36.06	\$8.25	\$19.10	\$0.00	\$63.41
6	75	\$38.63	\$8.25	\$19.65	\$0.00	\$66.53
7	80	\$41.21	\$8.25	\$20.20	\$0.00	\$69.66
8	90	\$46.36	\$8.25	\$21.30	\$0.00	\$75.91

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, NEW) *	01/01/2020	\$41.86	\$8.20	\$22.10	\$0.00	\$72.16
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. PAINTERS LOCAL 35 - ZONE 2	07/01/2020	\$41.21	\$8.25	\$22.40	\$0.00	\$71.86
	01/01/2021	\$42.96	\$8.25	\$22.75	\$0.00	\$73.96

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - New

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.93	\$8.20	\$0.00	\$0.00	\$29.13
2	55	\$23.02	\$8.20	\$5.94	\$0.00	\$37.16
3	60	\$25.12	\$8.20	\$6.48	\$0.00	\$39.80
4	65	\$27.21	\$8.20	\$7.02	\$0.00	\$42.43
5	70	\$29.30	\$8.20	\$18.86	\$0.00	\$56.36
6	75	\$31.40	\$8.20	\$19.40	\$0.00	\$59.00
7	80	\$33.49	\$8.20	\$19.94	\$0.00	\$61.63
8	90	\$37.67	\$8.20	\$21.02	\$0.00	\$66.89

Effective Date - 07/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.61	\$8.25	\$0.00	\$0.00	\$28.86
2	55	\$22.67	\$8.25	\$6.05	\$0.00	\$36.97
3	60	\$24.73	\$8.25	\$6.60	\$0.00	\$39.58
4	65	\$26.79	\$8.25	\$7.15	\$0.00	\$42.19
5	70	\$28.85	\$8.25	\$19.10	\$0.00	\$56.20
6	75	\$30.91	\$8.25	\$19.65	\$0.00	\$58.81
7	80	\$32.97	\$8.25	\$20.20	\$0.00	\$61.42
8	90	\$37.09	\$8.25	\$21.30	\$0.00	\$66.64

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT)	01/01/2020	\$39.92	\$8.20	\$22.10	\$0.00	\$70.22
PAINTERS LOCAL 35 - ZONE 2	07/01/2020	\$40.47	\$8.25	\$22.40	\$0.00	\$71.12
	01/01/2021	\$41.02	\$8.25	\$22.75	\$0.00	\$72.02

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$19.96	\$8.20	\$0.00	\$0.00	\$28.16
2	55	\$21.96	\$8.20	\$5.94	\$0.00	\$36.10
3	60	\$23.95	\$8.20	\$6.48	\$0.00	\$38.63
4	65	\$25.95	\$8.20	\$7.02	\$0.00	\$41.17
5	70	\$27.94	\$8.20	\$18.86	\$0.00	\$55.00
6	75	\$29.94	\$8.20	\$19.40	\$0.00	\$57.54
7	80	\$31.94	\$8.20	\$19.94	\$0.00	\$60.08
8	90	\$35.93	\$8.20	\$21.02	\$0.00	\$65.15

Effective Date - 07/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.24	\$8.25	\$0.00	\$0.00	\$28.49
2	55	\$22.26	\$8.25	\$6.05	\$0.00	\$36.56
3	60	\$24.28	\$8.25	\$6.60	\$0.00	\$39.13
4	65	\$26.31	\$8.25	\$7.15	\$0.00	\$41.71
5	70	\$28.33	\$8.25	\$19.10	\$0.00	\$55.68
6	75	\$30.35	\$8.25	\$19.65	\$0.00	\$58.25
7	80	\$32.38	\$8.25	\$20.20	\$0.00	\$60.83
8	90	\$36.42	\$8.25	\$21.30	\$0.00	\$65.97

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (TRAFFIC MARKINGS) LABORERS - ZONE 2	06/01/2020	\$34.06	\$8.60	\$15.77	\$0.00	\$58.43
	12/01/2020	\$34.95	\$8.60	\$15.77	\$0.00	\$59.32
	06/01/2021	\$35.87	\$8.60	\$15.77	\$0.00	\$60.24
	12/01/2021	\$36.78	\$8.60	\$15.77	\$0.00	\$61.15

For Apprentice rates see "Apprentice- LABORER"

PAINTER / TAPER (BRUSH, NEW) *	01/01/2020	\$40.46	\$8.20	\$22.10	\$0.00	\$70.76
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. PAINTERS LOCAL 35 - ZONE 2	07/01/2020	\$41.01	\$8.25	\$22.40	\$0.00	\$71.66
	01/01/2021	\$41.56	\$8.25	\$22.75	\$0.00	\$72.56

Apprentice - PAINTER - Local 35 Zone 2 - BRUSH NEW

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.23	\$8.20	\$0.00	\$0.00	\$28.43
2	55	\$22.25	\$8.20	\$5.94	\$0.00	\$36.39
3	60	\$24.28	\$8.20	\$6.48	\$0.00	\$38.96
4	65	\$26.30	\$8.20	\$7.02	\$0.00	\$41.52
5	70	\$28.32	\$8.20	\$18.86	\$0.00	\$55.38
6	75	\$30.35	\$8.20	\$19.40	\$0.00	\$57.95
7	80	\$32.37	\$8.20	\$19.94	\$0.00	\$60.51
8	90	\$36.41	\$8.20	\$21.02	\$0.00	\$65.63

Effective Date - 07/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$20.51	\$8.25	\$0.00	\$0.00	\$28.76
2	55	\$22.56	\$8.25	\$6.05	\$0.00	\$36.86
3	60	\$24.61	\$8.25	\$6.60	\$0.00	\$39.46
4	65	\$26.66	\$8.25	\$7.15	\$0.00	\$42.06
5	70	\$28.71	\$8.25	\$19.10	\$0.00	\$56.06
6	75	\$30.76	\$8.25	\$19.65	\$0.00	\$58.66
7	80	\$32.81	\$8.25	\$20.20	\$0.00	\$61.26
8	90	\$36.91	\$8.25	\$21.30	\$0.00	\$66.46

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, REPAINT)	01/01/2020	\$38.52	\$8.20	\$22.10	\$0.00	\$68.82
PAINTERS LOCAL 35 - ZONE 2	07/01/2020	\$39.07	\$8.25	\$22.40	\$0.00	\$69.72
	01/01/2021	\$39.62	\$8.25	\$22.75	\$0.00	\$70.62

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - BRUSH REPAINT

Effective Date - 01/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$19.26	\$8.20	\$0.00	\$0.00	\$27.46
2	55	\$21.19	\$8.20	\$5.94	\$0.00	\$35.33
3	60	\$23.11	\$8.20	\$6.48	\$0.00	\$37.79
4	65	\$25.04	\$8.20	\$7.02	\$0.00	\$40.26
5	70	\$26.96	\$8.20	\$18.86	\$0.00	\$54.02
6	75	\$28.89	\$8.20	\$19.40	\$0.00	\$56.49
7	80	\$30.82	\$8.20	\$19.94	\$0.00	\$58.96
8	90	\$34.67	\$8.20	\$21.02	\$0.00	\$63.89

Effective Date - 07/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$19.54	\$8.25	\$0.00	\$0.00	\$27.79
2	55	\$21.49	\$8.25	\$6.05	\$0.00	\$35.79
3	60	\$23.44	\$8.25	\$6.60	\$0.00	\$38.29
4	65	\$25.40	\$8.25	\$7.15	\$0.00	\$40.80
5	70	\$27.35	\$8.25	\$19.10	\$0.00	\$54.70
6	75	\$29.30	\$8.25	\$19.65	\$0.00	\$57.20
7	80	\$31.26	\$8.25	\$20.20	\$0.00	\$59.71
8	90	\$35.16	\$8.25	\$21.30	\$0.00	\$64.71

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PANEL & PICKUP TRUCKS DRIVER <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2020	\$34.98	\$12.41	\$13.72	\$0.00	\$61.11
	08/01/2020	\$34.98	\$12.91	\$13.72	\$0.00	\$61.61
	12/01/2020	\$34.98	\$12.91	\$14.82	\$0.00	\$62.71
	06/01/2021	\$35.78	\$12.91	\$14.82	\$0.00	\$63.51
	08/01/2021	\$35.78	\$13.41	\$14.82	\$0.00	\$64.01
	12/01/2021	\$35.78	\$13.41	\$16.01	\$0.00	\$65.20
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i> For apprentice rates see "Apprentice- PILE DRIVER"	08/01/2019	\$48.94	\$9.90	\$21.15	\$0.00	\$79.99
PILE DRIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2019	\$48.94	\$9.90	\$21.15	\$0.00	\$79.99

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PILE DRIVER - Local 56 Zone 1

Effective Date - 08/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.47	\$9.90	\$21.15	\$0.00	\$55.52
2	60	\$29.36	\$9.90	\$21.15	\$0.00	\$60.41
3	70	\$34.26	\$9.90	\$21.15	\$0.00	\$65.31
4	75	\$36.71	\$9.90	\$21.15	\$0.00	\$67.76
5	80	\$39.15	\$9.90	\$21.15	\$0.00	\$70.20
6	80	\$39.15	\$9.90	\$21.15	\$0.00	\$70.20
7	90	\$44.05	\$9.90	\$21.15	\$0.00	\$75.10
8	90	\$44.05	\$9.90	\$21.15	\$0.00	\$75.10

Notes:

Apprentice to Journeyworker Ratio:1:5

PIPELAYER	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
LABORERS - ZONE 2	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

PLUMBER & PIPEFITTER	03/02/2020	\$43.69	\$10.00	\$18.80	\$0.00	\$72.49
PLUMBERS & PIPEFITTERS LOCAL 51	08/31/2020	\$45.84	\$10.00	\$18.80	\$0.00	\$74.64
	08/30/2021	\$47.84	\$10.00	\$18.80	\$0.00	\$76.64

Apprentice - PLUMBER/PIPEFITTER - Local 51

Effective Date - 03/02/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$17.48	\$10.00	\$2.50	\$0.00	\$29.98
2	50	\$21.85	\$10.00	\$2.50	\$0.00	\$34.35
3	60	\$26.21	\$10.00	\$8.48	\$0.00	\$44.69
4	70	\$30.58	\$10.00	\$13.56	\$0.00	\$54.14
5	80	\$34.95	\$10.00	\$16.95	\$0.00	\$61.90

Effective Date - 08/31/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$18.34	\$10.00	\$2.50	\$0.00	\$30.84
2	50	\$22.92	\$10.00	\$2.50	\$0.00	\$35.42
3	60	\$27.50	\$10.00	\$8.48	\$0.00	\$45.98
4	70	\$32.09	\$10.00	\$13.56	\$0.00	\$55.65
5	80	\$36.67	\$10.00	\$16.95	\$0.00	\$63.62

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.) <i>PLUMBERS & PIPEFITTERS LOCAL 51</i>	03/02/2020	\$43.69	\$10.00	\$18.80	\$0.00	\$72.49
	08/31/2020	\$45.84	\$10.00	\$18.80	\$0.00	\$74.64
	08/30/2021	\$47.84	\$10.00	\$18.80	\$0.00	\$76.64

For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"

PNEUMATIC DRILL/TOOL OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40

For apprentice rates see "Apprentice- LABORER"

POWDERMAN & BLASTER <i>LABORERS - ZONE 2</i>	06/01/2020	\$35.06	\$8.60	\$15.77	\$0.00	\$59.43
	12/01/2020	\$35.95	\$8.60	\$15.77	\$0.00	\$60.32
	06/01/2021	\$36.87	\$8.60	\$15.77	\$0.00	\$61.24
	12/01/2021	\$37.78	\$8.60	\$15.77	\$0.00	\$62.15

For apprentice rates see "Apprentice- LABORER"

POWER SHOVEL/DERRICK/TRENCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$49.33	\$13.00	\$15.70	\$0.00	\$78.03
	12/01/2020	\$50.48	\$13.00	\$15.70	\$0.00	\$79.18
	06/01/2021	\$51.58	\$13.00	\$15.70	\$0.00	\$80.28
	12/01/2021	\$52.73	\$13.00	\$15.70	\$0.00	\$81.43

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

PUMP OPERATOR (CONCRETE) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$49.33	\$13.00	\$15.70	\$0.00	\$78.03
	12/01/2020	\$50.48	\$13.00	\$15.70	\$0.00	\$79.18
	06/01/2021	\$51.58	\$13.00	\$15.70	\$0.00	\$80.28
	12/01/2021	\$52.73	\$13.00	\$15.70	\$0.00	\$81.43

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PUMP OPERATOR (DEWATERING, OTHER) <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$32.72	\$13.00	\$15.70	\$0.00	\$61.42
	12/01/2020	\$33.50	\$13.00	\$15.70	\$0.00	\$62.20
	06/01/2021	\$34.25	\$13.00	\$15.70	\$0.00	\$62.95
	12/01/2021	\$35.04	\$13.00	\$15.70	\$0.00	\$63.74
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
READY-MIX CONCRETE DRIVER <i>TEAMSTERS 170 - Dauphinis (Bellingham)</i>	01/01/2020	\$24.00	\$11.01	\$2.50	\$0.00	\$37.51
RECLAIMERS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
RIDE-ON MOTORIZED BUGGY OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40
For apprentice rates see "Apprentice- LABORER"						
ROLLER/SPREADER/MULCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
ROOFER (Inc.Roofing Waterproofing &Roofing Damproofing) <i>ROOFERS LOCAL 33</i>	03/01/2020	\$45.67	\$11.50	\$15.90	\$0.00	\$73.07
	08/01/2020	\$47.10	\$11.50	\$15.90	\$0.00	\$74.50
	02/01/2021	\$48.53	\$11.50	\$15.90	\$0.00	\$75.93
	08/01/2021	\$49.96	\$11.50	\$15.90	\$0.00	\$77.36
	02/01/2022	\$51.39	\$11.50	\$15.90	\$0.00	\$78.79

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - ROOFER - Local 33

Effective Date - 03/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.84	\$11.50	\$3.69	\$0.00	\$38.03
2	60	\$27.40	\$11.50	\$15.90	\$0.00	\$54.80
3	65	\$29.69	\$11.50	\$15.90	\$0.00	\$57.09
4	75	\$34.25	\$11.50	\$15.90	\$0.00	\$61.65
5	85	\$38.82	\$11.50	\$15.90	\$0.00	\$66.22

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.55	\$11.50	\$3.69	\$0.00	\$38.74
2	60	\$28.26	\$11.50	\$15.90	\$0.00	\$55.66
3	65	\$30.62	\$11.50	\$15.90	\$0.00	\$58.02
4	75	\$35.33	\$11.50	\$15.90	\$0.00	\$62.73
5	85	\$40.04	\$11.50	\$15.90	\$0.00	\$67.44

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	03/01/2020	\$45.92	\$11.50	\$15.90	\$0.00	\$73.32
ROOFERS LOCAL 33	08/01/2020	\$47.35	\$11.50	\$15.90	\$0.00	\$74.75
	02/01/2021	\$48.78	\$11.50	\$15.90	\$0.00	\$76.18
	08/01/2021	\$50.21	\$11.50	\$15.90	\$0.00	\$77.61
	02/01/2022	\$51.64	\$11.50	\$15.90	\$0.00	\$79.04

For apprentice rates see "Apprentice- ROOFER"

SHEETMETAL WORKER	02/01/2020	\$49.36	\$13.35	\$24.12	\$2.61	\$89.44
SHEETMETAL WORKERS LOCAL 17 - A	08/01/2020	\$50.96	\$13.35	\$24.12	\$2.66	\$91.09
	02/01/2021	\$52.61	\$13.35	\$24.12	\$2.71	\$92.79
	08/01/2021	\$54.36	\$13.35	\$24.12	\$2.76	\$94.59
	02/01/2022	\$56.11	\$13.35	\$24.12	\$2.81	\$96.39

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - SHEET METAL WORKER - Local 17-A

Effective Date - 02/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$20.73	\$13.35	\$5.89	\$0.00	\$39.97
2	42	\$20.73	\$13.35	\$5.89	\$0.00	\$39.97
3	47	\$23.20	\$13.35	\$11.13	\$1.43	\$49.11
4	47	\$23.20	\$13.35	\$11.13	\$1.43	\$49.11
5	52	\$25.67	\$13.35	\$12.08	\$1.53	\$52.63
6	52	\$25.67	\$13.35	\$12.33	\$1.54	\$52.89
7	60	\$29.62	\$13.35	\$13.70	\$1.70	\$58.37
8	65	\$32.08	\$13.35	\$15.15	\$1.80	\$62.38
9	75	\$37.02	\$13.35	\$16.56	\$2.01	\$68.94
10	85	\$41.96	\$13.35	\$17.96	\$2.20	\$75.47

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$21.40	\$13.35	\$5.89	\$0.00	\$40.64
2	42	\$21.40	\$13.35	\$5.89	\$0.00	\$40.64
3	47	\$23.95	\$13.35	\$11.13	\$1.45	\$49.88
4	47	\$23.95	\$13.35	\$11.13	\$1.45	\$49.88
5	52	\$26.50	\$13.35	\$12.08	\$1.56	\$53.49
6	52	\$26.50	\$13.35	\$12.33	\$1.57	\$53.75
7	60	\$30.58	\$13.35	\$13.70	\$1.73	\$59.36
8	65	\$33.12	\$13.35	\$15.15	\$1.85	\$63.47
9	75	\$38.22	\$13.35	\$16.56	\$2.04	\$70.17
10	85	\$43.32	\$13.35	\$17.96	\$2.24	\$76.87

Notes:
Steps are 6 mos.

Apprentice to Journeyworker Ratio:1:4

SPECIALIZED EARTH MOVING EQUIP < 35 TONS <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2020	\$35.44	\$12.41	\$13.72	\$0.00	\$61.57
	08/01/2020	\$35.44	\$12.91	\$13.72	\$0.00	\$62.07
	12/01/2020	\$35.44	\$12.91	\$14.82	\$0.00	\$63.17
	06/01/2021	\$36.24	\$12.91	\$14.82	\$0.00	\$63.97
	08/01/2021	\$36.24	\$13.41	\$14.82	\$0.00	\$64.47
	12/01/2021	\$36.24	\$13.41	\$16.01	\$0.00	\$65.66
SPECIALIZED EARTH MOVING EQUIP > 35 TONS <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2020	\$35.73	\$12.41	\$13.72	\$0.00	\$61.86
	08/01/2020	\$35.73	\$12.91	\$13.72	\$0.00	\$62.36
	12/01/2020	\$35.73	\$12.91	\$14.82	\$0.00	\$63.46
	06/01/2021	\$36.53	\$12.91	\$14.82	\$0.00	\$64.26
	08/01/2021	\$36.53	\$13.41	\$14.82	\$0.00	\$64.76
	12/01/2021	\$36.53	\$13.41	\$16.01	\$0.00	\$65.95

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
SPRINKLER FITTER <i>SPRINKLER FITTERS LOCAL 550 - (Section A) Zone 1</i>	03/01/2020	\$60.82	\$9.68	\$20.55	\$0.00	\$91.05
	10/01/2020	\$62.32	\$9.68	\$20.55	\$0.00	\$92.55
	03/01/2021	\$63.82	\$9.68	\$20.55	\$0.00	\$94.05

Apprentice - SPRINKLER FITTER - Local 550 (Section A) Zone 1

Effective Date - 03/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$21.29	\$9.68	\$11.61	\$0.00	\$42.58
2	40	\$24.33	\$9.68	\$12.30	\$0.00	\$46.31
3	45	\$27.37	\$9.68	\$12.99	\$0.00	\$50.04
4	50	\$30.41	\$9.68	\$13.73	\$0.00	\$53.82
5	55	\$33.45	\$9.68	\$14.36	\$0.00	\$57.49
6	60	\$36.49	\$9.68	\$15.05	\$0.00	\$61.22
7	65	\$39.53	\$9.68	\$15.74	\$0.00	\$64.95
8	70	\$42.57	\$9.68	\$16.43	\$0.00	\$68.68
9	75	\$45.62	\$9.68	\$17.11	\$0.00	\$72.41
10	80	\$48.66	\$9.68	\$17.80	\$0.00	\$76.14

Effective Date - 10/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$21.81	\$9.68	\$11.61	\$0.00	\$43.10
2	40	\$24.93	\$9.68	\$12.30	\$0.00	\$46.91
3	45	\$28.04	\$9.68	\$12.99	\$0.00	\$50.71
4	50	\$31.16	\$9.68	\$13.73	\$0.00	\$54.57
5	55	\$34.28	\$9.68	\$14.36	\$0.00	\$58.32
6	60	\$37.39	\$9.68	\$15.05	\$0.00	\$62.12
7	65	\$40.51	\$9.68	\$15.74	\$0.00	\$65.93
8	70	\$43.62	\$9.68	\$16.43	\$0.00	\$69.73
9	75	\$46.74	\$9.68	\$17.11	\$0.00	\$73.53
10	80	\$49.86	\$9.68	\$17.80	\$0.00	\$77.34

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 <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TELECOMMUNICATION TECHNICIAN <i>ELECTRICIANS LOCAL 223</i>	03/01/2020	\$36.27	\$10.40	\$11.78	\$0.00	\$58.45

Apprentice - TELECOMMUNICATION TECHNICIAN - Local 223

Effective Date - 03/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Notes: See Electrician Apprentice Wages
Steps are 750hrs
Telecom Apprentice Wages shall be the same as the Electrician Apprentice Wages

Apprentice to Journeyworker Ratio:2:3***

TERRAZZO FINISHERS <i>BRICKLAYERS LOCAL 3 - MARBLE & TILE</i>	02/01/2020	\$53.34	\$10.75	\$21.94	\$0.00	\$86.03
	08/01/2020	\$54.69	\$10.75	\$22.09	\$0.00	\$87.53
	02/01/2021	\$55.33	\$10.75	\$22.09	\$0.00	\$88.17
	08/01/2021	\$56.73	\$10.75	\$22.25	\$0.00	\$89.73
	02/01/2022	\$57.32	\$10.75	\$22.25	\$0.00	\$90.32

Apprentice - TERRAZZO FINISHER - Local 3 Marble & Tile

Effective Date - 02/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.67	\$10.75	\$21.94	\$0.00	\$59.36
2	60	\$32.00	\$10.75	\$21.94	\$0.00	\$64.69
3	70	\$37.34	\$10.75	\$21.94	\$0.00	\$70.03
4	80	\$42.67	\$10.75	\$21.94	\$0.00	\$75.36
5	90	\$48.01	\$10.75	\$21.94	\$0.00	\$80.70

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$27.35	\$10.75	\$22.09	\$0.00	\$60.19
2	60	\$32.81	\$10.75	\$22.09	\$0.00	\$65.65
3	70	\$38.28	\$10.75	\$22.09	\$0.00	\$71.12
4	80	\$43.75	\$10.75	\$22.09	\$0.00	\$76.59
5	90	\$49.22	\$10.75	\$22.09	\$0.00	\$82.06

Notes:

Apprentice to Journeyworker Ratio:1:3

TEST BORING DRILLER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2020	\$40.55	\$8.60	\$17.24	\$0.00	\$66.39
	12/01/2020	\$41.53	\$8.60	\$17.24	\$0.00	\$67.37
	06/01/2021	\$42.55	\$8.60	\$17.24	\$0.00	\$68.39
	12/01/2021	\$43.56	\$8.60	\$17.24	\$0.00	\$69.40

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TEST BORING DRILLER HELPER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2020	\$39.27	\$8.60	\$17.24	\$0.00	\$65.11
	12/01/2020	\$40.25	\$8.60	\$17.24	\$0.00	\$66.09
	06/01/2021	\$41.27	\$8.60	\$17.24	\$0.00	\$67.11
	12/01/2021	\$42.28	\$8.60	\$17.24	\$0.00	\$68.12
For apprentice rates see "Apprentice- LABORER"						
TEST BORING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2020	\$39.15	\$8.60	\$17.24	\$0.00	\$64.99
	12/01/2020	\$40.13	\$8.60	\$17.24	\$0.00	\$65.97
	06/01/2021	\$41.15	\$8.60	\$17.24	\$0.00	\$66.99
	12/01/2021	\$42.16	\$8.60	\$17.24	\$0.00	\$68.00
For apprentice rates see "Apprentice- LABORER"						
TRACTORS/PORTABLE STEAM GENERATORS <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$48.81	\$13.00	\$15.70	\$0.00	\$77.51
	12/01/2020	\$49.95	\$13.00	\$15.70	\$0.00	\$78.65
	06/01/2021	\$51.04	\$13.00	\$15.70	\$0.00	\$79.74
	12/01/2021	\$52.18	\$13.00	\$15.70	\$0.00	\$80.88
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TRAILERS FOR EARTH MOVING EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2020	\$36.02	\$12.41	\$13.72	\$0.00	\$62.15
	08/01/2020	\$36.02	\$12.91	\$13.72	\$0.00	\$62.65
	12/01/2020	\$36.02	\$12.91	\$14.82	\$0.00	\$63.75
	06/01/2021	\$36.82	\$12.91	\$14.82	\$0.00	\$64.55
	08/01/2021	\$36.82	\$13.41	\$14.82	\$0.00	\$65.05
	12/01/2021	\$36.82	\$13.41	\$16.01	\$0.00	\$66.24
TUNNEL WORK - COMPRESSED AIR <i>LABORERS (COMPRESSED AIR)</i>	06/01/2020	\$51.38	\$8.60	\$17.69	\$0.00	\$77.67
	12/01/2020	\$52.36	\$8.60	\$17.69	\$0.00	\$78.65
	06/01/2021	\$53.38	\$8.60	\$17.69	\$0.00	\$79.67
	12/01/2021	\$54.39	\$8.60	\$17.69	\$0.00	\$80.68
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) <i>LABORERS (COMPRESSED AIR)</i>	06/01/2020	\$53.38	\$8.60	\$17.69	\$0.00	\$79.67
	12/01/2020	\$54.36	\$8.60	\$17.69	\$0.00	\$80.65
	06/01/2021	\$55.38	\$8.60	\$17.69	\$0.00	\$81.67
	12/01/2021	\$56.39	\$8.60	\$17.69	\$0.00	\$82.68
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR <i>LABORERS (FREE AIR TUNNEL)</i>	06/01/2020	\$43.45	\$8.60	\$17.69	\$0.00	\$69.74
	12/01/2020	\$44.43	\$8.60	\$17.69	\$0.00	\$70.72
	06/01/2021	\$45.45	\$8.60	\$17.69	\$0.00	\$71.74
	12/01/2021	\$46.46	\$8.60	\$17.69	\$0.00	\$72.75
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR (HAZ. WASTE) <i>LABORERS (FREE AIR TUNNEL)</i>	06/01/2020	\$45.45	\$8.60	\$17.69	\$0.00	\$71.74
	12/01/2020	\$46.43	\$8.60	\$17.69	\$0.00	\$72.72
	06/01/2021	\$47.45	\$8.60	\$17.69	\$0.00	\$73.74
	12/01/2021	\$48.46	\$8.60	\$17.69	\$0.00	\$74.75
For apprentice rates see "Apprentice- LABORER"						
VAC-HAUL <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	06/01/2020	\$35.44	\$12.41	\$13.72	\$0.00	\$61.57
	08/01/2020	\$35.44	\$12.91	\$13.72	\$0.00	\$62.07
	12/01/2020	\$35.44	\$12.91	\$14.82	\$0.00	\$63.17
	06/01/2021	\$36.24	\$12.91	\$14.82	\$0.00	\$63.97
	08/01/2021	\$36.24	\$13.41	\$14.82	\$0.00	\$64.47
	12/01/2021	\$36.24	\$13.41	\$16.01	\$0.00	\$65.66

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
WAGON DRILL OPERATOR <i>LABORERS - ZONE 2</i>	06/01/2020	\$34.31	\$8.60	\$15.77	\$0.00	\$58.68
	12/01/2020	\$35.20	\$8.60	\$15.77	\$0.00	\$59.57
	06/01/2021	\$36.12	\$8.60	\$15.77	\$0.00	\$60.49
	12/01/2021	\$37.03	\$8.60	\$15.77	\$0.00	\$61.40
For apprentice rates see "Apprentice- LABORER"						
WASTE WATER PUMP OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2020	\$49.33	\$13.00	\$15.70	\$0.00	\$78.03
	12/01/2020	\$50.48	\$13.00	\$15.70	\$0.00	\$79.18
	06/01/2021	\$51.58	\$13.00	\$15.70	\$0.00	\$80.28
	12/01/2021	\$52.73	\$13.00	\$15.70	\$0.00	\$81.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
WATER METER INSTALLER <i>PLUMBERS & PIPEFITTERS LOCAL 51</i>	03/02/2020	\$43.69	\$10.00	\$18.80	\$0.00	\$72.49
	08/31/2020	\$45.84	\$10.00	\$18.80	\$0.00	\$74.64
	08/30/2021	\$47.84	\$10.00	\$18.80	\$0.00	\$76.64
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						
Outside Electrical - East						
CABLE TECHNICIAN (Power Zone) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$28.83	\$8.75	\$1.86	\$0.00	\$39.44
	08/30/2020	\$29.67	\$9.25	\$1.89	\$0.00	\$40.81
For apprentice rates see "Apprentice- LINEMAN"						
CABLEMAN (Underground Ducts & Cables) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$40.84	\$8.75	\$10.02	\$0.00	\$59.61
	08/30/2020	\$42.03	\$9.25	\$10.27	\$0.00	\$61.55
For apprentice rates see "Apprentice- LINEMAN"						
DRIVER / GROUNDMAN CDL <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$33.64	\$8.75	\$9.86	\$0.00	\$52.25
	08/30/2020	\$34.62	\$9.25	\$10.07	\$0.00	\$53.94
For apprentice rates see "Apprentice- LINEMAN"						
DRIVER / GROUNDMAN -Inexperienced (<2000 Hrs) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$26.43	\$8.75	\$1.79	\$0.00	\$36.97
	08/30/2020	\$27.20	\$9.25	\$1.82	\$0.00	\$38.27
For apprentice rates see "Apprentice- LINEMAN"						
EQUIPMENT OPERATOR (Class A CDL) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$40.84	\$8.75	\$14.10	\$0.00	\$63.69
	08/30/2020	\$42.03	\$9.25	\$14.35	\$0.00	\$65.63
For apprentice rates see "Apprentice- LINEMAN"						
EQUIPMENT OPERATOR (Class B CDL) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$36.04	\$8.75	\$10.65	\$0.00	\$55.44
	08/30/2020	\$37.09	\$9.25	\$10.87	\$0.00	\$57.21
For apprentice rates see "Apprentice- LINEMAN"						
GROUNDMAN <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$21.62	\$8.75	\$1.65	\$0.00	\$32.02
	08/30/2020	\$22.25	\$9.25	\$1.67	\$0.00	\$33.17
For apprentice rates see "Apprentice- LINEMAN"						
GROUNDMAN -Inexperienced (<2000 Hrs.) <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$26.43	\$8.75	\$1.79	\$0.00	\$36.97
	08/30/2020	\$27.20	\$9.25	\$1.82	\$0.00	\$38.27
For apprentice rates see "Apprentice- LINEMAN"						
JOURNEYMAN LINEMAN <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	09/01/2019	\$48.05	\$8.75	\$17.19	\$0.00	\$73.99
	08/30/2020	\$49.45	\$9.25	\$17.48	\$0.00	\$76.18

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - LINEMAN (Outside Electrical) - East Local 104

Effective Date - 09/01/2019

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$28.83	\$8.75	\$3.36	\$0.00	\$40.94
2	65	\$31.23	\$8.75	\$3.44	\$0.00	\$43.42
3	70	\$33.64	\$8.75	\$3.51	\$0.00	\$45.90
4	75	\$36.04	\$8.75	\$5.08	\$0.00	\$49.87
5	80	\$38.44	\$8.75	\$5.15	\$0.00	\$52.34
6	85	\$40.84	\$8.75	\$5.23	\$0.00	\$54.82
7	90	\$43.25	\$8.75	\$7.30	\$0.00	\$59.30

Effective Date - 08/30/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$29.67	\$9.25	\$3.39	\$0.00	\$42.31
2	65	\$32.14	\$9.25	\$3.46	\$0.00	\$44.85
3	70	\$34.62	\$9.25	\$3.54	\$0.00	\$47.41
4	75	\$37.09	\$9.25	\$5.11	\$0.00	\$51.45
5	80	\$39.56	\$9.25	\$5.19	\$0.00	\$54.00
6	85	\$42.03	\$9.25	\$5.26	\$0.00	\$56.54
7	90	\$44.51	\$9.25	\$7.34	\$0.00	\$61.10

Notes:

Apprentice to Journeyworker Ratio:1:2

TELEDATA CABLE SPLICER <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	02/04/2019	\$30.73	\$4.70	\$3.17	\$0.00	\$38.60
TELEDATA LINEMAN/EQUIPMENT OPERATOR <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	02/04/2019	\$28.93	\$4.70	\$3.14	\$0.00	\$36.77
TELEDATA WIREMAN/INSTALLER/TECHNICIAN <i>OUTSIDE ELECTRICAL WORKERS - EAST LOCAL 104</i>	02/04/2019	\$28.93	\$4.70	\$3.14	\$0.00	\$36.77

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.

"General Decision Number: MA20200001 08/07/2020

Superseded General Decision Number: MA20190001

State: Massachusetts

Construction Type: Building

Counties: Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk and Suffolk Counties in Massachusetts.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes and apartments up to and including 4 stories)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.80 for calendar year 2020 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, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.80 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 calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020
1	02/14/2020
2	02/21/2020
3	03/13/2020
4	08/07/2020

ASBE0006-001 09/01/2019

Rates Fringes

	Rates	Fringes
Insulator/asbestos worker		
Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems		
(ZONE A).....	\$ 48.44	29.90
(ZONE B).....	\$ 48.44	29.90

ZONES:

ZONE A

BARNSTABLE COUNTY (Brewster, Chatham, Dennis, Eastham, Harwich, Orleans, Provincetown, Truro, Wellfleet, Yarmouth) BRISTOL COUNTY (Easton), MIDDLESEX COUNTY, and NORFOLK COUNTY (Avon, Braintree, Brookline, Canton, Cohasset, Dedham, Dover, Foxborough, Holbrook, Medfield, Medway, Millis, Milton, Needham, Norfolk, Norwood, Quincy, Randolph, Sharon, Stoughton, Walpole, Wellesley, Westwood, Weymouth)

ZONE B

BARNSTABLE COUNTY (Barnstable, Bourne, Falmouth, Mashpee, Sandwich), BRISTOL COUNTY (All cities except Easton), and NORFOLK COUNTY (Bellingham, Franklin, Plainville)

ASBE0006-002 12/01/2019

BARNSTABLE (Brewster, Chatham, Dennis, Eastham, Harwich, Orleans, Provincetown, Truro, Wellfleet and Yarmouth); BRISTOL (Easton); ESSEX; MIDDLESEX; NORFOLK (Avon, Braintree, Brookline, Canton, Cohasset, Dedham, Dover, Foxboro, Holbrook, Hull, Medfield, Medway, Millis, Milton, Needham, Norfolk, Norwood, Quincy, Randolph, Sharon Stoughton, Walpole, Wellesley, Westwood, and Weymouth) AND SUFFOLK COUNTIES

Rates Fringes

HAZARDOUS MATERIAL HANDLER (Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials from mechanical systems whether they contain asbestos or not)....\$ 36.60 22.25

ASBE0006-010 09/01/2019

BARNSTABLE (Barnstable, Bourne, Falmouth, Mashpee and Sandwich); BRISTOL (Acushnet, Attleboro city, Berkeley, Dartmouth, Dighton, Fairhaven, Fall river City, Freetown, Marion, Mansfield, New Bedford City, North Attleboro, Norton, Raynham, Rehoboth, Seekonk, Somerset, Swansea, Taunton City and Westport); DUKES; NANTUCKET; NORFOLK (Bellingham, Franklin, Plainville, and Wrentham); PLYMOUTH (Lakeville, Mattapoisett, Middleboro, Rochester and Wareham)

Rates Fringes

Insulator/asbestos worker (Includes the application of all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems.)....\$ 48.44 29.90

BOIL0029-001 01/01/2017

Rates Fringes

BOILERMAKER.....\$ 42.42 24.92

BRMA0001-008 02/01/2019

FOXBORO CHAPTER

BRISTOL (Attleboro, Berkley, Dighton, Mansfield, North Attleboro, Norton, Raynham, Rehoboth, Seekonk, Taunton) AND NORFOLK (Bellingham, Canton, Dedham, Foxboro, Franklin, Norfolk, Norwood, Plainville, Sharon, Walpole, Westwood, Wrentham) COUNTIES

	Rates	Fringes
Bricklayer, Cement Mason, Plasterer.....	\$ 51.41	31.09

* BRMA0001-009 02/01/2020

LOWELL CHAPTER

MIDDLESEX (Acton, Asby, Ayer, Bedford, Billerica, Boxboro, Carlisle, Chemsford, Dracut, Dunstable, Ft. Denvens, Groton, Littleton, Lowell, North Acton, Pepperell, Shirley, South Acton, Tewksbury, Townsend, Tyngsboro, West Acton, Westford, Wilmington)

	Rates	Fringes
Bricklayer and plasterer.....	\$ 52.26	34.26

* BRMA0001-010 02/01/2020

LOWELL CHAPTER

MIDDLESEX (Ashland, Framingham, Holliston, Hopkinton, Hudson, Maynard, Natick, Sherborn, Stow); and NORFOLK (Medfield, Medway, Millis)

	Rates	Fringes
BRICKLAYER.....	\$ 52.26	34.26

* BRMA0003-001 02/01/2020

	Rates	Fringes
Marble & Tile Finisher.....	\$ 41.49	32.82
Marble, Tile & Terrazzo Workers.....	\$ 53.34	34.80
TERRAZZO FINISHER.....	\$ 54.42	34.98

* BRMA0003-003 02/01/2020

BOSTON CHAPTER

MIDDLESEX (Arlington, Cambridge, Everett, Malden, Medford, Melrose, Somerville); NORFOLK (Brookline, Milton); and SUFFOLK

	Rates	Fringes
BRICKLAYER.....	\$ 54.40	35.01

* BRMA0003-006 02/01/2020

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 (Reading, North Reading, Wakefield)

Rates Fringes

Bricklayer, cement mason and plasterer.....\$ 54.40 35.01

* BRMA0003-007 02/01/2020

WALTHAM CHAPTER MIDDLESEX (Belmont, Burlington, Concord, Lexington, Lincoln, Stoneham, Sudbury, Waltham, Watertown, Wayland, Weston, Winchester, Woburn)

Rates Fringes

Bricklayer and plasterer.....\$ 54.40 35.01

* BRMA0003-008 02/01/2020

NEWTON CHAPTER MIDDLESEX (Newton) and NORFOLK (Dover, Needham, Wellesley)

Rates Fringes

Bricklayer, cement mason and plasterer.....\$ 54.40 35.01

* BRMA0003-009 02/01/2020

NEW BEDFORD BARNSTABLE; BRISTOL (Acushnet, Darmouth, Farhaven, Fall River, Freetown, New Bedford, Somerset, Swansea, Westport); DUKES; and NANTUCKET COUNTIES

Rates Fringes

Bricklayer, cement mason and plasterer.....\$ 54.40 35.01

* BRMA0003-010 02/01/2020

QUINCY CHAPTER NORFOLK COUNTY (Avon, Braintree, Cohasset, Holbrook, Quincy, Randolph, Soughton, Weymouth)

Rates Fringes

Bricklayer, cement mason and plasterer.....\$ 54.40 35.01

CARP0056-011 08/01/2018

SUFFOLK (All of County); and those areas of BARNSTABLE, BRISTOL, ESSEX, MIDDLESEX & NORFOLK COUNTIES situated inside

Boston Beltway (I-495) and North of Cape Cod Canal. ALL of
DUKES AND NANTUCKET COUNTIES

	Rates	Fringes
PILEDRIVERMAN.....	\$ 46.07	32.25

CARP0056-012 08/01/2018		

The areas of BARNSTABLE, BRISTOL, and NORFOLK COUNTIES situated
OUTSIDE Boston Beltway (I-495) and South of Cape Cod Canal

	Rates	Fringes
PILEDRIVERMAN.....	\$ 46.07	32.25

CARP0056-013 08/01/2018		

Those areas of ESSEX and MIDDLESEX COUNTIES situated OUTSIDE
Boston Beltway (I-495)

	Rates	Fringes
PILEDRIVERMAN.....	\$ 46.07	32.25

CARP0327-001 09/01/2019		

MIDDLESEX (Belmont, Cambridge, Everett, Malden, Medford,
Somerville); NORFOLK (Brookline, Dedham, Milton); and SUFFOLK

	Rates	Fringes
CARPENTER.....	\$ 49.79	29.30

CARP0339-001 09/01/2019		

BRISTOL (Attleborough, North Attleborough); ESSEX; MIDDLESEX
(Except Belmont, Cambridge, Everett, Malden, Medford,
Somerville); AND NORFOLK (Bellingham, Canton, Foxboro,
Franklin, Medfield, Medway, Millis, Needham, Norfolk, Norwood,
Plainville, Sharon, Walpole, Wellesley, Westwood, Wrentham)

	Rates	Fringes
CARPENTER.....	\$ 41.90	29.00

CARP0346-003 09/01/2019		

NORFOLK COUNTY (Braintree, Cohasset, Scituate, Weymouth,
Quincy)

	Rates	Fringes
CARPENTER.....	\$ 41.90	29.00

CARP0624-005 09/01/2017		

DUKES; NANTUCKET

	Rates	Fringes
CARPENTER.....	\$ 46.43	28.35

CARP0624-007 09/01/2017		

BARNSTABLE; BRISTOL (Except Attleboro & North Attleboro); AND NORFOLK (Avon, Holbrook, Randolph, Stoughton) COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 39.28	27.90

CARP1121-001 01/06/2020		

SUFFOLK COUNTY

	Rates	Fringes
MILLWRIGHT.....	\$ 42.32	31.15

CARP1121-003 01/06/2020		

BARNSTABLE, BRISTOL, DUKES, ESSEX, MIDDLESEX, NANTUCKET and NORFOLK COUNTIES

	Rates	Fringes
MILLWRIGHT.....	\$ 38.47	31.15

CARP2168-001 09/01/2019		

MIDDLESEX (Belmont, Cambridge, Everett, Malden, Medford, Somerville); NORFOLK (Brookline, Dedham, Milton); and SUFFOLK

	Rates	Fringes
FLOOR LAYER: Carpet.....	\$ 46.25	29.45

CARP2168-004 09/01/2019		

BRISTOL; ESSEX; MIDDLESEX (Except Belmont, Cambridge, Everett, Malden, Medford, Somerville); Remainder of Norfolk County

	Rates	Fringes
FLOOR LAYER: Carpet.....	\$ 46.25	29.45

CARP2168-005 09/01/2019		

BARNSTABALE; DUKES; AND NANTUCKET

	Rates	Fringes
FLOOR LAYER: Carpet.....	\$ 46.25	29.45

ELEC0096-001 07/01/2019		

MIDDLESEX (Ashby, Ashland, Ayer, Ft. Devens, Groton, Hopkinton, Hudson, Marlboro, Pepperell, Shirley, Stow, Townsend)

	Rates	Fringes
ELECTRICIAN.....	\$ 44.07	11%+22.53
Teledata System Installer.....	\$ 30.10	25.32

* ELEC0099-001 06/01/2020

BRISTOL (Attleboro, North Attleboro, Seekonk)

	Rates	Fringes
ELECTRICIAN.....	\$ 41.61	60.24%
Teledata System Installer.....	\$ 31.21	13.1%+14.93

* ELEC0103-001 03/01/2020

ESSEX; MIDDLESEX (Excluding Ashby, Ashland, Ayer, Ft. Devens, Groton, Hopkinton, Hudson, Marlboro, Pepperell, Shirley, Stow, Townsend); NORFOLK (Excluding Avon, Holbrook, Plainville, Randolph, Stoughton) SUFFOLK

	Rates	Fringes
Teledata System Installer.....	\$ 40.13	34.47

* ELEC0103-002 03/01/2020

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.....	\$ 53.50	38.00

* ELEC0103-004 03/01/2020

ESSEX (Beverly, Danvers, Essex, Gloucester, Hamilton, Ipswich, Manchester, Marblehead, Middleton, Peabody, Rockport, Salem, Topsfield, Wenham)

	Rates	Fringes
ELECTRICIAN.....	\$ 53.50	38.00

* ELEC0103-005 03/01/2020

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, Franklino, Medfield, Medway, Millis, Milton, Needham, Norfolk, Norwood, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth, Wrentham); PLYMOUTH (Hingham and Hull); SUFFOLK

	Rates	Fringes
ELECTRICIAN.....	\$ 53.50	38.00

ELEC0104-001 09/03/2017

	Rates	Fringes
Line Construction:		
Cableman.....	\$ 38.45	18.42+A
Equipment Operator.....	\$ 38.45	22.50+A
Groundman.....	\$ 24.88	10.24+A
Lineman.....	\$ 45.23	25.71+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.

ELEC0223-005 03/01/2020

BARNSTABLE; BRISTOL (Except Attleboro, North Attleboro, Seekonk); DUKES; NANTUCKET AND NORFOLK (Avon, Halbrook, Plainville, Randolph, Stoughton)

	Rates	Fringes
ELECTRICIAN.....	\$ 42.87	31.18%+12.15

ELEC0223-006 03/01/2020

BARNSTABLE; BRISTOL (Except Attleboro, North Attleboro, Seekonk); DUKES; NANTUCKET AND NORFOLK (Avon, Halbrook, Plainville, Randolph, Stoughton)

	Rates	Fringes
Teledata System Installer.....	\$ 36.27	31.09%+11.90

ELEV0004-001 01/01/2020

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 61.42	34.765

FOOTNOTE FOR ELEVATOR MECHANICS:

a. Vacation: 6%/under 5 years based on regular hourly rate for all hours worked. 8%/over 5 years based on regular hourly rate for all hours worked.

b. PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Veterans' Day; Thanksgiving Day; the Friday after Thanksgiving Day; and Christmas Day.

* ENGI0004-001 06/01/2020

	Rates	Fringes
Power equipment operators:		

Group 1.....	\$ 49.33	29.75
Group 2.....	\$ 48.81	29.75
Group 3.....	\$ 32.72	29.75
Group 4.....	\$ 40.30	29.75
Group 5.....	\$ 23.13	29.75
Group 6.....	\$ 27.79	29.75

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

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

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

Group 1: Crane; shovel; truck crane; cherry picker; dragline; trench hoe; backhoe; three drum machine; derrick; pile driver; elevator tower; hoist; gradall; shovel dozer; front end loader; fork lift; suger; boring machine; rotaryu drill; post hole hammer; post hole digger; pumpcrete machine; asphalt plant (on site); concrete batching and/or mixing plant (on site); crusher plant (on site); paving concrete mixer; timber jack

Group 2: Sonic or vibratory hammer; grader; scraper; tandem scraper; concrete pump; bulldozer; tractor; york rake; mulching machine; portable steam boiler; portable steam generator; roller; spreader; tamper (self propelled or tractor drawn); asphalt paver; mechanic - maintenance; paving screed machine; stationary steam boiler; paving concrete finishing machine; cal truck; ballast regulator; switch tamper; rail anchor machine; tire truck

Group 3: Pumps (1-3 grouped); compressor; welding machine (1-3 grouped); generator; concrete vibrator; heater (power driven 1- 5); well point system (operating); syphon-pulsometer; concrete mixer; valves controlling permanent plant air or steam; conveyor; Jackson type tamper; single diaphragm pump; lighting plant

Group 4: Assistant engineer (fireman)

Group 5: Oiler (other than truck cranes and gradalls)

Group 6: Oiler (on truck cranes and gradalls) stant engineer (on truck crane and gradall)

* IRON0007-006 09/16/2019

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); 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, Wilmington)

Rates Fringes

Ironworkers:

AREA 1.....	\$ 47.39	32.81
AREA 2.....	\$ 42.98	32.81

* IRON0007-010 09/16/2019

MIDDLESEX (Ashby, Ashland, Ayer, Boxboro, Holliston, Hopkinton, Hudson, Marlboro, Shirley, Stow, Townsend); NORFOLK (Medway)

Rates Fringes

IRONWORKER.....	\$ 47.09	32.81
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* IRON0037-005 09/16/2019

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)

Rates Fringes

IRONWORKER.....	\$ 36.27	28.98
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LABO0014-001 06/01/2018

Rates Fringes

Plasterer tender

BARNSTABLE, BRISTOL, DUKES, ESSEX, NANTUCKET, MIDDLESEX (with the exception of Arlington, Belmont, Burlington, Cambridge, Everett, Malden, Medford, Melrose, Reading, Somerville, Stoneham, Wakefield, Winchester, Winthrop and Woburn); NORFOLK (with the exception of Brookline Dedham and Milton) COUNTIES.	\$ 33.25	22.92
SUFFOLK COUNTY (Boston, Chelsea, Revere, Winthrop, Deer Island, Nut Island); 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)....	\$ 38.00	24.10

 * LAB00022-009 06/01/2020

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.....	\$ 38.00	24.10
GROUP 1.....	\$ 39.15	27.04
Group 2.....	\$ 38.25	24.10
GROUP 2.....	\$ 39.40	27.04
Group 3.....	\$ 38.75	24.10
GROUP 3.....	\$ 39.90	27.04
Group 4.....	\$ 39.00	24.10
GROUP 4.....	\$ 40.15	27.04
Group 5.....	\$ 38.75	24.10
GROUP 5.....	\$ 39.90	27.04
Group 6.....	\$ 39.00	24.10
Group 7.....	\$ 21.50	24.10

LABORERS CLASSIFICATIONS

GROUP 1: Laborers; Carpenter Tenders

GROUP 2: Jackhammer operator; pavement breaker; asphalt raker carbide core drilling machine; chain saw operator; pipelayer; barco type jumping tampers; laser beam; concrete pump; mason tender; motorized mortar mixer; ride-on motorized buggy; fence and beam rail erector

GROUP 3: Air track, block paver; rammer; curb setter, hydraulic and similar self-powered drills

GROUP 4: Blaster; powderman

GROUP 5: Pre-cast floor and roof plank erector

GROUP 6: Asbestos removal laborers/haz-mat laborers

GROUP 7: Flaggers

 * LAB00022-010 06/01/2020

Counties of BARNSTABLE; BRISTOL; DUKES; ESSEX; NANTUCKET; MIDDLESEX (with the exception of Arlington, Belmont, Burlington, Cambridge, Everett, Malden, Medford, Melrose, Reading, Somerville, Stoneham, Wakfield, Winchester, Winthrop and Woburn); NORFOLK (with the exception of Brookline, Dedham and Milton)

	Rates	Fringes
Laborers:		
Group 1.....	\$ 33.25	22.92
GROUP 1.....	\$ 34.06	25.72
Group 2.....	\$ 33.50	22.92

GROUP 2.....	\$ 34.31	25.72
Group 3.....	\$ 34.00	22.92
GROUP 3.....	\$ 34.81	25.72
Group 4.....	\$ 34.25	22.92
GROUP 4.....	\$ 35.06	25.72
Group 5.....	\$ 34.00	22.92
GROUP 5.....	\$ 39.90	25.72
Group 6.....	\$ 34.25	22.92

LABORERS CLASSIFICATIONS

GROUP 1: Laborers; Carpenter Tenders

GROUP 2: Jackhammer operator; pavement breaker; asphalt raker carbide core drilling machine; chain saw operator; pipelayer; barco type jumping tampers; laser beam; concrete pump; mason tender; motorized mortar mixer; ride-on motorized buggy; fence and beam rail erector

GROUP 3: Air track, block paver; hammer; curb setter, hydraulic and similar self-powered drills

GROUP 4: Blaster; powderman

GROUP 5: Pre-cast floor and roof plank erector

GROUP 6: Asbestos removal laborers/haz-mat laborers

LAB01421-004 06/01/2018

BARNSTABLE, BRISTOL, DUKES, ESSEX, MIDDLESEX, NANTUCKET NORFOLK AND SUFFOLK COUNTIES

	Rates	Fringes
Laborers: (Wrecking)		
Group 1.....	\$ 38.15	24.10
Group 2.....	\$ 38.90	24.10
Group 3.....	\$ 39.15	24.10
Group 4.....	\$ 34.15	24.10
Group 5.....	\$ 37.25	24.10
Group 6.....	\$ 38.15	24.10

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.

* PAIN0011-007 06/01/2020

BARNSTABLE, BRISTOL, DUKES, AND NANTUCKET COUNTIES

	Rates	Fringes
GLAZIER.....	\$ 39.18	22.55+A

FOOTNOTE:

A. PAID HOLIDAY: LABOR DAY (provided employee has worked any

part of the week prior to Labor Day and any part of the week after Labor Day)

PAIN0035-004 01/01/2019

BARNSTABLE; BRISTOL; ESSEX; NANTUCKET; DUKES; COUNTIES;
REMAINDER OF NORFOLK; MIDDLESEX AND SUFFOLK COUNTIES

Rates Fringes

PAINTER

NEW CONSTRUCTION:

Brush, Taper.....\$ 39.86 30.25
Spray, Sandblast.....\$ 41.26 30.25

REPAINT:

Brush, Taper.....\$ 37.92 30.25
Spray, Sandblast.....\$ 39.32 30.25

PAIN0035-013 01/01/2019

MIDDLESEX (Cambridge, Everett, Malden, Medford, Somerville)
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:

Brush, Taper.....\$ 43.71 30.25
Spray, Sandblast.....\$ 45.11 30.25

PAIN0035-020 01/01/2019

ESSEX; MIDDLESEX; NORFOLK; SUFFOLK

Rates Fringes

GLAZIER.....\$ 39.86 30.25

* PLAS0534-001 01/01/2020

ESSEX; MIDDLESEX; NORFOLK AND SUFFOLK COUNTY

Rates Fringes

CEMENT MASON/CONCRETE FINISHER...\$ 43.00 37.66

* PLAS0534-004 01/01/2020

MIDDLESEX; NORFOLK AND SUFFOLK COUNTIES

Rates Fringes

PLASTERER.....\$ 43.00 37.66

* PLUM0004-001 03/01/2020

MIDDLESEX (Ashby, Ayer-West of Greenville branch of Boston and
Maine Railroad, Ft. Devens, Groton, Shirley, Townsend)

	Rates	Fringes
Plumbers and Pipefitters.....	\$ 46.16	26.61

PLUM0012-005 09/02/2019

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.....	\$ 53.61	30.43

PLUM0012-007 09/02/2019

ESSEX (Lynn, Lynnfield, Nahant, Saugus, and Swampscott); MIDDLESEX (Acton, Arlington, Ashford, Ayer-except west of Greenville Branch of Boston & Maine Rail Road, Bedford, Belmont, Billerica, Boxboro, Burlington, Cambridge, Carlise, 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, Watham, Watertown, Wayland, Westford, Wilmington, Winchester and Woburn), NORFOLK (Bellingham, Braintree, Brookline, Canton, Cohasset, Dedham, Dover, Foxboro, Franklin, Medford, Medway, Millis, Milton, Needham, Norfolk, Norwood, Plainville, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth and Wrentham); PLYMOUTH (Hingham, Hull, Scituate); SUFFOLK; WORCESTER (Hopedale and Southboro)

	Rates	Fringes
PLUMBER.....	\$ 57.59	30.43

PLUM0051-004 09/01/2018

BARNSTABLE; BRISTOL; DUKES; NANTUCKET; AND NORFOLK (Avon, Holbrook, Randolph, Stoughton) COUNTIES

	Rates	Fringes
Plumbers and Pipefitters.....	\$ 42.04	29.91

* PLUM0537-005 03/01/2020

ESSEX (Ames, Andover, Beverly, Boxford, Byfield, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence, Lynn, Lynnfield, Manchester, Marblehead, Merrimac, Methuen, Middleton, Nahant, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salem, Salisbury, Saugus, Swampscott, Topsfield, Wenham, West Newbury); MIDDLESEX (Acton, Arlington, Ashford, Ayer-except west of Greenville Branch of Boston & Maine Rail Road, Bedford, Belmont, Billerica, Boxboro, Burlington, Cambridge, Carlise, 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, Watham, Watertown, Wayland, Westford, Wilmington, Winchester and Woburn); NORFOLK (Bellingham, Braintree, Brookline, Canton, Cohasset, Dedham, Dover, Foxboro, Franklin, Medford, Medway, Millis, Milton, Needham, Norfolk, Norwood, Plainville, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth and Wrentham); PLYMOUTH (Hingham, Hull, Scituate); SUFFOLK; WORCHESTER (Hopedale and Southboro)

	Rates	Fringes
PIPEFITTER.....	\$ 54.94	34.21

* ROOF0033-001 03/01/2020

	Rates	Fringes
Roofers: All Tear-off and/or removal of any types of roofing and all spudding, sweeping, vacuuming and/or cleanup of any and all areas of any type where a roof is to be relaid.....	\$ 45.67	28.25

SFMA0550-001 01/01/2020

BRISTOL (Portion within 35 mile radius from Boston City Hall; ESSEX; MIDDLESEX (Except Ashby, Townsend, and portions of Pepperell and Shirley beyond 35 mile radius from Boston City Hall); NORFOLK; PLYMOUTH (Portion within 35 mile radius of Boston City Hall); SUFFOLK

	Rates	Fringes
SPRINKLER FITTER.....	\$ 60.07	30.29+a

a. PAID HOLIDAYS: Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas Day, provided the employee has been in the employment of a contractor 20 working days prior to any such paid holiday.

SFMA0550-002 01/01/2020

BRISTOL (Seekonk, Swansea, and Somerset)

	Rates	Fringes
SPRINKLER FITTER.....	\$ 54.06	30.29+a

a. PAID HOLIDAYS: Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas Day, provided the employee has been in the employment of a contractor 20 working days prior to any such paid holiday.

* SFMA0669-001 04/01/2020

BARNSTABLE; BRISTOL (Beyond 35 mile radius of Boston City Hall); DUKES; MIDDLESEX (Ashby, Townsend, portions of Pepperell and Shirley beyond 35 mile radius of Boston City Hall); NANTUCKET; PLYMOUTH (Beyond 35 mile radius of Boston City Hall)

	Rates	Fringes
SPRINKLER FITTER.....	\$ 41.61	36.86

* SHEE0017-003 02/01/2020

BRISTOL (Attleboro, Berkley, Easton, Mansfield, North Attleboro, Norton, Raynham, Taunton); ESSEX; MIDDLESEX; NORFOLK; PLYMOUTH (except except Marion, Mattapoisett, Rochester, Wareham); SUFFOLK

	Rates	Fringes
Sheet metal worker.....	\$ 49.36	44.03

* SHEE0017-007 02/01/2020

BARNSTABLE; BRISTOL (Acushnet, Assonet, Dartmouth, Dighton, Fairhaven, Fall River, Freetown, New Bedford, Rehoboth, Seekonk, Somerset, Swansea, Westport); DUKES; AND NANTUCKET

	Rates	Fringes
Sheet metal worker.....	\$ 49.36	44.03

TEAM0379-001 06/01/2019

	Rates	Fringes
Truck drivers:		
Group 1.....	\$ 34.08	25.1125+A+B
Group 2.....	\$ 34.25	25.1125+A+B
Group 3.....	\$ 34.32	25.1125+A+B
Group 4.....	\$ 34.44	25.1125+A+B
Group 5.....	\$ 34.54	25.1125+A+B
Group 6.....	\$ 34.83	25.1125+A+B
Group 7.....	\$ 35.12	25.1125+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

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 www.dol.gov/whd/govcontracts.

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 Regional Office for the area in which the survey was conducted because those Regional Offices have 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 DECISION"

ATTACHMENT C

Massachusetts Equal Employment Opportunity Package

**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) 5.9%

Disadvantaged WBE (D/WBE) 6.4%

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 DBEs 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.

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)

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

- | | |
|---|--|
| <input type="checkbox"/> An individual | <input type="checkbox"/> A partnership |
| <input type="checkbox"/> A corporation | <input type="checkbox"/> A joint venture with: _____ |
| <input type="checkbox"/> Other (explain): _____ | |

° 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
		\$	%

° 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	(Authorized Original Signature)	Date
ADDRESS:		ADDRESS:	
TELEPHONE #:		TELEPHONE #:	
FEIN:		FEIN:	
EMAIL ADDRESS:		EMAIL ADDRESS:	

ORIGINALS:

- ° Compliance Mgr. City/Town Project Location
- ° DEP Program Manager for DEP's AAO Director

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

EEO-DEP-191C

EEO-DEP-E Page 11 of 16

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

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. _____

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;

- 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

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;
- 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
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)

3. Concrete cradle or encasement
(to be identified where applicable)

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:

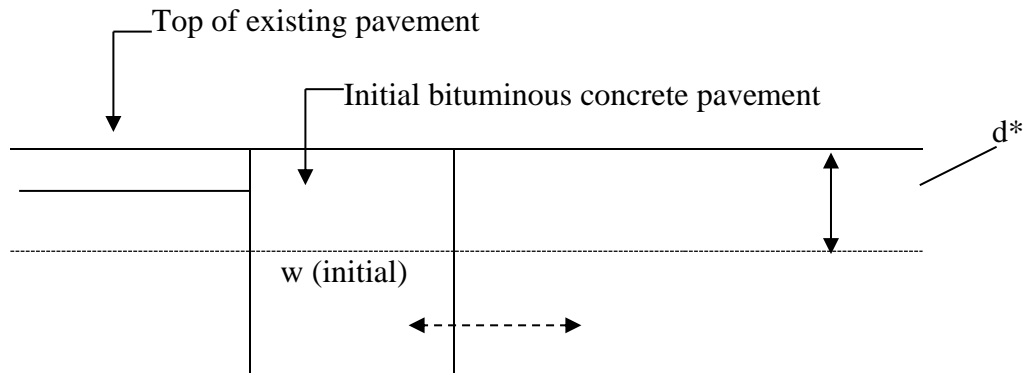
<u>Nominal Pipe Diameter</u>	<u>Maximum Eligible Widths</u>	
	<u>Initial Pavement</u>	<u>Permanent Trench</u>
0-24”	6’-6”	8’-6”

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.

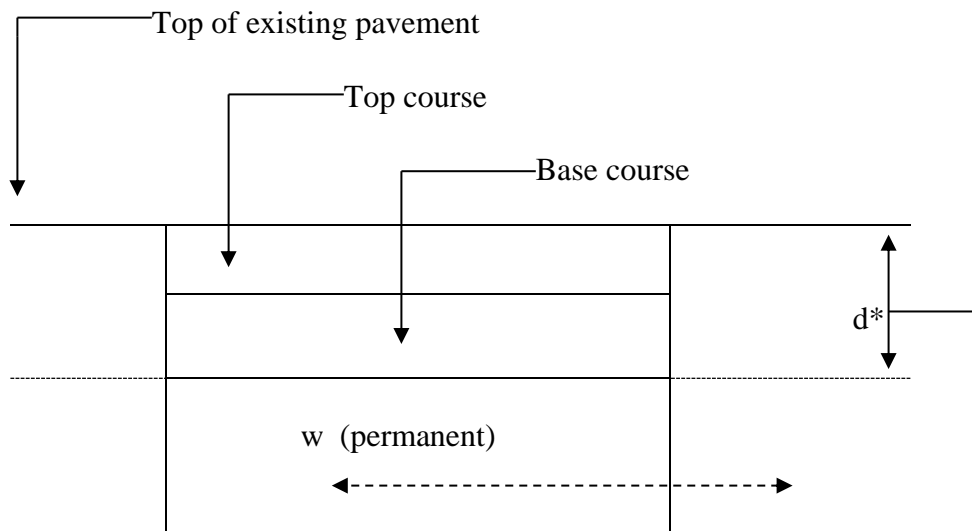
At the design phase of a project the owner has the option to elect either Initial Pavement with Option I (Permanent Trench replacement) or Initial with Option II (curb to curb over initial)

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.

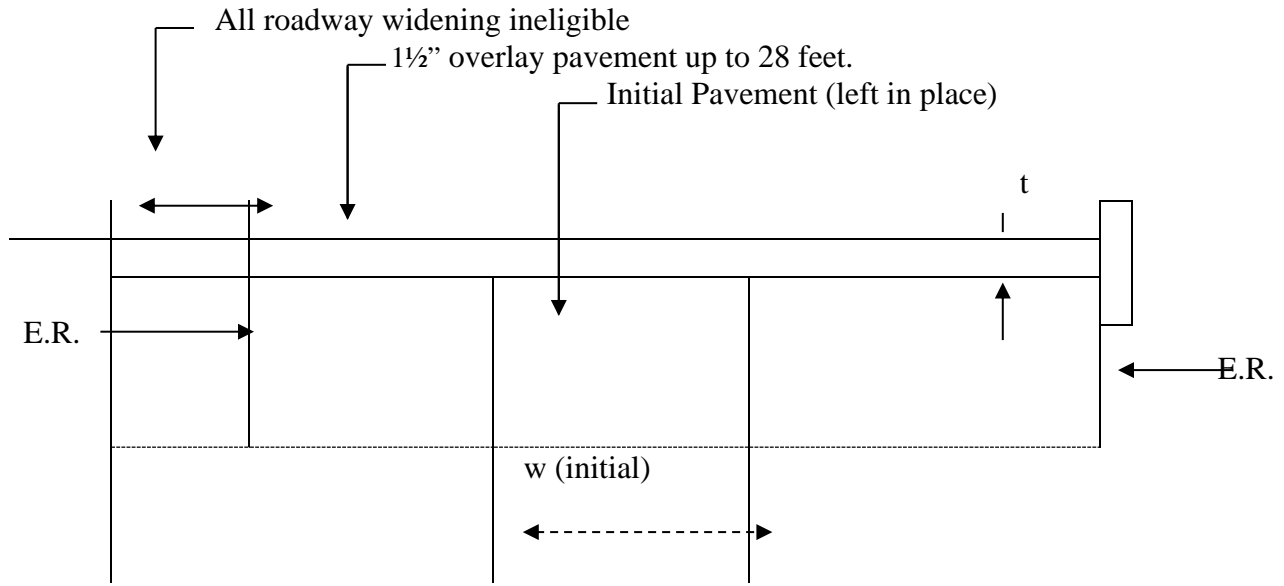
OPTION I Permanent Trench Pavement



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.

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 (1 1/2") 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 therefore 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.

POLICY 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.

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.
- D. 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 If applied to any required
 - Builders Risk Insurance direct labor costs.
 - Experience Modification Insurance
 - Surcharges

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.

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

Do not write below: this space reserved for STATE AGENCY APPROVAL

CHANGE ORDER FORM (Continued)

Public Entity _____

SRF No: _____ Contract No. _____ Change Order No. _____

Contract Title: _____

Owner's Name: _____

Owner's Address: _____

Contractor's Name: _____

Contractor's Address: _____

Description of Change

Reason for Change

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		<u>168.00</u>
				\$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)			<u>25.00</u>
				2,025.00
(4)	Equipment			
	1 Backhoe	10 hrs @ \$80.00/hr	\$	800.00
	1 Truck-crane	10 hrs @ \$100.00/hr		<u>1,000.00</u>
				<u>1,800.00</u>
		Total (Items 1 through 4)		4,407.00
(5)	20% markup for Overhead, Profit			
	20% of \$4,407			881.00
(6)	7 ½% markup for general contractor (if subcontractor is involved)			
	7 ½% of \$4,407			331.00
(7)	Credits (deductibles)			<u>- 323.00</u>
		Total Cost	\$	5,296.00

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 stations, 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;

Policy Memorandum No. CG-13 – Bid Opening Procedures (Con't)

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

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)	
						YES	NO
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) _____

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
		Yes	No; Rejected	
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	All addenda acknowledge Any alternative	Yes	No; Rejected	
5. Dollar Amount	Dollar amount in words Specified for each line item in bid	Yes	No; Rejected	

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.

<u>Depth From Ground Surface</u>	<u>Pay Width</u>	
<u>To Invert Pipe</u>	<u>(Nominal Pipe Diameter)</u>	
	<u>0-24”</u>	<u>Over 24”</u>
* 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.

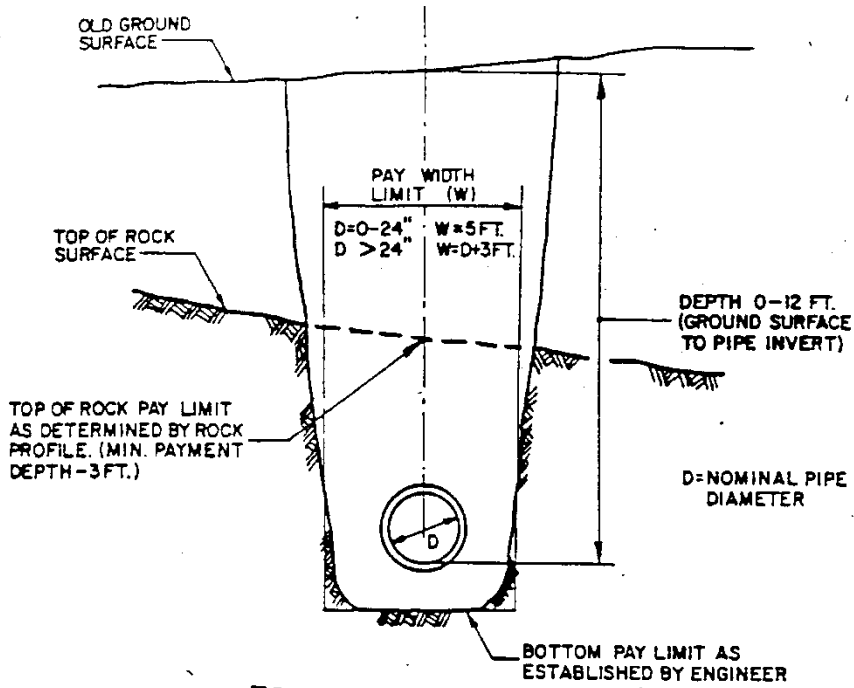
The pay limit for rock removal outside proposed manholes shall commence one foot (1’) outside the widest dimension of the structure of shall be the maximum connecting trench width, whichever is greater.

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.

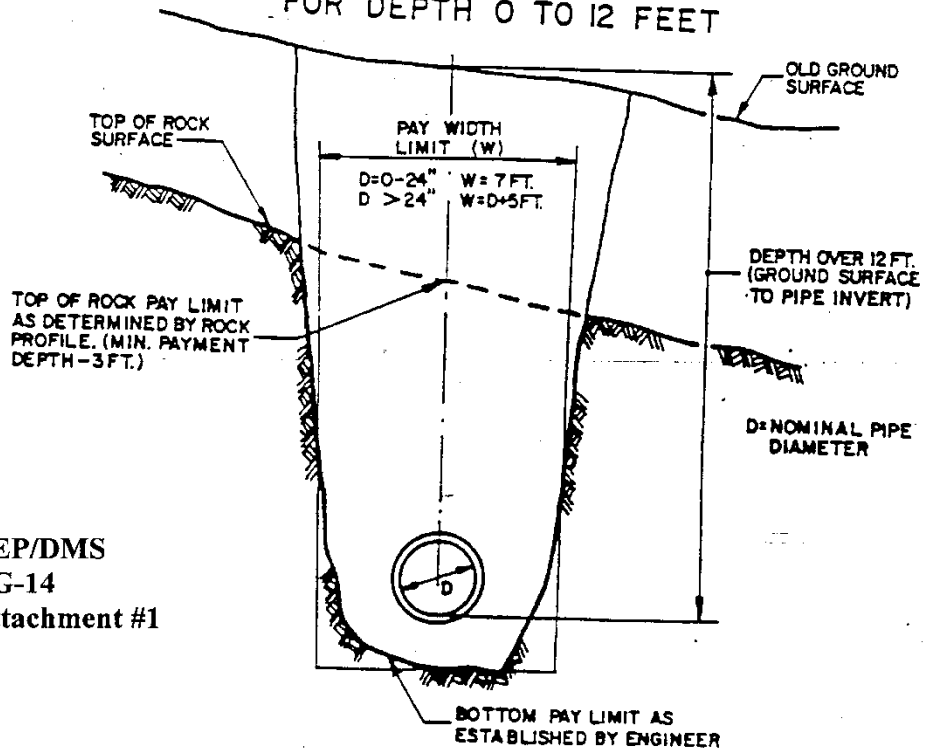
Payment for rock removed, using the same or equal equipment as utilized for normal trench excavation, shall be limited to the actual depth removed within the limits established by the contract documents.

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 QUANITITES**

<u>Unit</u>	<u>Documentation required</u>
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.

Note:

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:

Steven J. McCurdy
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 assemblies. 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 Data 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:

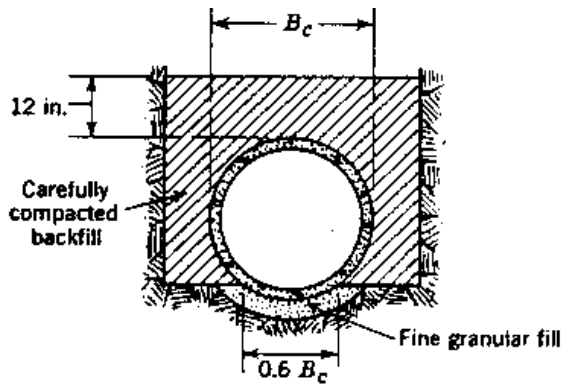
- (1)the location of all nearby existing or potential surface water supplies, tributaries thereto, and watershed boundaries;
- (2)the location of existing and potential public and municipal potable groundwater supply wells.

The Department reserves the right to impose more restrictive measures than those contained in this policy as deemed appropriate.

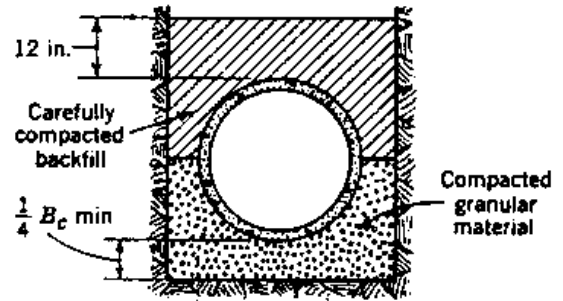
Definitions

- 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.

Davis Bacon Act Requirements

All construction projects are subject to the Davis Bacon wage rate requirements and must include the appropriate sections of the following document in its entirety in the contract documents.

The vast majority of SRF projects will be bid by Governmental Entities (i.e., Cities, Towns, Authorities, Water Districts, Wastewater Districts). These projects must include the following language in construction contracts:

I.3. Contract and Subcontract Provisions

I.4. Contract Provisions for Contracts in Excess of \$100,000 (if applicable)

I.5. Compliance Verification

This language may be found on pages DB-3-DB-11.

In certain cases, SRF projects may be bid by non-Governmental Entities (i.e., private water companies, private PWSs, etc.). These projects must include the following language in construction contracts:

II.3. Contract and Subcontract Provisions

II.4. Contract Provisions for Contracts in Excess of \$100,000 (if applicable)

II.5. Compliance Verification

This language may be found on pages DB-11-DB-21

Preamble

With respect to the Clean Water and Safe Drinking Water State revolving Funds, EPA provides capitalization grants to each State which in turn provides subgrants or loans to eligible entities within the State. Typically, the subrecipients are municipal or other local governmental entities that manage the funds. For these types of recipients, the provisions set forth under Roman Numeral I, below, shall apply. Although EPA and the State remain responsible for ensuring subrecipients' compliance with the wage rate requirements set forth herein, those subrecipients shall have the primary responsibility to maintain payroll records as described in Section 3(ii)(A), below and for compliance as described in Section I-5.

Occasionally, the subrecipient may be a private for profit or not for profit entity. For these types of recipients, the provisions set forth in Roman Numeral II, below, shall apply. Although EPA and the State remain responsible for ensuring subrecipients' compliance with the wage rate requirements set forth herein, those subrecipients shall have the primary responsibility to maintain payroll records as described in Section II-3(ii)(A), below and for compliance as described in Section II-5.

I. Requirements For Subrecipients That Are Governmental Entities:

The following terms and conditions specify how recipients will assist EPA in meeting its Davis-Bacon (DB) responsibilities when DB applies to EPA awards of financial assistance with respect to State recipients and subrecipients that are governmental entities. If a subrecipient has

questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State recipient. If a State recipient needs guidance, the recipient may contact Valerie Marshall at EPA Region 1 (617-918-1674) for guidance. The recipient or subrecipient may also obtain additional guidance from DOL's web site at <https://www.dol.gov/whd/govcontracts/dbra.htm>

1. Applicability of the Davis- Bacon (DB) prevailing wage requirements.

DB prevailing wage requirements apply to the construction, alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the recipient State before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov weekly to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.

(ii) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(b) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(c) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(d) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the subrecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

3. Contract and Subcontract provisions.

(a) The Recipient shall insure that the subrecipient(s) shall insert in full in any contract in excess of \$2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the FY 2012 Appropriations Act, the following clauses:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in §5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein:

Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, www.dol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

- (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
- (2) The classification is utilized in the area by the construction industry; and
- (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient (s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <https://www.dol.gov/whd/forms/wh347.pdf> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

- (5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.
- (6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.
- (7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.
- (8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.
- (9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29

CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

4. Contract Provision for Contracts in Excess of \$100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (a)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other

Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

5. Compliance Verification

(a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its

assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at https://www.dol.gov/whd/whd_district_offices.pdf.

II. Requirements For Subrecipients That Are Not Governmental Entities

The following terms and conditions specify how recipients will assist EPA in meeting its DB responsibilities when DB applies to EPA awards of financial assistance with respect to subrecipients that are not governmental entities. If a subrecipient has questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State recipient for guidance. If a State recipient needs guidance, the recipient may contact Valerie Marshall at EPA Region 1 (617-918-1674) for guidance. The recipient or subrecipient may also obtain additional guidance from DOL's web site at <https://www.dol.gov/whd/govcontracts/dbra.htm>

Under these terms and conditions, the subrecipient must submit its proposed DB wage determinations to the State recipient for approval prior to including the wage determination in any solicitation, contract task orders, work assignments, or similar instruments to existing contractors.

1. Applicability of the Davis- Bacon (DB) prevailing wage requirements.

DB prevailing wage requirements apply to the construction, alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the recipient State before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Subrecipients must obtain proposed wage determinations for specific localities at www.wdol.gov. After the Subrecipient obtains its proposed wage determination, it must submit the wage determination to (insert contact information for State recipient DB point of contact for wage determination) for approval prior to inserting the wage determination into a solicitation, contract or issuing task orders, work assignments or similar instruments to existing contractors (ordering instruments unless subsequently directed otherwise by the State recipient Award Official).

(b) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov on a weekly basis to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.

(ii) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(c) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(d) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(e) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the subrecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

3. Contract and Subcontract provisions.

(a) The Recipient shall insure that the subrecipient(s) shall insert in full in any contract in excess of \$2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the FY 2011 Full-Year Continuing Appropriation, the following clauses:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in §5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, www.dol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient(s) to the State award official. The State award official will transmit the report, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request, and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s) shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is

available for this purpose from the Wage and Hour Division Web site at <https://www.dol.gov/whd/forms/wh347.pdf> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

- (1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;
- (2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;
- (3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of

fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

4. Contract Provision for Contracts in Excess of \$100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient shall upon the request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

(c) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

5. Compliance Verification

(a). The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c). The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB . In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d). The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at https://www.dol.gov/whd/whd_district_offices.pdf.

APPENDIX I

AMERICAN IRON AND STEEL REQUIREMENTS



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 20 2014

OFFICE OF WATER

MEMORANDUM

SUBJECT: Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014

FROM: Andrew D. Sawyer, Director
Office of Wastewater Management (4201M)

Peter C. Grevatt, Director
Office of Ground Water and Drinking Water (4601M)

TO: Water Management Division Directors
Regions I - X

P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an "American Iron and Steel (AIS)" requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works if the project is funded through an assistance agreement executed beginning January 17, 2014 (enactment of the Act), through the end of Federal Fiscal Year 2014.

Section 436 also sets forth certain circumstances under which EPA may waive the AIS requirement. Furthermore, the Act specifically exempts projects where engineering plans and specifications were approved by a State agency prior to January 17, 2014.

The approach described below explains how EPA will implement the AIS requirement. The first section is in the form of questions and answers that address the types of projects that must comply with the AIS requirement, the types of products covered by the AIS requirement, and compliance. The second section is a step-by-step process for requesting waivers and the circumstances under which waivers may be granted.

Implementation

The Act states:

Sec. 436 (a)(1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term “iron and steel products” means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the “Administrator”) finds that—

(1) applying subsection (a) would be inconsistent with the public interest;

(2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

(3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

(e) The Administrator may retain up to 0.25 percent of the funds appropriated in this Act for the Clean and Drinking Water State Revolving Funds for carrying out the provisions described in subsection (a)(1) for management and oversight of the requirements of this section.

(f) This section does not apply with respect to a project if a State agency approves the engineering plans and specifications for the project, in that agency's capacity to approve such plans and specifications prior to a project requesting bids, prior to the date of the enactment of this Act.

The following questions and answers provide guidance for implementing and complying with the AIS requirements:

Project Coverage

1) What classes of projects are covered by the AIS requirement?

All treatment works projects funded by a CWSRF assistance agreement, and all public water system projects funded by a DWSRF assistance agreement, from the date of enactment through the end of Federal Fiscal Year 2014, are covered. The AIS requirements apply to the entirety of the project, no matter when construction begins or ends. Additionally, the AIS requirements apply to all parts of the project, no matter the source of funding.

2) Does the AIS requirement apply to nonpoint source projects or national estuary projects?

No. Congress did not include an AIS requirement for nonpoint source and national estuary projects unless the project can also be classified as a 'treatment works' as defined by section 212 of the Clean Water Act.

3) Are any projects for the construction, alteration, maintenance, or repair of a public water system or treatment works excluded from the AIS requirement?

Any project, whether a treatment works project or a public water system project, for which engineering plans and specifications were approved by the responsible state agency prior to January 17, 2014, is excluded from the AIS requirements.

4) What if the project does not have approved engineering plans and specifications but has signed an assistance agreement with a CWSRF or DWSRF program prior to January 17, 2014?

The AIS requirements do not apply to any project for which an assistance agreement was signed prior to January 17, 2014.

5) What if the project does not have approved engineering plans and specifications, but bids were advertised prior to January 17, 2014 and an assistance agreement was signed after January 17, 2014?

If the project does not require approved engineering plans and specifications, the bid advertisement date will count in lieu of the approval date for purposes of the exemption in section 436(f).

6) What if the assistance agreement that was signed prior to January 17, 2014, only funded a part of the overall project, where the remainder of the project will be funded later with another SRF loan?

If the original assistance agreement funded any construction of the project, the date of the original assistance agreement counts for purposes of the exemption. If the original assistance agreement was only for planning and design, the date of that assistance agreement will count for purposes of the exemption only if there is a written commitment or expectation on the part of the assistance recipient to fund the remainder of the project with SRF funds.

7) What if the assistance agreement that was signed prior to January 17, 2014, funded the first phase of a multi-phase project, where the remaining phases will be funded by SRF assistance in the future?

In such a case, the phases of the project will be considered a single project if all construction necessary to complete the building or work, regardless of the number of contracts or assistance agreements involved, are closely related in purpose, time and place. However, there are many situations in which major construction activities are clearly undertaken in phases that are distinct in purpose, time, or place. In the case of distinct phases, projects with engineering plans and specifications approval or assistance agreements signed prior to January 17, 2014 would be excluded from AIS requirements while those approved/signed on January 17, 2014, or later would be covered by the AIS requirements.

8) What if a project has split funding from a non-SRF source?

Many States intend to fund projects with “split” funding, from the SRF program and from State or other programs. Based on the Act language in section 436, which requires that American iron and steel products be used in any project for the construction, alteration, maintenance, or repair of a public water system or treatment works receiving SRF funding between and including January 17, 2014 and September 30, 2014, any project that is funded in whole or in part with such funds must comply with the AIS requirement. A “project” consists of all construction necessary to complete the building or work regardless of the number of contracts or assistance agreements involved so long as all contracts and assistance agreements awarded are closely related in purpose, time and place. This precludes the intentional splitting of SRF projects into separate and smaller contracts or assistance agreements to avoid AIS coverage on some portion of a larger project, particularly where the activities are integrally and proximately related to the whole. However, there are many situations in which major construction activities are clearly undertaken in separate phases that are distinct in purpose, time, or place, in which case, separate contracts or assistance agreement for SRF and State or other funding would carry separate requirements.

9) What about refinancing?

If a project began construction, financed from a non-SRF source, prior to January 17, 2014, but is refinanced through an SRF assistance agreement executed on or after January 17, 2014 and prior to October 1, 2014, AIS requirements will apply to all construction that occurs on or after January 17, 2014, through completion of construction, unless, as is likely, engineering plans and specifications were approved by a responsible state agency prior to January 17, 2014. There is no retroactive application of the AIS requirements where a refinancing occurs for a project that has completed construction prior to January 17, 2014.

10) Do the AIS requirements apply to any other EPA programs, besides the SRF program, such as the Tribal Set-aside grants or grants to the Territories and DC?

No, the AIS requirement only applies to funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12)

Covered Iron and Steel Products

11) What is an iron or steel product?

For purposes of the CWSRF and DWSRF projects that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the public water system or treatment works:

- Lined or unlined pipes or fittings;
- Manhole Covers;
- Municipal Castings (defined in more detail below);
- Hydrants;
- Tanks;
- Flanges;
- Pipe clamps and restraints;
- Valves;
- Structural steel (defined in more detail below);
- Reinforced precast concrete; and
- Construction materials (defined in more detail below).

12) What does the term ‘primarily iron or steel’ mean?

‘Primarily iron or steel’ places constraints on the list of products above. For one of the listed products to be considered subject to the AIS requirements, it must be made of

greater than 50% iron or steel, measured by cost. The cost should be based on the material costs.

13) Can you provide an example of how to perform a cost determination?

For example, the iron portion of a fire hydrant would likely be the bonnet, body and shoe, and the cost then would include the pouring and casting to create those components. The other material costs would include non-iron and steel internal workings of the fire hydrant (i.e., stem, coupling, valve, seals, etc). However, the assembly of the internal workings into the hydrant body would not be included in this cost calculation. If one of the listed products is not made primarily of iron or steel, United States (US) provenance is not required. An exception to this definition is reinforced precast concrete, which is addressed in a later question.

14) If a product is composed of more than 50% iron or steel, but is not listed in the above list of items, must the item be produced in the US? Alternatively, must the iron or steel in such a product be produced in the US?

The answer to both question is no. Only items on the above list must be produced in the US. Additionally, the iron or steel in a non-listed item can be sourced from outside the US.

15) What is the definition of steel?

Steel means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel and other specialty steels.

16) What does ‘produced in the United States’ mean?

Production in the United States of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

17) Are the raw materials used in the production of iron or steel required to come from US sources?

No. Raw materials, such as iron ore, limestone, scrap iron, and scrap steel, can come from non-US sources.

18) If an above listed item is primarily made of iron or steel, but is only at the construction site temporarily, must such an item be produced in the US?

No. Only the above listed products made primarily of iron or steel, permanently incorporated into the project must be produced in the US. For example trench boxes, scaffolding or equipment, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

19) What is the definition of ‘municipal castings’?

Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings are:

- Access Hatches;
- Ballast Screen;
- Benches (Iron or Steel);
- Bollards;
- Cast Bases;
- Cast Iron Hinged Hatches, Square and Rectangular;
- Cast Iron Riser Rings;
- Catch Basin Inlet;
- Cleanout/Monument Boxes;
- Construction Covers and Frames;
- Curb and Corner Guards;
- Curb Openings;
- Detectable Warning Plates;
- Downspout Shoes (Boot, Inlet);
- Drainage Grates, Frames and Curb Inlets;
- Inlets;
- Junction Boxes;
- Lampposts;
- Manhole Covers, Rings and Frames, Risers;
- Meter Boxes;
- Service Boxes;
- Steel Hinged Hatches, Square and Rectangular;
- Steel Riser Rings;
- Trash receptacles;
- Tree Grates;

Tree Guards;
Trench Grates; and
Valve Boxes, Covers and Risers.

20) What is ‘structural steel’?

Structural steel is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

21) What is a ‘construction material’ for purposes of the AIS requirement?

Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered “structural steel”. This includes, but is not limited to, the following products: wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), welding rods, decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors, and stationary screens.

22) What is not considered a ‘construction material’ for purposes of the AIS requirement?

Mechanical and electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples (including their appurtenances necessary for their intended use and operation) are NOT considered construction materials: pumps, motors, gear reducers, drives (including variable frequency drives (VFDs)), electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators), mixers, gates, motorized screens (such as traveling screens), blowers/aeration equipment, compressors, meters, sensors, controls and switches, supervisory control and data acquisition (SCADA), membrane bioreactor systems, membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, analytical instrumentation, and dewatering equipment.

23) If the iron or steel is produced in the US, may other steps in the manufacturing process take place outside of the US, such as assembly?

No. Production in the US of the iron or steel used in a listed product requires that all manufacturing processes must take place in the United States, except metallurgical processes involving refinement of steel additives.

24) What processes must occur in the US to be compliant with the AIS requirement for reinforced precast concrete?

While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing bar and wire must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin.

If the reinforced concrete is cast at the construction site, the reinforcing bar and wire are considered to be a construction material and must be produced in the US.

Compliance

25) How should an assistance recipient document compliance with the AIS requirement?

In order to ensure compliance with the AIS requirement, specific AIS contract language must be included in each contract, starting with the assistance agreement, all the way down to the purchase agreements. Sample language for assistance agreements and contracts can be found in Appendix 3 and 4.

EPA recommends the use of a step certification process, similar to one used by the Federal Highway Administration. The step certification process is a method to ensure that producers adhere to the AIS requirement and assistance recipients can verify that products comply with the AIS requirement. The process also establishes accountability and better enables States to take enforcement actions against violators.

Step certification creates a paper trail which documents the location of the manufacturing process involved with the production of steel and iron materials. A step certification is a process under which each handler (supplier, fabricator, manufacturer, processor, etc) of the iron and steel products certifies that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin. A certification can be quite simple. Typically, it includes the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. Attached, as Appendix 5, are sample certifications. These certifications should be collected and maintained by assistance recipients.

Alternatively, the final manufacturer that delivers the iron or steel product to the worksite, vendor, or contractor, may provide a certification asserting that all manufacturing processes occurred in the US. While this type of certification may be acceptable, it may not provide the same degree of assurance. Additional documentation may be needed if the certification is lacking important information. Step certification is the best practice.

26) How should a State ensure assistance recipients are complying with the AIS requirement?

In order to ensure compliance with the AIS requirement, States SRF programs must include specific AIS contract language in the assistance agreement. Sample language for assistance agreements can be found in Appendix 3.

States should also, as a best practice, conduct site visits of projects during construction and review documentation demonstrating proof of compliance which the assistance recipient has gathered.

27) What happens if a State or EPA finds a non-compliant iron and/or steel product permanently incorporated in the project?

If a potentially non-compliant product is identified, the State should notify the assistance recipient of the apparent unauthorized use of the non-domestic component, including a proposed corrective action, and should be given the opportunity to reply. If unauthorized use is confirmed, the State can take one or more of the following actions: request a waiver where appropriate; require the removal of the non-domestic item; or withhold payment for all or part of the project. Only EPA can issue waivers to authorize the use of a non-domestic item. EPA may use remedies available to it under the Clean Water Act, the Safe Drinking Water Act, and 40 CFR part 31 grant regulations, in the event of a violation of a grant term and condition.

It is recommended that the State work collaboratively with EPA to determine the appropriate corrective action, especially in cases where the State is the one who identifies the item in noncompliance or there is a disagreement with the assistance recipient.

If fraud, waste, abuse, or any violation of the law is suspected, the Office of Inspector General (OIG) should be contacted immediately. The OIG can be reached at 1-888-546-8740 or OIG_Hotline@epa.gov. More information can be found at this website: <http://oig.hhs.gov/fraud/report-fraud/>

28) How do international trade agreements affect the implementation of the AIS requirements?

The AIS provision applies in a manner consistent with United States obligations under international agreements. Typically, these obligations only apply to direct procurement by the entities that are signatories to such agreements. In general, SRF

assistance recipients are not signatories to such agreements, so these agreements have no impact on this AIS provision. In the few instances where such an agreement applies to a municipality, that municipality is under the obligation to determine its applicability and requirements and document the actions taken to comply for the State.

Waiver Process

The statute permits EPA to issue waivers for a case or category of cases where EPA finds (1) that applying these requirements would be inconsistent with the public interest; (2) iron and steel products are not produced in the US in sufficient and reasonably available quantities and of a satisfactory quality; or (3) inclusion of iron and steel products produced in the US will increase the cost of the overall project by more than 25 percent.

In order to implement the AIS requirements, EPA has developed an approach to allow for effective and efficient implementation of the waiver process to allow projects to proceed in a timely manner. The framework described below will allow States, on behalf of the assistance recipients, to apply for waivers of the AIS requirement directly to EPA Headquarters. Only waiver requests received from states will be considered. Pursuant to the Act, EPA has the responsibility to make findings as to the issuance of waivers to the AIS requirements.

Definitions

The following terms are critical to the interpretation and implementation of the AIS requirements and apply to the process described in this memorandum:

Reasonably Available Quantity: The quantity of iron or steel products is available or will be available at the time needed and place needed, and in the proper form or specification as specified in the project plans and design.

Satisfactory Quality: The quality of iron or steel products, as specified in the project plans and designs.

Assistance Recipient: A borrower or grantee that receives funding from a State CWSRF or DWSRF program.

Step-By-Step Waiver Process

Application by Assistance Recipient

Each local entity that receives SRF water infrastructure financial assistance is required by section 436 of the Act to use American made iron and steel products in the construction of its project. However, the recipient may request a waiver. Until a waiver is granted by EPA, the AIS requirement stands, except as noted above with respect to municipalities covered by international agreements.

The waiver process begins with the SRF assistance recipient. In order to fulfill the AIS requirement, the assistance recipient must in good faith design the project (where applicable) and solicit bids for construction with American made iron and steel products. It is essential that the assistance recipient include the AIS terms in any request for proposals or solicitations for bids, and in all contracts (see Appendix 3 for sample construction contract language). The assistance recipient may receive a waiver at any point before, during, or after the bid process, if one or more of three conditions is met:

1. Applying the American Iron and Steel requirements of the Act would be inconsistent with the public interest;
2. Iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
3. Inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Proper and sufficient documentation must be provided by the assistance recipient. A checklist detailing the types of information required for a waiver to be processed is attached as Appendix 1.

Additionally, it is strongly encouraged that assistance recipients hold pre-bid conferences with potential bidders. A pre-bid conference can help to identify iron and steel products needed to complete the project as described in the plans and specifications that may not be available from domestic sources. It may also identify the need to seek a waiver prior to bid, and can help inform the recipient on compliance options.

In order to apply for a project waiver, the assistance recipient should email the request in the form of a Word document (.doc) to the State SRF program. It is strongly recommended that the State designate a single person for all AIS communications. The State SRF designee will review the application for the waiver and determine whether the necessary information has been included. Once the waiver application is complete, the State designee will forward the application to either of two email addresses. For CWSRF waiver requests, please send the application to: cwsrfwaiver@epa.gov. For DWSRF waiver requests, please send the application to: dwsrfwaiver@epa.gov.

Evaluation by EPA

After receiving an application for waiver of the AIS requirements, EPA Headquarters will publish the request on its website for 15 days and receive informal comment. EPA Headquarters will then use the checklist in Appendix 2 to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver – that it is quantitatively and qualitatively sufficient – and to determine whether or not to grant the waiver.

In the event that EPA finds that adequate documentation and justification has been submitted, the Administrator may grant a waiver to the assistance recipient. EPA will notify the State designee that a waiver request has been approved or denied as soon as such a decision has been made. Granting such a waiver is a three-step process:

1. Posting – After receiving an application for a waiver, EPA is required to publish the application and all material submitted with the application on EPA’s website for 15 days. During that period, the public will have the opportunity to review the request and provide informal comment to EPA. The website can be found at: http://water.epa.gov/grants_funding/aisrequirement.cfm
2. Evaluation – After receiving an application for waiver of the AIS requirements, EPA Headquarters will use the checklist in Appendix 2 to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver – that it is quantitatively and qualitatively sufficient – and to determine whether or not to grant the waiver.
3. Signature of waiver approval by the Administrator or another agency official with delegated authority – As soon as the waiver is signed and dated, EPA will notify the State SRF program, and post the signed waiver on our website. The assistance recipient should keep a copy of the signed waiver in its project files.

Public Interest Waivers

EPA has the authority to issue public interest waivers. Evaluation of a public interest waiver request may be more complicated than that of other waiver requests so they may take more time than other waiver requests for a decision to be made. An example of a public interest waiver that might be issued could be for a community that has standardized on a particular type or manufacturer of a valve because of its performance to meet their specifications. Switching to an alternative valve may require staff to be trained on the new equipment and additional spare parts would need to be purchased and stocked, existing valves may need to be unnecessarily replaced, and portions of the system may need to be redesigned. Therefore, requiring the community to install an alternative valve would be inconsistent with public interest.

EPA also has the authority to issue a public interest waiver that covers categories of products that might apply to all projects.

EPA reserves the right to issue national waivers that may apply to particular classes of assistance recipients, particular classes of projects, or particular categories of iron or steel products. EPA may develop national or (US geographic) regional categorical waivers through the identification of similar circumstances in the detailed justifications presented to EPA in a waiver request or requests. EPA may issue a national waiver based on policy decisions regarding the public’s interest or a determination that a particular item is not produced domestically in reasonably available quantities or of a sufficient quality. In such cases, EPA may determine it is necessary to issue a national waiver.

If you have any questions concerning the contents of this memorandum, you may contact us, or have your staff contact Jordan Dorfman, Attorney-Advisor, State Revolving Fund Branch, Municipal Support Division, at dorfman.jordan@epa.gov or (202) 564-0614 or Kiri Anderer, Environmental Engineer, Infrastructure Branch, Drinking Water Protection Division, at anderer.kirsten@epa.gov or (202) 564-3134.

Attachments

Attachment 1: Information Checklist for Waiver Request

The purpose of this checklist is to help ensure that all appropriate and necessary information is submitted to EPA. EPA recommends that States review this checklist carefully and provide all appropriate information to EPA. This checklist is for informational purposes only and does not need to be included as part of a waiver application.

Items	✓	Notes
<p>General</p> <ul style="list-style-type: none"> • Waiver request includes the following information: <ul style="list-style-type: none"> — Description of the foreign and domestic construction materials — Unit of measure — Quantity — Price — Time of delivery or availability — Location of the construction project — Name and address of the proposed supplier — A detailed justification for the use of foreign construction materials • Waiver request was submitted according to the instructions in the memorandum • Assistance recipient made a good faith effort to solicit bids for domestic iron and steel products, as demonstrated by language in requests for proposals, contracts, and communications with the prime contractor 	✓	
<p>Cost Waiver Requests</p> <ul style="list-style-type: none"> • Waiver request includes the following information: <ul style="list-style-type: none"> — Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products — Relevant excerpts from the bid documents used by the contractors to complete the comparison — Supporting documentation indicating that the contractor made a reasonable survey of the market, such as a description of the process for identifying suppliers and a list of contacted suppliers 		
<p>Availability Waiver Requests</p> <ul style="list-style-type: none"> • Waiver request includes the following supporting documentation necessary to demonstrate the availability, quantity, and/or quality of the materials for which the waiver is requested: <ul style="list-style-type: none"> — Supplier information or pricing information from a reasonable number of domestic suppliers indicating availability/delivery date for construction materials — Documentation of the assistance recipient's efforts to find available domestic sources, such as a description of the process for identifying suppliers and a list of contacted suppliers. — Project schedule — Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of construction materials • Waiver request includes a statement from the prime contractor and/or supplier confirming the non-availability of the domestic construction materials for which the waiver is sought • Has the State received other waiver requests for the materials described in this waiver request, for comparable projects? 		

Attachment 2: HQ Review Checklist for Waiver Request

Instructions: To be completed by EPA. Review all waiver requests using the questions in the checklist, and mark the appropriate box as Yes, No or N/A. Marks that fall inside the shaded boxes may be grounds for denying the waiver. If none of your review markings fall into a shaded box, the waiver is eligible for approval if it indicates that one or more of the following conditions applies to the domestic product for which the waiver is sought:

1. The iron and/or steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.
2. The inclusion of iron and/or steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Review Items	Yes	No	N/A	Comments
<p>Cost Waiver Requests</p> <ul style="list-style-type: none"> • Does the waiver request include the following information? <ul style="list-style-type: none"> — Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products — Relevant excerpts from the bid documents used by the contractors to complete the comparison — A sufficient number of bid documents or pricing information from domestic sources to constitute a reasonable survey of the market • Does the Total Domestic Project exceed the Total Foreign Project Cost by more than 25%? 				
<p>Availability Waiver Requests</p> <ul style="list-style-type: none"> • Does the waiver request include supporting documentation sufficient to show the availability, quantity, and/or quality of the iron and/or steel product for which the waiver is requested? <ul style="list-style-type: none"> — Supplier information or other documentation indicating availability/delivery date for materials — Project schedule — Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of materials • Does supporting documentation provide sufficient evidence that the contractors made a reasonable effort to locate domestic suppliers of materials, such as a description of the process for identifying suppliers and a list of contacted suppliers? • Based on the materials delivery/availability date indicated in the supporting documentation, will the materials be unavailable when they are needed according to the project schedule? (By item, list schedule date and domestic delivery quote date or other relevant information) • Is EPA aware of any other evidence indicating the non-availability of the materials for which the waiver is requested? <p>Examples include:</p> <ul style="list-style-type: none"> — Multiple waiver requests for the materials described in this waiver request, for comparable projects in the same State — Multiple waiver requests for the materials described in this waiver request, for comparable projects in other States — Correspondence with construction trade associations indicating the non-availability of the materials <ul style="list-style-type: none"> • Are the available domestic materials indicated in the bid documents of inadequate quality compared those required by the project plans, specifications, and/or permits? 				

Attachment 3: Example Loan Agreement Language

ALL ASSISTANCE AGREEMENT MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE AIS REQUIREMENT. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN SRF ASSISTANCE AGREEMENTS. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE LAW:

Comply with all federal requirements applicable to the Loan (including those imposed by the 2014 Appropriations Act and related SRF Policy Guidelines) which the Participant understands includes, among other, requirements that all of the iron and steel products used in the Project are to be produced in the United States (“American Iron and Steel Requirement”) unless (i) the Participant has requested and obtained a waiver from the Agency pertaining to the Project or (ii) the Finance Authority has otherwise advised the Participant in writing that the American Iron and Steel Requirement is not applicable to the Project.

Comply with all record keeping and reporting requirements under the Clean Water Act/Safe Drinking Water Act, including any reports required by a Federal agency or the Finance Authority such as performance indicators of program deliverables, information on costs and project progress. The Participant understands that (i) each contract and subcontract related to the Project is subject to audit by appropriate federal and state entities and (ii) failure to comply with the Clean Water Act/Safe Drinking Water Act and this Agreement may be a default hereunder that results in a repayment of the Loan in advance of the maturity of the Bonds and/or other remedial actions.

Attachment 4: Sample Construction Contract Language

ALL CONTRACTS MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE AIS REQUIREMENT. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN ALL CONTRACTS IN PROJECTS THAT USE SRF FUNDS. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE OR LOCAL LAW:

The Contractor acknowledges to and for the benefit of the City of _____ (“Purchaser”) and the _____ (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 Contractor 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.

Attachment 5: Sample Certification 1

The following information is provided as a sample letter of step certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Step Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. XXXX
2. XXXX
3. XXXX

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Attachment 5: Sample Certification 2

The following information is provided as a sample letter of certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. XXXX
2. XXXX
3. XXXX

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

ATTACHMENT D

Massachusetts Diesel Retrofit Certifications

DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION

Each Contractor and its Subcontractor(s) must sign and submit this form to MassDEP and the Municipality within 10 days after the Contractor is notified that it is awarded the Contract.

Local Governmental Unit City of Taunton, MA **SRF Project No.** _____

Contract No. S-2020-3 **Contact Title** WWTF Solids Handling Improvements

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.

DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION

_____ shall notify MassDEP 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 MassDEP. _____ 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: _____

SECTION 01069

HEALTH & SAFETY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing a Health and Safety Plan (HASP) and maintenance of health and safety while performing the Work.

1.02 REQUIREMENTS

- A. Monitor working conditions at all times during construction and provide appropriate protective clothing, equipment and facilities for personnel, and establish workplace procedures to ensure personnel safety.
- B. Implement a Health and Safety protection program. The procedures for such implementation shall be submitted to the Engineer and Owner for approval. The procedures shall include provisions for stations allowing workers to wash and to put on and remove protective clothing, and stations for vehicles to be cleaned, if necessary, before leaving the site, air monitoring, and evaluation of areas where unsafe levels of gas has accumulated.
- C. Comply with all Federal, State, and local safety requirements related to the hazards anticipated to be encountered during the course of this project.
- D. In addition to the above requirements, comply with the following:
 - 1. All construction equipment on the site shall be equipped with vertical exhaust pipes or a spark proof exhaust.
 - 2. Smoking shall not be permitted in any area where gases can accumulate, or in areas where contaminated soil is present.
 - 3. Welding or open flames shall not be permitted in enclosed areas.
 - 4. Toxic gas indicators, an organic vapor analyzer, a combustible gas indicator, an oxygen indicator, and fire extinguishers shall be available at all times during operations. Periodic monitoring with portable monitoring devices shall be employed as dictated by the Health and Safety Plan.
 - 5. During operations, whenever unsafe levels of toxic gases are detected, all work will cease in that area until acceptable levels are reached.

1.03 SHOP DRAWINGS

- A. Submit site specific Health and Safety Plan (HASP) that complies with all applicable OSHA requirements to the Engineer for review and acceptance within fifteen (15) working days of the Contractor's Notice to Proceed. Certified Industrial Hygienist must certify the Contractor's plan prior to submittal to and review by the Engineer. The Contractor is not to proceed with any subsurface or site work without review and acceptance of the submitted Health and Safety Plan by the Engineer.

1.04 QUALITY ASSURANCE

- A. Engage an independent, qualified Health and Safety expert having experience in similar construction conditions, to monitor site conditions and recommend all necessary Health and

Safety protection. This person shall be a Certified Industrial Hygienist (CIH). The Contractor shall follow such recommendations and shall provide such protection to his personnel, and personnel of the Owner and Engineer, as may be affected.

1.05 REGULATORY REQUIREMENTS

- A. Establish workplace procedures, enforce the use of these procedures, and the associated equipment and facilities in accordance with the following guidelines:
 - 1. Safety and Health Regulations Promulgated by the U.S. Department of Labor OSHA, 29 CFR 1910 - Occupational Safety and Health Standards, and 29 CFR 1920 - Safety and Health Regulations for Construction.
 - 2. Occupational Safety and Health Standards, 29 CFR 1926 - Safety and Health Regulations for Construction.
 - 3. U.S. Environmental Protection Agency Medical Monitoring Program Guidelines.

1.06 SITE CONDITIONS

- A. The Contractor's attention is directed to the fact that the work includes connecting new pipelines to the existing sewer system. In addition to confined space issues, hazardous gasses and oxygen depletion may be encountered in the existing sewer system where proposed work is to take place.
- B. BETA has performed subsurface soil and groundwater sampling in the Project Area. A summary of all analytical results compiled by BETA is included in Appendix 2 of the Specifications.
- C. The Contractor is also responsible for reviewing site specific investigation reports included in the various Appendices of the Contract Documents.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 PROTECTION

- A. If, at any time, the Owner or the Engineer is apprised of a safety hazard which demands immediate attention because of its high potential for harm to the public travel, persons on or about the Work, or public or private property, the Owner or the Engineer shall have the right to order such safeguards to be erected and such precautions to be taken as necessary and the Contractor shall comply with such orders. If, under such circumstances, the Contractor does not or cannot immediately put the Work into proper and approved condition, or if the Contractor or his representative is not upon the site so that he can be notified immediately of the insufficiency of safety precautions, then the Owner may put the Work into such a condition that is, in his opinion, in all respects safe, and the Contractor shall pay all expenses of such labor and materials as may have been used for this purpose by him or by the Owner. The fact that the Owner or the Engineer does not observe a safety hazard or does not order the Contractor to take remedial measures shall in no way relieve the Contractor of the entire responsibility for any costs, loss or damage by any party sustained on account of the

insufficiency of the safety precautions taken by him or by the Owner acting under authority of this Section.

- B. If the Contractor is alerted to the fact that conditions of high hazard are present or can be present at the site during the performance of the Work, it is the responsibility of the Contractor to take appropriate safety precautions to meet whatever conditions of hazard may be present during the performance of the Work, whether reasonably foreseeable or not. The safety conditions enumerated in the Specifications are the minimum permissible and neither the Owner nor the Engineer makes any representation that the safety standards provided herein will be adequate to meet all eventualities. The Contractor is therefore alerted to the fact that it shall be his responsibility to anticipate and provide such additional safety precautions, facilities, personnel and equipment as shall be necessary to protect life and property from whatsoever conditions of hazard are present or may be present.
- C. The Contractor shall supply and erect highly visible safety fencing a minimum of three feet in height around all construction areas that pose a threat to safety and post proper signage as required by Local, State and Federal requirements. The Contractor shall erect safety fencing as documented in the Contract Drawings or as directed by the Engineer and shall maintain such fencing and signage until such a time that the potential safety hazard has been rectified. Upon final completion of construction all safety fencing shall be removed off-site by the Contractor. Safety fencing requirements of OSHA shall be enforced by the Contractor.

END OF SECTION

SECTION 01090

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Reference material, abbreviations, and terms used in the Construction Documents and establishes edition dates and complete titles for standards referenced elsewhere in the Specifications.

1.02 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. Obtain copies of standards when required by Contract Documents.
- C. Maintain copy at jobsite during submittals, planning, and progress of the specific work, until Substantial Completion.
- D. Should specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.03 SCHEDULE OF REFERENCES

AA	Aluminum Association 1400 Crystal Dr. Suite 430 Arlington, VA 22202
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W. Washington, DC 20001
ACI	American Concrete Institute 38800 Country Club Dr. Farmington Hills, MI 48331-3439
AFBMA	Anti-Friction Bearing Manufacturers Association 2025 M. Street, NW Washington, DC 20036-3309
AGC	Associated General Contractors of America 2300 Wilson Blvd. Arlington, VA 22201

AGM	American Gear Manufacturers Association 1001 N. Fairfax Street Alexandria, VA 22314-1587
AI	Asphalt Institute 2696 Research Park Drive Lexington, KY 40511-8480
AISC	American Institute of Steel Construction One East Wacker Drive Chicago, IL 60601-1802
AISI	American Iron and Steel Institute 25 Massachusetts Drive Washington, DC 20001
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004
ANS	American National Standard
ANSI	American National Standards Institute 1899 L Street, NW, 11 th Floor Washington, DC 20036
API	American Petroleum Institute 1220 L Street, NW Washington, DC 20005
ARI	Air-Conditioning and Refrigeration Institute 2111 Wilson Boulevard Arlington, VA 22201
ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329
ASME	American Society of Mechanical Engineers Two Park Avenue New York, NY 10016-5990
ASPA	American Sod Producers Association 1855 A Hicks Road Rolling Meadows, IL 60008

ASTM	American Society for Testing and Materials 100 Bar Harbor Drive PO Box C700 West Conshohocken, PA 19428-2959
AWG	American or Brown and Sharpe Wire Gage
AWPA	American Wood-Preservers' Association 100 Chase Park South Birmingham, AL 35244-1851
AWS	American Welding Society
AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
BIA	Brick Institute of America 1850 Centennial Park Drive Reston, VA 20191
CS	Commercial Standard
EJCDC	Engineers' Joint Contract Document Committee American Consulting Engineers Council 1015 15 th Street, N.W. Washington, DC 20005
FM	Factory Mutual System 1151 Boston-Providence Turnpike PO Box 688 Norwood, Massachusetts 02062
Fed Spec.	Federal Specification General Services Administration Specification and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Bldg. 197 Washington, DC 20407
HMA	Hot Mix Asphalt
IBR	Institute of Boiler and Radiator Manufacturers
ICBO	International Conference of Building Officials 900 Montclair Road Birmingham, AL 35213-2298
IPS	Iron Pipe Size
JIC	Joint Industry Conference Standards

MIL	Military Specification Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120
NASSCO	National Association of Sewer Service Companies 2470 Longstone Lane Marriottsville, MD 21104
NBS	National Bureau of Standards
NCMA	National Concrete Masonry Association 13750 Sunrise Valley Drive Herndon, VA 20171
NCPWB	National Certified Pipe Welding Bureau
NEMA	National Electrical Manufacturers' Association 1300 North 17 th Street Arlington, VA 22209
NFPA	National Fire Protection Association Battery March Park Quincy, MA 02269
NPT	National Pipe Thread
OS&Y	Outside screw and yoke
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077
SMACNA	Sheet Metal and Air Conditioning Contractors' National Assoc. 4201 Lafayette Center Drive Chantilly, VA 20151-1219
Stl. WG	U.S. Steel Wire Washburn and Moen, American Steel and Wire or Roebling Gage
UL	Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062
USS Gage	United States Standard Gage
125-lb. ANS 250-lb. ANS	American National Standard for Cast-Iron Pipe Flanges and Flange Fittings, Designation B16.1-1975, for the appropriate class

1.04 EDITION DATES

- A. Reference to publications and reference material shall be understood to mean the latest edition, unless stated otherwise.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION

SECTION 01170

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for environmental protection during and as the result of construction operations under this Contract except for those measures set forth in other provisions of these Specifications.
2. Environmental protection requires consideration of air, water and land, noise, solid waste management, vector and fire control.

B. Related Sections

1. Section 01300 - Submittals
2. Section 02228 - Waste Material Disposal

1.02 QUALITY ASSURANCE

A. Requirements of regulatory agencies:

1. In order to prevent environmental pollution and to provide for environmental protection arising from 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 environmental protection, as well as the specific requirements stated in the Section and elsewhere in the Specifications.

1.03 SUBMITTALS

A. Under the requirements of Section 01300 - Submit the following.

B. Implementation Plan

1. Prior to commencement of the work, the Contractor shall:
 - a. Submit in writing his plans for implementing this Section for environmental protection.
 - b. Meet with the Engineer to develop mutual understandings relative to compliance with the provisions of this Section and administration of the environmental protection program.

C. Temporary Excavation and Embankments

1. If the Contractor proposes to construct temporary roads or embankments and excavations for work areas, he shall submit the following for approval prior to scheduled start of such temporary work:
 - a. A layout of all temporary roads, excavations and embankments to be constructed within the work area.
 - b. Plans and cross-sections of proposed embankments and their foundations, including a description of proposed materials.
 - c. A landscaping plan showing the proposed restoration of the area. Removal of any necessary trees and shrubs outside the limits of existing cleared areas shall

be indicated. The plan shall provide for the obliteration of construction scars and shall provide for a reasonably natural appearing final condition of the area. Modification of the Contractor's plans shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction, including disposal areas will be permitted.

D. Erosion Sedimentation Plan

1. The Contractor shall submit to the Engineer, a detailed erosion and sedimentation plan for approval at least 10 days prior to initiation of work. The plan shall include location and construction details of the Contractor's proposed dikes, basins, etc. The Contractor shall provide and submit his control measures for stockpile material.

PART 2 PRODUCTS

2.01 GENERAL

- A. All materials shall be as specified elsewhere in this Specification.

PART 3 EXECUTION

3.01 PROTECTION OF LAND RESOURCES

- A. It is intended that the land resources within the project boundaries and outside the limits of permanent work performed under this Contract be preserved in their present condition, or be restored to a condition after completion of construction, that will appear to be natural and not detract from the appearance of the project. The Contractor shall confine his construction activities to areas defined on the Drawings or in the Specifications except with written approval of the property owners and the Engineer.
- B. Limits of working areas include areas for storage of construction material, and shall be cleared in a manner which will enable satisfactory restoration and which will not affect the environment during or after the construction period. The Contractor shall not enter beyond the working limits of the working area except with written approval of the Engineer and Owner.
- C. The location of areas for storage of the Contractor's materials required temporarily in the performance of the work, shall be within the limits of the working area and shall require written approval of the Engineer prior to use. The preservation of the landscape shall be an imperative consideration in the selection of all such sites. Where temporary structures are constructed on sidehills, the Engineer may require cribbing to be used to obtain level foundation. Benching or leveling of earth may not be allowed, depending on the location of the proposed facility.
- D. The Contractor shall obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which permit the growth of vegetation thereon. The disturbed areas shall be graded and filled as

required, and topsoil shall be spread to a depth of approximately 6 inches over the entire area and the entire area shall be seeded.

3.02 PROTECTION OF WATER RESOURCES

- A. The Contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumen's, calcium chloride, acids or harmful materials. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State, County, and Municipal laws concerning pollution of rivers, streams and impounded water. All work under this Contract shall be performed in such a manner that objectionable conditions will not be created in streams through, or bodies of water adjacent to, the project area.
- B. Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall, if turbidity producing materials are present, be held in suitable sedimentation basins or shall be graded to control erosion within acceptable limits. Temporary erosion and sediment control measures such as berms, dikes, drains, or sedimentation basins, if required to meet the above standards, shall be provided and maintained until permanent drainage and erosion control facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum.
- C. Apply temporary mulch on denuded ground immediately after rough grading is completed. This shall apply to all areas not subject to appreciable traffic during construction, even those that are to receive some form of construction later if ground is to be exposed 30 days or more.
- D. Stream and drainage ditch crossings by fording with equipment shall be limited to control turbidity, and in areas of frequent crossings, temporary culverts or bridge structures shall be installed. Any temporary culverts or bridge structures shall be removed upon completion of the project. Fills and waste areas shall be constructed by selective placement to eliminate silts or clays on the surface that will erode and contaminate adjacent streams.
- E. At all times of the year, special measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, waste washings, herbicides and insecticides, and cement and surface drainage from entering public waters.
- F. Disposal of any materials, wastes, effluents, trash, garbage, oil, grease, chemicals, etc., in areas adjacent to streams or other waterways shall be disposed of by the Contractor in accordance with the applicable governing regulations. If any waste material is dumped in unauthorized area, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed area. If necessary, contaminated ground shall be excavated, disposed of as specified hereinbefore, and replaced with suitable fill material, compacted and finished with topsoil, all at the expense of the Contractor.

3.03 MAINTENANCE

- A. The Contractor shall dispose of all discarded debris and aggregate samples in a manner approved by the Engineer. Toilet facilities shall be kept clean and sanitary at all times. Services shall be performed at such a time and in such a manner to least interfere with the operations. Services shall be accomplished to the satisfaction of the Engineer.

- B. The Contractor shall frequently remove materials no longer required on the site so that, at all times, the site, access routes to the site and any other areas disturbed by his operations shall present a neat, orderly, workmanlike appearance.
- C. Before semi-final payment, the Contractor shall remove all surplus material, plant of any description, and debris of every nature resulting from his operations, and put the site in a neat, orderly condition; and restore all areas which have been used for storage of materials and equipment, and all areas which have been disturbed by his operations, to their original condition or to a condition satisfactory to and approved by the Engineer.

3.04 DUST CONTROL

- A. The Contractor shall maintain all excavations, embankments, stockpiles, haul roads, permanent access roads, waste areas, borrow areas and all other work areas within or without the project boundaries free from dust which would cause a hazard or nuisance to others or contaminate surface water.

3.05 NOISE CONTROL

- A. The Contractor shall use every effort and means possible to minimize or eliminate noise caused by his operation which the Engineer may consider objectionable.
- B. All equipment utilized by the Contractor at the Landfill shall be equipped with adequate muffler systems to minimize on-site noise generation.

3.06 ODOR CONTROL

- A. Suitable measures shall be taken to minimize odors at the Landfill. Any odors originating from the Contractor's operations which expose solid waste shall be minimized by immediately covering with adequate layers of approved cover material.
- B. Under no circumstances shall exposed solid waste remain uncovered overnight.

3.07 LITTER CONTROL

- A. Any litter generated by the Contractor's operation, whether from disturbance of existing buried solid waste or generated in the course of performing the work under Contract, shall be collected and properly disposed of on a daily basis.

3.08 VECTOR CONTROL

- A. Sanitary measures and conditions shall be maintained at the Landfill, by the Contractor, at all times in order to avoid harboring, feeding, and breeding of vectors.

3.09 FIRE PREVENTION AND CONTROL

- A. Open burning of any type within the Landfill or on adjacent property is prohibited.

- B. The Contractor shall take necessary precautions and implement procedures to prevent and control fires, whether on the Landfill or within a piece of equipment used in performing the work under Contract.

3.10 PROHIBITED CONSTRUCTION PROCEDURES

- A. The Contractor is advised that the disposal of excess excavated material in wetlands, stream corridors, and floodplains is strictly prohibited. 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.
- B. The Contractor shall comply with the following requirements regarding prohibited construction procedures as follows:
 - 1. Dumping of spoil material into any stream corridor, any wetland, any surface waters, or at unspecified locations.
 - 2. Indiscriminate, arbitrary or capricious operation of equipment in any stream corridors, any wetlands or surface waters.
 - 3. Pumping of silt-laden water from trenches or other excavations into any surface waters, any stream corridors or any wetlands.
 - 4. Damaging vegetation adjacent to, or outside of, the area of the work.
 - 5. Disposal of trees, brush and other debris in any stream corridors, any wetlands, any surface waters, or at unspecified locations.
 - 6. Permanent or unspecified alteration of the flow line of any stream.
 - 7. Open burning of project debris.
 - 8. Location of storage stockpile areas in environmentally sensitive areas.
 - 9. Disposal of excess or unsuitable excavation material in wetlands or floodplains even with permission of the property owner.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Administrative and procedural requirements for project meetings.

1.02 PRECONSTRUCTION CONFERENCE

- A. The Engineer will schedule and administer a pre-construction conference.
- B. The pre-construction conference will be scheduled and administered within fourteen (14) calendar days after the dated "Notice to Proceed". The Contractor shall be prepared to address such topics as projected construction schedules, major personnel, critical work areas, construction facilities and shop drawing submittals.

1.03 PROGRESS MEETINGS

- A. The Engineer will schedule and administer progress meetings and specially called meetings throughout the duration of the Work at minimum monthly intervals.
- B. The time and location of such meetings shall be designated by the Engineer and shall be convenient for all parties involved.
- C. The Engineer will, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies to participants, and those affected by decisions made.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for submission of schedules and shop drawings, including requirements for American Iron and Steel compliance.
- B. For submittal requirements related to contaminated soils, refer to Specification Section 02080 – Excavation and Management of Contaminated Soils.**

1.02 PROGRESS SCHEDULE

- A. Within fourteen (14) calendar days after execution of the Contract Documents, the Contractor shall submit to the Engineer for review a construction progress schedule conforming to requirements specified. This schedule should show the proposed dates of commencement and completion of each of the various subdivisions of work required under this Contract and the anticipated monthly percentage of completion based on the total contract price. The Contractor shall be responsible for updating and/or revising this schedule whenever directed by the Engineer throughout the duration of the Contract.
- B. Special attention is directed to the requirement that the Contractor shall start the Work, as specified under this Contract, no later than thirty (30) calendar days after the execution of the Contract Documents, unless otherwise directed by the Owner. The Contractor shall comply with all pre-construction requirements as specified. The Owner reserves the right to delay the commencement of the Work or any part thereof if the specified requirements as determined by the Engineer have not been satisfied. The Owner further reserves the right to limit or, delay construction, or certain activities thereof, in certain areas of the Contract should the Owner deem it to be in the public's best interest and/or safety to do so.
- C. The Contractor shall contact the appropriate town or city authorities concerning any public or semi-public events that may occur during the construction period that may affect construction. The Contractor alone shall be responsible for arranging his construction sequence to conform to any restrictions these events may impose. No claims for extras will be allowed because of any delay, extra materials handling, extra excavation, etc. caused by the imposed restrictions. However, additional time may be granted for completion of the work to compensate for delays caused by said restrictions.

1.03 SHOP DRAWINGS

- A. Submit copies of all shop and working drawings of concrete reinforcement, structural details, piping layout, wiring, materials fabricated especially for the Contract, and materials and equipment for which such drawings are specifically requested.

- B. Shop drawings may be submitted electronically or via hard copy. Engineer's cover sheet, properly completed, shall accompany each submittal.
- C. A maximum of two (2) submittals of each shop drawing will be reviewed by the Engineer. If more submittals are required due to the Contractor's neglect or failure to fulfill the requirements of the Contract plans and specifications, or to make corrections or modifications required by the Engineer in the review of the first two submittals, the Engineer will review the submittal and the Contractor will be responsible for the cost of the review, as determined by the Owner based on the Engineer's documentation of time and rates for additional services established in the Engineering Agreement between the Owner and the Engineer.
- D. Such drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When the dimensions are of particular importance, or when specified, the drawings shall be certified by the manufacturer or fabricator as correct for the Contract.
- E. When so specified or if considered by the Engineer to be acceptable, manufacturer's specifications, catalog data, descriptive matter, illustrations, etc., may be submitted in place of shop and working drawings.
- F. The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings to eliminate delay to the Work due to the absence of such drawings. All shop and working drawings must be submitted to the Engineer within thirty (30) calendar days prior to incorporation into the Work, unless otherwise permitted by the Engineer. **Prior to the submittal of any shop drawings, the Contractor shall submit a schedule of proposed shop drawing transmittals.** The schedule shall identify the subject matter of each transmittal, the corresponding specification section number and the proposed date of submission. Prior to and during the progress of the Work the schedule shall be revised and resubmitted as requested by the Engineer.
- G. No material or equipment shall be purchased or fabricated for the Contract until the required shop and working drawings have been submitted as hereinabove provided and reviewed for conformance to the Contract requirements. All such materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by said drawings.
- H. Until the necessary review has been made, the Contractor shall not proceed with any portion of the Work (such as the construction of foundations) for which review is required.
- I. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from his subcontractors and returning reviewed drawings to them. All shop and working drawings shall be prepared on standard size, 24 inch by 36 inch sheets, except those which are made by changing existing standard shop and working drawings. All drawings shall be clearly marked with the names of the Owner, Contractor, and building, equipment, or

structure to which the drawing applies, and shall be suitable numbered. Submitted shop drawings shall be accompanied by a letter of transmittal, completed by the Contractor as approved by the Engineer.

- J. Only drawings which have been checked and corrected by the fabricator should be submitted to the Contractor by his subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to satisfy himself that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings which are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer; other drawings shall be returned for correction.
- K. If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in his letter of transmittal.
- L. The review of shop and working drawings by the Engineer will be general only, and nothing contained in this Section shall relieve, diminish or alter in any respect the responsibilities of the Contractor under the Contract Documents and in particular, the specific responsibility of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance as specified. The Contractor shall be responsible for errors and omissions in shop drawings.
- M. Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires, appurtenances, or layouts etc., either existing or as detailed on the Drawings, he shall also submit details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do the work necessary to make such modifications.
- N. The Contractor shall furnish additional copies of shop drawings or catalog cuts when so requested.

1.04 AMERICAN IRON AND STEEL (AIS)

- A. **All shop drawings shall demonstrate compliance with the American Iron and Steel (AIS) requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014. All “iron and steel products” shall be produced in the United States.**

In this section, the term “iron and steel products” means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

- B. Certification of compliance with AIS requirements shall consist of a certification letter from the product manufacturer. The Certification letter shall, at minimum, contain the following information:

- 1. Project Name – Taunton Wastewater Treatment Facility Improvements

2. Item(s) being provided to the Project
3. Location of manufacture (Factory Name, City and State)
4. Name of Contractor to whom product was delivered
5. Reference to American Iron and Steel requirements, and statement of compliance with them.
6. Signature of Company Representative.

A sample certification letter is attached to this section for the Contractor's reference.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

NOTE: The following information is provided as a sample letter of certification for AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

Item, Products and/or Materials:

1. XXXX
2. XXXX
3. XXXX

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

SECTION 01310

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for computer generated Critical Path Method (CPM) construction scheduling and Narrative progress report.
- B. No portion of this specification shall take precedent over SECTION 00500-Contract Agreement.

1.02 SUBMITTALS

- A. Submit in accordance with SECTION 01300-Submittals
 - 1. Quality Assurance/Control Submittal
 - a. Name and version of CPM software proposed for use.
 - b. List of construction projects completed on which progress of work was controlled with CPM software.
 - 2. Schedule
 - a. Within **14 days** following the receipt of the Notice to Proceed, the Contractor shall submit **two** color copies of a computer generated schedule and a list of activities to the Engineer. Following review by the Engineer and Owner the Contractor shall meet with the Engineer and Owner to discuss the review. The Contractor shall incorporate the Engineer's comments into the schedule and submit eight color copies of the revised schedule within 14 days following receipt of the Engineer's comments.

PART 2 PRODUCTS

2.01 SOFTWARE

- A. Computer based scheduling software used by the Contractor shall be the product of a recognized commercial computer software producer and shall be capable of meeting the requirements specified herein.

PART 3 EXECUTION

3.01 PREPARATION

- A. General
 - 1. The Contractor shall prepare his proposed CPM schedule based on a breakdown of work tasks that he has developed.
 - 2. The construction schedule and updates shall be prepared by the Contractor or the Contractor's qualified consultant.

B. Schedule

1. Each schedule shall be prefaced with the following summary data:
 - a. Contract name and number
 - b. Contractor's Name
 - c. Contract duration
 - d. The effective or starting date of the schedule
 - e. Revision date of the latest schedule.
2. The CPM schedule shall be sequenced by early start date and shall include the following minimum items:
 - a. Activity Name
 - b. Estimated duration
 - c. Activity description
 - d. Early start date (calendar date)
 - e. Early finish date (calendar date)
 - f. Latest allowable start date (calendar date)
 - g. Latest allowable finish date (calendar date)
 - h. Status (whether critical)
 - i. Estimated cost of the activity
 - j. Float (total and free)
 - k. Major milestones
3. Separate milestones shall be included for Notice-to-Proceed and Project Completion Date.
4. Activities shall include major components of the work including submittals that might impact the critical path, subcontractor work, major and critical equipment design, fabrication, testing, delivery and installation times, system/subsystem/component testing, process and facility startup, training, demobilization, project cleanup and closeout. Critical portions of process instrumentation and control system work, shall be defined in detail in a sub schedule.
5. The sum of the costs assigned to the activities shall be equal to the Contract price. Activity costs shall not be assigned to submittals or submittal reviews. Comply with SECTION 01026-Schedule of Values. Provide a table showing the anticipated monthly percentage of completion, based on the total contract price.
6. Critical activities, predecessors, free float and total float shall be clearly displayed on the schedule in graphical form. Schedules that contain activities showing negative float or that extend beyond the contract completion date will not be approved.
7. Each schedule submittal shall also include a list of activities in the order in which the activities will be performed, along with activity durations, activity predecessors, type of predecessor (finish-start, finish-finish, start-start, lead/lag), and any dependency or required date.
8. The schedule shall be based on a standard 5-day work week with allowance for holidays and adverse weather.
9. Engineer's approval of the CPM schedule is advisory only and shall not relieve the Contractor of responsibility for accomplishing the work prior to the contract completion date. Omissions and errors in the approved CPM schedule shall not excuse performance less than that required by the Contract. Approval by the Engineer in no way makes the Engineer an insurer of the CPM schedule's success or liable for time or cost overruns flowing from its shortcomings. The Owner hereby disclaims any obligation or liability by reason of approval by its agent, the Engineer, of the CPM schedule.

C. Narrative Progress Report

1. Include as a minimum:
 - a. Summary of work completed during the previous period (since submission of last narrative progress report).
 - b. Explanation for variations between actual work completed in previous period and planned work as reported in last period.
 - c. Summary of work planned during the next period.
 - d. Current and anticipated delaying factors and their estimated impacts on other activities and milestones, both critical and non-critical.
 - e. Corrective actions taken or proposed.
2. A Narrative Progress Report shall be submitted monthly to the Engineer, at least 5 working days prior to the progress meeting.
3. At the discretion of the Engineer, the Contractor may be required to submit a revised CPM schedule showing completion to date and any changes to the previous schedule.

3.02 MONITORING SCHEDULE

- A. The CPM approved construction schedule shall be used by the Contractor throughout the duration of the project for planning, organizing, and directing the Work, and for reporting progress of the Work
- B. The Contractor is solely responsible for monitoring schedule compliance. When a delay to the critical path occurs, the Contractor shall immediately notify the Engineer in writing. Within one week of the notification, the Contractor shall submit for the Engineer's approval, a description of proposed actions to return the project to schedule.

3.03 MODIFYING SCHEDULE

- A. If the Contractor desires to make changes in his method of operating which affect the approved CPM schedule, he shall notify the Engineer in writing stating what changes are proposed and the reason for the change. If the Engineer approves these changes, the Contractor shall revise and submit for approval, without additional cost to the Owner, all of the affected portions of the CPM schedule.
- B. It may be necessary for the contract schedule or completion time to be adjusted by the Owner to reflect the effects of job conditions, weather, technical difficulties, strikes, unavoidable delays on the part of the Owner or its representatives and other unforeseeable conditions which may indicate schedule adjustments or completion time extensions. Under such conditions, the Engineer will direct the Contractor to reschedule the work or contract completion time to reflect the changed conditions and the Contractor shall revise his schedule accordingly.
- C. Float time is a project resource available to both the Contractor and the Owner to meet contract milestones and completion dates. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited, and use of float time disclosed or implied by use of alternate float suppression techniques shall be shared to proportionate benefit of OWNER and CONTRACTOR.

- D. If the Contractor provides an accepted schedule with an early completion date, the Owner reserves the right to reduce the Time of Completion to match the early completion date by issuing a deductive Change Order at no change in Contract Price.

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for Contractor's quality control of products, suppliers, manufacturers, services, site conditions, and workmanship, to produce Work of specified quality.

1.02 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Comply fully with manufacturers' instructions, including each step in sequence.
- B. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- D. Perform work by persons qualified to produce workmanship of specified quality.
- E. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.03 FIELD SAMPLES

- A. Install field samples at the site as required by individual specifications sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Where field sample is specified to be removed, clear area only after field sample has been accepted by the Engineer.

1.04 CERTIFIED WELDERS

- A. Structural welds shall be made only by operators who have been qualified by tests, as prescribed in the "Standard Qualification Procedure" of the American Welders Society, to perform the type of work required.
- B. Pipe welds shall be made only by operators who have been qualified by the National Certified Pipe Welding Bureau and each operator's qualification record shall be submitted to the Engineer before any work is performed.
- C. Shop welding shall be in accordance with the "Code for Welding in Building Construction".

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01410

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Qualification, duties and responsibilities of testing laboratories.
2. Coordination and scheduling responsibilities of the Contractor.

B. Related Sections

1. Section 01600 - Materials and Equipment

1.02 PAYMENT PROCEDURES

A. Initial Testing

1. The Contractor will pay for initial testing services required by the Engineer, unless noted otherwise.

B. Retesting

1. When initial tests indicate noncompliance with the Contract Documents, subsequent retesting occasioned by the noncompliance shall be performed by the same testing agency, and costs thereof will be deducted by the Owner from the Contract Sum.

C. Contractors Convenience Testing

1. Inspecting and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

1.04 REQUIREMENTS

A. Work included:

1. Cooperate with the Owner's selected testing agency and all others responsible or testing and inspecting the Work.
2. Provide other testing and inspecting as specified to be furnished by the Contractor in this Section and/or elsewhere in the Contract Documents.
3. Where no testing requirements are described, but the Owner directs testing, the Contractor shall provide testing under the requirements of this Specification.

B. Work not included:

1. Selection of testing laboratory: The Owner will select a qualified independent testing laboratory.

1.05 QUALITY ASSURANCE

A. Qualifications

1. The testing laboratory will be qualified to the Owner's approval in accordance with ASTM E329.

B. Regulatory requirements

1. Testing, when required, will be in accordance with all pertinent codes and regulations and with selected standards of the American Society for Testing and Materials.
2. Regulatory Requirements Inspections and tests required by codes or ordinances, or by a plan approved authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01600 - Materials and Equipment.

- ##### B. Promptly process and distribute, to the Engineer, required copies of test reports and instructions to assure necessary retesting and replacement of materials with the least possible delay in progress of the Work.

1.07 SCHEDULING

A. Establishing schedule

1. By advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings.
2. Provide all required time within the construction schedule.
3. Coordinate testing activity with the appropriate testing laboratory.

B. Revising schedule

1. When changes of construction schedule are necessary during construction, coordinate all such changes with the testing laboratory as required.

C. Adherence to schedule

1. When the testing laboratory is ready to test according to the established schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra charges for testing attributable to the delay may be back-charged to the Contractor and shall not be borne by the Owner.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Site Tests

1. Representatives of the testing laboratory shall have access to the Work at all times and at all locations where the Work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.
2. All specimens and samples for testing, unless otherwise provided in the Contract Documents, shall be taken by the testing personnel. All sampling equipment and personnel will be provided by the testing laboratory. All deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

END OF SECTION

SECTION 01525

TEMPORARY ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for protecting portions of the Work which are affected by inclement weather conditions.
- B. Provide "Weather Protection" and heat to permit construction work to be carried on during the months of November through March. These Specifications are not to be construed as requiring enclosures or heat for operations that are not economically feasible to protect in the judgment of the Engineer. Included in the preceding category, without limitation, are such items as site work, excavation, pile driving, steel erection, erection of certain "exterior" wall panels, roofing, and similar operation.

1.02 SUBMITTALS

- A. Within 30 calendar days after execution of this contract, submit in accordance with Specification Section 01300, proposed methods for "Weather Protection".

1.03 WEATHER PROTECTION

- A. Weather Protection shall be provided for protection of that work adversely affected by moisture, wind and cold, by covering, enclosing and/or heating. This protection shall provide adequate working areas during dates consistent with the approved Progress Schedule to permit the continuous progress of all work necessary to maintain an orderly and efficient sequence of construction operations.
- B. Furnish and install all enclosures and be responsible for all costs, including heating required to maintain a minimum temperature of 40 degrees F., at the working surface. This provision does not supersede any specific requirements for methods of construction, curing of materials or the applicable general conditions set forth in the Contract Documents with added regard to performance obligations of the Contractor.
- C. Installation of weather protection and heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection devices. Heating devices which may cause damage to finish surfaces shall not be used.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION

SECTION 01560

TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for cleaning, maintenance of the site, barriers and fences required during construction.

1.02 CLEANING DURING CONSTRUCTION

- A. Unless otherwise specified under the various trade Sections of the Specifications, the General Contractor shall perform clean-up operations during construction as herein specified.
 - 1. Control accumulation of waste materials and rubbish; periodically dispose of off-site. Bear all costs, including fees resulting from disposal.
 - 2. Clean interior areas prior to start finish work and maintain areas free of dust and other contaminants during finishing operations.
 - 3. Maintain project in accordance with all local, State and Federal Regulatory Requirements.
 - 4. Store volatile wastes in covered metal containers, and remove from premises.
 - 5. Prevent accumulation of wastes that create hazardous conditions.
 - 6. Provide adequate ventilation during use of volatile or noxious substances
- B. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - 1. Do not burn or bury rubbish and waste materials on site.
 - 2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 3. Do not dispose of wastes into streams or waterways.
 - 4. Use only those materials which will not create hazards to health or property and which will not damage surfaces.
 - 5. Use only those cleaning materials and methods recommended by manufacturer of surface material to be cleaned.
 - 6. Execute cleaning to ensure that the buildings, the sites, and adjacent properties are maintained free from accumulations of waste materials and rubbish and wind blown debris, resulting from construction operations.
 - 7. Provide on-site containers for collection of waste materials, debris, and rubbish.
 - 8. Remove waste materials, debris, and rubbish from the site periodically and dispose of at legal disposal areas off the construction site.
 - 9. Handle material in a controlled manner with as little handling as possible. Do not drop or throw materials from heights.
 - 10. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not damage surrounding surfaces.
 - 11. During its progress, the work and the adjacent areas affected thereby shall be kept 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.
 - 12. 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.

1.03 DUST CONTROL

- A. Provide adequate means for the purpose of preventing dust caused by construction operations throughout the period of the construction contract.
- B. This provision does not supersede any specific requirements for methods of construction or applicable general conditions or performance obligations of the General Contractor.

1.04 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize amount of bare soil exposed at one time.
- C. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts for clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Construct sediment control devices for discharge from dewatering trenches.
- G. Construct all sedimentation control devices shown on the plans.

1.05 NOISE CONTROL

- A. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum.
- B. Execute construction work by methods and by use of equipment which will reduce excess noise.
 - 1. Equip air compressors with Silencers, and power equipment with mufflers.
 - 2. Manage vehicular traffic and scheduling to reduce noise.

1.06 POLLUTION CONTROL

- A. Special care shall be taken to prevent contamination or muddying up or interfering in any way with the stream flows, if any along the line of work. No waste matter of any kind will be allowed to discharge into the stream flows or impounded water of any pools or other bodies of water.

1.07 SURFACE WATER CONTROL

- A. Take all precautions to prevent damage to the work or equipment by high waters or by storms. The Engineer with the approval of the Owner may prohibit the carrying out of any work at any time when in his judgment, high water or storm conditions are unfavorable or not suitable, or at any time, regardless of the weather, when proper precautions are not being taken to safeguard previously constructed work or work in progress.
- B. In case of damage caused by the failure of the Contractor to take adequate precautions, the Contractor shall repair or replace equipment damaged and shall make such repairs or rebuild such parts of the damaged work, as the Engineer may require, at no additional expense to the Owner.

1.08 BARRIERS AND ENCLOSURES

A. Fences and Barricades

- 1. Provide and maintain temporary fences, barriers, lights, guardrails, and barricades as indicated in the Contract Documents, or as necessary to secure the Work and adjacent property, and protect persons and property.
- 2. Obtain necessary approvals and permits and provide temporary expedients as necessary to accommodate tasks requiring items mentioned herein.

B. Protection of Trees

- 1. The Contractor shall take care not to harm trees along the sides of roads or with in the existing facility in which the construction work is to be done or trees on adjacent lands except as indicated on the drawings or with the written permission of the Owner and any other owner of the trees involved. Care shall be taken not to cut tree roots so as to harm the growth of trees to remain.
- 2. If, in the opinion of the Engineer, any trees damaged during construction can be repaired, the Contractor shall satisfactorily repair same at no further cost to the Owner.
- 3. If, in the opinion of the Engineer, any tree damaged during construction cannot be repaired and should be removed, the Contractor shall satisfactorily remove and replace, in kind, same at no further cost to the Owner.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for delivery, storage, handling and installation of systems, materials, manufactured units, equipment, components, and accessories used in the work.

B. Related Sections

1. Section 01300 - Submittals

1.02 DELIVERY

A. Refer to Specifications' Sections for requirements pertaining to delivery and handling of materials and equipment.

B. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturers' unopened containers or packaging, dry.

C. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

D. Promptly inspect shipments to assure that products comply with requirements, that quantities are correct, and products are undamaged.

1.03 STORAGE AND PROTECTION

A. Refer to Specifications' Sections for requirements pertaining to storage and protection of materials and equipment.

B. Store products in accordance with manufacturers' instruction, with seals and labels intact and legible. Store sensitive products in weather tight enclosures; maintain within temperature and humidity ranges required by manufacturers' instructions.

C. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

D. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

E. Arrange storage to provide access for inspection. Periodically inspect to assure that products are undamaged, and are maintained under required conditions.

1.04 INSTALLATION STANDARDS

- A. Comply with Specifications and referenced standards as minimum requirements.
- B. Components required to be supplied in quantity within a Specification Section shall be the same, and shall be interchangeable.
- C. Do not use materials and equipment removed from existing structures, except as specifically required, or allowed, by the Contract Documents.
- D. Perform work by persons qualified to produce workmanship of specified quality.
- E. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.
- F. When work is specified to comply with manufacturers' instructions, submit copies as specified in Section 01300 - Submittals, distribute copies to persons involved, and maintain one set in field office.
- G. Perform work in accordance with details of instructions and specified requirements.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01665

SERVICES OF MANUFACTURER'S REPRESENTATIVES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for services provided by manufacturer's representatives.

1.02 SERVICES OF MANUFACTURER'S REPRESENTATIVES

A. General

1. Arrange for a qualified factory trained service representative from each company manufacturing or supplying certain equipment and systems, as listed in the Table at the end of this section and as specified in Division 11 through Division 16, to perform the duties described herein.
2. Qualified factory trained service representative shall be approved by the Engineer
3. All 8-hour days specified herein and in other sections of the specifications are exclusive of travel time
4. Services of Manufacturer's Representative shall not commence until an Operation and Maintenance Manual has been submitted and approved for each piece of equipment and system.

B. Supervision of Installation

1. Provide on-site supervision and advice to the Contractor to insure that proper procedures are followed during equipment installation.

C. Equipment Checkout

1. Inspect, align, operate, test and adjust the equipment after equipment installation has been completed and equipment is presumably ready for operation, but before it is operated by others.
2. The inspection shall include, but shall not be limited to, the following points as applicable:
 - a. Soundness (without cracked or otherwise damaged parts)
 - b. Completeness in all details as specified
 - c. Correctness of setting, alignment, and relative arrangement of various parts
 - d. Adequacy and correctness of packing, sealing and lubricants.
3. Operate, test and adjust the equipment, as required, to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.
4. Upon completion of the work, submit a complete signed report of the result of the inspection, operation, adjustments and tests to the Engineer via the Contractor. The report shall include:
 - a. Detailed descriptions of the points inspected and work completed
 - b. Deficiencies noted and/or corrected
 - c. Tests and adjustments made
 - d. Quantitative results obtained if such are specified
 - e. Suggestions for precautions to be taken to ensure proper maintenance

- f. A certificate that specifically states that "... the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacture's warrantee null and void".

D. Field Acceptance Test

1. Tests shall be conducted by the Contractor, with assistance from the manufacturer's representative, after the Engineer has reviewed completed and equipment checkout report
2. Manufacturer's representative shall be present during field acceptance tests

E. Pre-Startup Operator Training

1. General

- a. Provision for classroom and hands on training to plant personnel in the operation and maintenance of the equipment prior to placing the equipment in full operation.
- b. Provide the Owner's personnel and their consultants with sufficient information and skills training on the theory, design, site specific operation and maintenance practices (including items such as routine monitoring with normal and abnormal parameters, troubleshooting techniques, and preventive and corrective maintenance requirements) to insure that equipment and systems can be efficiently and effectively operated and maintained by the trainees upon completion of the training.
- c. Training shall be a combination of classroom, field observance and hands-on applications.
- d. Provide the following as specified herein:
 - 1) Lesson Plans
 - 2) Trainee Manuals
 - 3) Catalog of training materials.
- e. The Contractor shall provide a credit to the Owner for any unused instructor hours.
- f. Training classes shall be based on the approved Contractor Operation and Maintenance Manual.
- g. Conduct the training at scheduled times in accordance with the Contractor's approved comprehensive training schedule for all equipment, system and components. All training shall be coordinated and scheduled with the Owner a minimum of 7 days in advance. All training sessions will be conducted during the day shift. Currently the day shift is approximately 7:00 AM to 3:00 PM. For scheduling and training effectiveness, no one class will be longer than 4 hours.

2. Operations Sessions

- a. Overview of the equipment and its' auxiliary support/systems covering nomenclature, function and theory of operation.
- b. General safety requirements for operation of the equipment and its' auxiliary/support systems, including suggested safety equipment.
- c. Pre-start-up safety and equipment check.
- d. Equipment and auxiliary/support systems start-up procedures covering manual and automatic modes, if available.
- e. Routine operation and monitoring requirements; including specifics on normally expected ranges for items such as oil, water pressure and temperatures, discharge pressures, sensory observations, etc., procedures to change operating parameters (such as air or flow rates).
- f. Equipment/systems shut down procedures covering manual and automatic modes (if applicable).
- g. Operational troubleshooting of equipment and auxiliary/support systems.
- h. Procedures for handling non-routine operational problems such as response to alarms, power failures, emergency shutdown, auxiliary/support system failures, etc.

3. Maintenance Sessions

- a. If session is specific to a discipline; (e.g., electrical, mechanical, I&C), include only appropriate maintenance items for the discipline. If session is to include multiple disciplines, include all items for those disciplines and indicate in submittal outline which discipline the material refers to.
- b. For All Disciplines provide:
 - 1) An overview of the equipment and its' auxiliary/support systems covering nomenclature, function and theory of operation.
 - 2) General safety requirements for maintenance of the equipment and its' auxiliary/support systems appropriate to each discipline including suggested safety equipment and practices. Cover local/remote lockout procedures, safe procedures for handling alarms and built in safety devices during preventive and corrective maintenance.
 - 3) Overview of pre-start-up, routine operation monitoring, and shutdown procedures covering automatic and manual modes (if applicable).
- c. For Each Specific Discipline provide:
 - 1) Preventive maintenance procedures to be followed; include parts' lube quantities, types, frequencies, application points, time requirements to perform procedures, etc.
 Note: Information should be provided to trainees from the O&M manuals which cross references manufacturer's lube requirements.
 - 2) Specific procedures to cover adjustment requirements for alignment, wear, calibration, etc. for all preventive maintenance and corrective maintenance procedures, including time required to perform.
 - 3) Special tools, techniques or procedures required for either preventive or corrective maintenance of equipment or its' auxiliary support systems.
 - 4) Assembly/disassembly procedures required for preventive or corrective maintenance, including time required to perform.
 - 5) Maintenance troubleshooting of equipment and auxiliary/support systems.

F. Post-Startup Services

1. Provision for assistance to the Owner in the calibration, tuning and troubleshooting, plus any additional training which may be required during the one-year guarantee period.

1.03 SUBMITTALS

1. Submit instructor qualifications, training outline, and lesson plans 90 calendar days prior to pre-startup operator training. Qualifications of the factory trained service representative, as defined below.
2. Submit trainee manuals at least 30 calendar days prior to scheduled training.
3. Training Outline/ Lesson Plans:
 - a. 4 copies
 - b. Training outline/lesson plans to cover each major trainee group (i.e.: operations, electrical maintenance, instrumentation, etc). If the same session outline is to be used for more than one type of trainee group, such as one which would cover equipment identification and principals of operation, this information should be so indicated on the outline. The outline should be detailed and include length of session for each major topic and type of session; i.e., field or classroom.
 - c. The lesson plan shall be cross referenced to the trainee manuals provided and include instructor references for the use of training aids, training strategies, etc. They should contain sufficient technical material to guide the instructor in the delivery of the training material session. Lesson plans are to be provided for each separate technical discipline to be trained. Generic "informational" lesson plans may be used for

multiple trainee discipline target groups. The specific number of lesson plans for each session will be determined by the complexity, content and objectives of the subject equipment covered.

- d. The purpose of the manual is to provide specific guidance for the instructor and the trainees on what is to be taught and how, as well as to insure consistency and completeness of the sessions when they are presented to different groups of the same target trainee group.
4. Trainee Manuals
 - a. 4 final copies.
 - b. Key trainee manuals to the training outline. Copies should be available to pass out to each trainee at the session, they are to be retained by the trainee for future use. This trainee manual is not the O&M manual required in the specification, however, similar materials may be included as appropriate.
 - c. The purpose of the manual is to provide an organized package of information for the trainee, which will be used during the training sessions as well as for future reference material.
 - d. The organization of the manual should correspond to the training outline. Material in the manual should include information on the training topics, the training outline, and other relative reference material. Specifically, all manuals should be geared toward an eighth grade level of reading.
 - e. Manuals for Operations training sessions should include a description of the equipment, pre-start-up checks, start-up and shutdown procedure, specific monitoring checks including expected parameters, troubleshooting and safety procedures, etc. as described previously.
 - f. Manuals for Maintenance training sessions should include a description of the equipment, pre-start-up checks, start-up and shutdown procedure, specific monitoring checks including expected parameters, troubleshooting and safety procedures, etc. as described previously.
 5. 2 copies of a catalog of all training materials including training outline, lesson plans and trainee manuals.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Factory trained service representative shall have the training and experience to provide technical and/or process related advice, and/or assistance, relating to the installation, operation, maintenance and utilization of the products that he represents. Additional qualifications may be specified elsewhere.
2. Representative is subject to acceptance by Engineer. No Substitute representatives will be allowed unless prior written approval by Engineer has been given.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

- A. Equipment and Components Requiring Services is listed in the Table at the end of this section.

B. Provide a credit to the Owner for unused service manhours as specified below, at the manufacturer's published field service rate plus travel costs.

SERVICES OF MANUFACTURER'S REPRESENTATIVE
Manhour Requirements Table

Specification Section	Section Number	Supervision of Installation	Equipment Checkout	Field Acceptance Tests	Pre-Startup Operator Training	Post-Startup Services

EQUIPMENT CERTIFICATION

Owner: _____ Date: _____

Project : _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

Specification Section: _____

As an authorized representative of the Equipment Manufacturer, the undersigned certifies that the equipment listed above conforms to the requirements of the construction contract between the Contract and the Owner. The undersigned further certifies that the equipment has been installed in accordance with the Manufacturer's written instructions, that the equipment is ready for permanent operation and that nothing in the installation will render the Equipment Manufacturer's warranty null and void.

(Authorized Manufacturer's Representative)

Date: _____

(Witness)

Date: _____

Remarks: _____

EQUIPMENT TRAINING CERTIFICATION

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

Specification Section: _____

As an authorized representative of the Equipment Manufacturer, I certify that I have trained the Owner's personnel in the proper operation and maintenance of the above equipment.

(Authorized Manufacturer's Representative)

Date: _____

The following personnel listed below attended the training session(s):

(Owner's Representative)

Date: _____

(Beta Group, Inc. Witness)

Date: _____

END OF SECTION

SECTION 01680

EQUIPMENT AND SYSTEM CHECKOUT, CERTIFICATIONS AND TESTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements and procedures for physical checkout certification, and testing of equipment.

1.02 DEFINITIONS

- A. 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).
- B. Equipment 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 functional testing.
- C. Field 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. While field testing can be described as "shop testing in the field", it may be required regardless of whether or not shop testing was performed on the same piece of equipment or material.
- D. 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.
- E. Manufacturer's Representative, sometimes referred to as the Factory-Trained Service Technician, is defined as a person or persons provided by the manufacturer, 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 manufacturer, for installation and utilization in the work. Such training and experience shall include a minimum of three years participation in similar work including no less than three similar projects during this three year period. The qualifications of each representative must be submitted to the Engineer for approval at least 30 days prior to their first site visit.
- F. The Testing 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 at least two similar projects in the last four years.

1.03 ROLES AND RESPONSIBILITIES

- A. The Contractor shall 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, engineers, quality control technicians, manufacturers' representative(s), and required governmental agency representatives.

1.04 CHECKOUT PLAN

- A. The Contractor shall submit a checkout plan based upon the requirements defined herein to the Engineer. Six copies of checkout plan (preliminary) shall be submitted for review within 90 calendar days prior to the proposed date of the first test, whichever occurs first. The plan shall define:
 - 1. The logical and systematic performance of physical inspections, shop, field, and system tests.
 - 2. 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.
 - 3. Participants in the testing.
 - 4. Special test equipment.
 - 5. Sources of the test media (water, power, air) and the proposed method of delivery of the media to the equipment to be tested.
 - 6. Ultimate disposal of the test media.
- B. The plan shall be reviewed by the Engineer, modified or revised as necessary by the Contractor, then approved by the Engineer. The Contractor shall continue to update the checkout plan, working in conjunction with the Engineer prior to the start of the scheduled equipment checkout and functional testing activities.
- 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, as approved by the Engineer.

1.05 EQUIPMENT AND SYSTEM CHECKOUT AND CERTIFICATIONS

- A. Checkout is defined as inspection by the Contractor, Engineer and Owner to verify conformance to the contract drawings and specifications. Checkout procedures will be conducted by the Contractor in the presence of the Engineer and Owner to verify the presence, appropriateness, and proper construction or installation of each being "checked out". Typical elements of the checkout include the following:
 - 1. Verify exterior areas for backfill, grading, surfacing, drainage, landscaping, roadways, fencing, and gates.
 - 2. Verify buildings for structure, masonry, architectural, mechanical systems, electrical/lighting, communications, and HVAC.
 - 3. Verify concrete structures for structural integrity, finish tolerance, durability, appearance, embedded and inserted items, painting and surface applications.
 - 4. Verify steel structures for member alignment, connection bolts torque, connection welds integrity, painting, fire proofing and surface applications.
 - 5. Verify mechanical systems and items for setting, alignment and securing, check and adjust packing and seals, lubrication, drying out, drive connection and alignment

including rotation and belt/chain tension, painting or surface applications, and tagging for project system.

6. Verify piping systems for material, size, components, direction, alignment of joints and bolts/welding, packing and seals, screens and filters and strainers, leak and pressure hydro tests, painting and color coding, hangers and anchors and expansion provision and supports, clean out of foreign matter and tagging for project system.
 7. Verify electrical and control/instrumentation systems for conduit and tray installation, wire/cable material and size, circuit continuity and identification, voltage testing, ground continuity and testing, terminal installation and identification, jar switches and circuit breakers and transformers tested, substation operation tested, and tagging for project system.
 8. Verify communication system including telephone, fire/smoke alarm, security, page/part, closed circuit TV similar to electrical above.
 9. Verify computer systems by station, function, and network interface.
- B. Each piece of equipment and system must be certified by the manufacturer's representative as specified in Section 01665 Services of Manufacturer's Representatives.
- C. Certifications shall not be completed until an Operation and Maintenance Manual has been submitted and approved.

1.06 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 equipment and system testing process defined herein and in accordance with the approved checkout plan.
- B. Provide ninety 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 prove conformance with 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.
 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. Provide test forms 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 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. 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. Operational Requirements. Include valve positions, set-ups, gate positions, including temporary arrangements that are required to run the tests so that the Owner can anticipate and plan for the testing situation.
 9. Provide seven days written notice to the Engineer 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.
- C. Field test procedures will be reviewed and returned by the Engineer within 30 days of receipt. 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.
- D. Submit within one week after completion of the tests, the following to the Engineer for approval:
1. Completed test forms for each device tested.
 2. Completed certification documentation.
 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 SYSTEM TESTING

- A. Specific system tests shall be performed by the general contractor in addition to the requirement for shop, field, and other tests called for in the technical specifications. System tests will be performed with fluid or gaseous substances that are generally non-septic, non-corrosive, non-toxic, and non-inflammable.
- B. Provide 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 Engineer for approval:
1. 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.
 2. 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.
 3. Schedule for Testing: Schedule shall include frequency of measurements, personnel present, and contingency plans for equipment and/or system test failure.
 4. Test forms. Provide test forms for recording reporting on the field test data, prior to the test.
 5. Material and equipment required for the test. This material and equipment shall be supplied at no additional cost to the Owner.
 6. 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 system testing purposes. 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.

7. Operational Requirements. Include valve positions, set-ups, and gate positions that are required to run the tests in the written request so that the Engineer can anticipate and plan for the testing.
 8. Provide seven days written notice to the Engineer 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.
- C. The Engineer, and the Owner may witness the performance of these tests, at their option.
- D. A review of the system test package by the Engineer will be made within two weeks of receiving the package. The Contractor shall incorporate minor comments on the procedures, equipment, and personnel prior to testing. Major comments by the Engineer will require a resubmission of the system test package and test date.
- E. Submit within one week after completion of the tests, the following to the Engineer for approval.
1. Completed test forms, for each device.
 2. Completed certification.
 3. A written summary of testing, reporting on the results and summarizing the entire procedure.
 4. A schedule for retesting, if necessary, 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.

1.08 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 replacement, to the option of the Engineer. 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.

1.09 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 CLOSE-OUT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for specific administrative procedures, record keeping, close-out submittals, and forms used at substantial and final completion of the Work.
- B. Contractor shall satisfy all administrative requirements within the Contract Documents and the Requirements listed in this section prior to Contract Close-out.

1.02 FINAL CLEANING

- A. 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 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.
- B. The Contractor shall restore or replace, when and as directed, any public or private property damage 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.
- C. Unless otherwise specified under the various Sections of the Specifications, the Contractor shall perform final cleaning operations as herein specified prior to final inspection.
- D. At completion of work, remove waste materials, rubbish tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces; leave project clean and ready for occupancy.
- E. Cleaning shall include all surfaces, interior and exterior in which the Contractor and all Subcontractors have had access whether existing or new.
- F. Refer to Sections of the Specifications for cleaning of specific products or work.
- G. Use only those materials which will not create hazards to health or property and which will not damage surfaces.
- H. Use only those cleaning materials and methods that are recommended by the manufacturer of surfaces material to be cleaned.
- I. Employ experienced workmen, or professional cleaners, for final cleaning operations.

1.03 PROJECT RECORD DOCUMENTS

- A. Project Record Documents also referred here as Record Drawings shall consist of all the contract drawings.
- B. The Contractor and all Subcontractors shall be required to maintain one set of Record Drawings, as the work relates to their Sections of the Specifications, at the site.
- C. Record Drawings shall be stored and maintained in the General Contractor's field office apart from other documents used for construction. The Record Drawings shall be maintained in a clean, dry, and legible condition and shall not be used for construction purposes.
- D. Record Drawings shall be available at all time for inspection by the Engineer. All deficiencies noted shall be promptly corrected.
- E. The following information shall be indicated on the Record Drawings for building construction:
 - 1. Record all changes, including change orders, in the location, size, number, and type both horizontally and vertically of all elements of the projects which deviate from those indicated on all the contract drawings.
 - 2. The tolerance for the actual location of utilities and appurtenances within the building to be marked on the Record Drawings shall be plus or minus two (2) inches.
 - 3. The location of all underground utilities and appurtenances referenced to permanent surface improvements, both horizontally and vertically at ten (10) ft. intervals and at all changes of direction.
 - 4. The location of all internal utilities and appurtenances, concealed by finish materials, including but not limited to valves, coils, dampers, vents, clean outs, strainers, pipes, junction boxes, turning vanes, variable and constant volume boxes, ducts, traps and maintenance devices. The location of these internal utilities, appurtenances and devices shall be shown by offsets to the column grid lines on the drawings.
 - 5. Each of the utilities and appurtenances shall be referenced by showing a tag number, area served and function on the Record Drawings.
 - 6. Prior to the installation of all finish materials, a review of the Record Drawings shall be made to confirm that all changes have been recorded. All costs to investigate such conditions shall be borne by the applicable party as demonstrated by the Engineer.
- F. The following information shall be indicated on the Record Drawings for sewer construction:
 - 1. Location of manholes with 3 swing ties.
 - 2. Linear distance of sewer from manhole to manhole, including size and type of pipe.
 - 3. Manhole rim elevation and invert elevations of all pipes within manholes, including drops.
 - 4. Recalculated pipe slopes based on record elevations.
 - 5. Location in feet from downstream manhole of wyes and chimneys and vertical height of chimneys.
 - 6. Length of service connections.
 - 7. Location of service connection terminus (at property line) with 3 swing ties and depth from existing surface grade.
 - 8. Pumping station information as detailed in 1.03, E.
- G. The following information shall be indicated on the Record Drawings for water main construction:

1. Linear distance along watermain from appurtenance (i.e. vault to tee, tee to bends, bends to valves, blow offs and service corporations, including size and type of pipe).
 2. Depths of pipe and fittings.
 3. Location of vaults, valves, hydrants, bends, blow offs and service curb boxes with 3 swing ties.
 4. Rim elevation on vaults (meter, air release etc.).
- H. The following information shall be indicated on the Record Drawings for storm drain construction:
1. Rim elevations on inlets, catch basins, manholes and other structures.
 2. Invert elevations of all pipes within inlets, catch basins, manholes, end sections, headwalls, culverts and other structures.
 3. Linear distance along drain from structure to structure, and branch connections, including size and type of pipe.
 4. Recalculated pipe slopes based on record elevations.
 5. Location of manholes, inlets, catch basins, outlets, headwalls, other structures and service line connections with 3 swing ties.
- I. At the end of each month and before payment for materials installed, the Contractor, and his Subcontractors, shall review Record Drawings for purpose of payment. If the changes in location of all installed elements are not shown on the Record Drawings and verified in the field, then the material shall not be considered as installed and payment will be withheld.
- J. At the completion of the contract, each Subcontractor shall submit to the Contractor a complete set of his respective Record Drawings indicating all changes. After checking the above drawings, the Contractor shall certify in writing on the title sheet of the drawings that they are complete and correct and shall submit the Record Drawings to the Engineer.

1.04 EQUIPMENT AND SYSTEM CHECKOUT, CERTIFICATIONS AND TESTING

- A. Comply with requirements of Section 01680 Equipment and System Checkout, Certifications and Testing.

1.05 OPERATING AND MAINTENANCE MANUALS

- A. Comply with requirements of Section 01730 Operation and Maintenance Manuals.

1.06 SPARE PARTS

- A. Comply with requirements of Section 01750 Spare Parts.

1.07 LUBRICANTS

- A. Comply with requirements of Section 01751 Lubricants.

1.08 WARRANTIES

- A. Comply with requirements of Section 01740 Warranties.

1.09 FINAL INSPECTION

A. The Contractor shall submit written certification that:

1. Project has been inspected for compliance with Contract Documents.
2. Equipment and systems have been tested in the presence of the manufacturer's representative and are operational and satisfactory.
3. Project is completed, and ready for final inspection.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01710

STARTUP

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Startup requirements for processes, equipment and components, and the roles and responsibilities of the Contractor and the Owner.

1.02 DEFINITIONS

- A. Startup: The initial operation of a sufficiently completed facility and/or plant by the Owner, utilizing wastewater and related substances (sludge, wastewater, scum), or other media, which the facility has been designed to process.

1.03 DESCRIPTION OF WORK

- A. The primary responsibility for startup rests with the Contractor with assistance from the Owner as specified herein.
- B. 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 his work will effect or be effected by the existing facilities operation he 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 effected and the assistance requested of the Owner.
- C. At the discretion of the Engineer, individual startups may be required for various phases of the work. If this occurs, the phase startups will be ordered by the Engineer when the following has been completed for all equipment and systems within each Phase. The Engineer may order the startups prior to the completion of non-essential items of work.
 - 1. Compliance with Section 01665 Services of Manufacturer's Representatives, including:
 - a. Supervision of Installation
 - b. Equipment Checkout
 - c. Field Testing of Equipment
 - d. Pre-Startup Operator Training
 - 2. Compliance with requirements of Section 01680 Equipment and System Checkout, Certifications and Testing
 - 3. Compliance with requirements of Section 01730 Operation and Maintenance Manuals
 - 4. Compliance with requirements of Section 01750 Spare Parts
 - 5. Compliance with requirements of Section 01751 Lubricants
- D. The Contractor shall be responsible for maintaining all equipment until the dates of substantial completion.
- E. The Contractor shall assist the Owner during startup in any way deemed appropriate by the Engineer.

- F. There will be a date of substantial completion certified by the Engineer for each Phase of construction. These dates will not be certified until the following requirements have been satisfied by the Contractor:
1. All Contract requirements are coordinated into a fully operational system. All individual units of equipment and treatment processes are fully operative and performing at specified efficiencies. Where efficiencies are not specified, performance must meet acceptable standards for the particular unit.
 2. All field tests have been completed and satisfactory reports forwarded to the Engineer.
 3. All pre-startup training has been completed by the manufacturer's representatives.
 4. All spare parts and lubricants have been satisfactorily delivered to the Owner.

1.04 ROLES AND RESPONSIBILITIES

A. Contractor's Responsibilities

1. Startup
 - a. Develop specific startup plans and schedule.
 - b. Provide specific startup material and operating supplies until substantial completion or until acceptance of a specific system. Supplies include lubricants, chemicals, gases, specialized fluids, electric power, water (City and non-potable process water) and all other required appurtenances.
 - c. 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.
 - d. Clarify submittals, testing requirements, schedules, or other items related to the startup of the equipment and facilities specified and indicated in the Contract Documents.
 - e. Correct all failures or equipment problems identified during startup when notified by the Engineer.
 - f. Attend meetings related to the review of startup plan(s).
2. Performance Testing (where specified in individual technical specifications Sections 11 through 16).
 - a. Review procedures for performance testing.
 - b. Provide manufacturer's representative to provide guidance during performance testing.
 - c. 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.
 - d. Resolve and correct all equipment or system failures during the performance testing.
3. Provide to the Engineer a list of 24 hour, "on call" representative supervisory persons who will monitor the startup and performance testing.

B. Owner's Responsibilities

1. Assist in the startup 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 startup.

1.05 SUBMITTALS

- A. Specific Startup Plans and schedule for all phases of startup.
- B. List of 24-hour "on call" representative supervisory persons.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for compiling and submitting operation and maintenance manuals.

1.02 OPERATION AND MAINTENANCE MANUALS

A. General

1. Include all elements and components of the system including instrumentation. Provide a description of how the equipment or complete system works. Additionally, where a number of components are furnished to provide a complete system, describe the operation of components as they relate to the complete system.
2. Include all necessary instruction for the maintenance and operation of the equipment or system in accordance with the manufacturer's recommendations, and as herein specified.
3. Customize the manual so that only data pertaining to the specific equipment or system to be furnished is included. If a standard type manual is utilized, it shall be neatly annotated to highlight the data pertaining to, and deleting the data not pertaining to, the specific equipment or equipment being furnished.
4. Bind each manual for each type of equipment or system separately as specified below

B. Content of Manuals

1. Table of Contents and index. Provide title of Contract and schedule of products and systems, indexed to content of the volume.
2. Brief description of each system and components. Identify function, normal operating characteristics and limiting conditions. Include performance curves, with engineering data and tests. Include equipment Nameplate Data (Serial No., Model No., rating, voltage, etc.).
3. Names, addresses, and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
4. One copy of each approved shop drawing and each Contractor's coordination and layout drawing
5. Record drawings of wiring diagrams and control schematics including external connection diagrams.
6. Test and balancing reports, calibration data, alignment records, and other information.
7. Copy of any applicable warranties, guarantees and bonds
8. Operating Procedures:
 - a. Include start-up, break-in, and routine normal operating instructions and sequence. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - b. Manufacturer's printed operating instructions.
9. Maintenance Procedures:
 - a. Complete maintenance instructions (include routine, preventive and corrective maintenance).
 - b. Manufacturer's printed maintenance instructions, parts list, illustrations, and diagrams.

- c. Include maintenance schedule and types of lubricants. Cross-reference lubricants to products offered by at least three major lubricant suppliers.
10. Spare Parts:
- a. List of recommended spare parts, manufacturer's current price, and recommended quantity
 - b. Parts lists to include the specific part or identification number used by the manufacturer of the parts. Arbitrary sequential numbers or letters keyed to a sectional diagram are not satisfactory.
11. Additional Requirements: As specified in individual product specification sections.

C. Format

1. Binder

- a. Binders: Commercial quality, 8-1/2 x 11 inch three-ring binders with hardback, cleanable, plastic covers; two inch maximum ring size. When multiple binders are used, correlate data into related, consistent groupings. Provide a table of contents in each binder.
- b. All binders to be of similar design and color, but sized to suit the individual manuals with a minimum allowable edge of width of 1 inch.
- c. Identify each manual with a permanent label affixed to the outside binding of the binder and include the following information:
 - 1) Name of Contract, Contract Number
 - 2) Location of equipment or system (i.e. Primary Settling Tanks)
 - 3) Common name of equipment or system (i.e. Chain and Flight Sludge Collectors)
- d. Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

2. Material for Content

- a. Loose leaf on 60 pound, punched paper
- b. Holes reinforced with plastic cloth or metal
- c. Page size, 8 1/2 by 11 inches
- d. Diagrams, illustrations, and attached foldouts as required, of original quality, reproduced by dry copy method
- e. Drawings: Provide with reinforced punched, binder tab. Bind in with text; fold larger drawings to size of text pages

1.03 SUBMITTALS

- A. Sample of typical binder, cover and tabbed fly leaf.
- B. Provide three (3) copies of O&M manuals for approval no later than the time that the equipment is delivered to the site. If the manual is satisfactory, the Engineer will retain all three (3) copies. If the manual is not satisfactory, the Engineer will retain one (1) copy and return five (2) copies to the Contractor. When manuals are resubmitted, three (3) copies will again be required. When the manual is satisfactory, except for some missing information, the Engineer may, at his option, retain all three (3) copies of the manual and request three (3) copies of the additional information to be provided.
- C. All manuals pertaining to equipment or a system within each specific components of construction must be completely approved prior to the Field Acceptance Tests of that component.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01740

WARRANTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers standard warranties on products and special warranties.

1.02 SUBMITTAL

- A. 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 a date of Substantial Completion for the Work, or a designed portion of the Work, submit written warranties upon request of the Owner.
- B. 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 prior to acceptance of this portion of the Work.
- C. Refer to individual Sections of Division 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.

1.03 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.

1.04 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. 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.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01750

SPARE PARTS

PART 1 GENERAL

1.01 DESCRIPTION

- A. Spare parts which are identical and interchangeable with original parts shall be provided with equipment as specified in each Section of the Specifications. Spare parts shall be individually packaged in boxes bearing the equipment reference, tag number, and part identification (Example: Primary Scum Pump No. 1).
- B. Subsequent to the approval of the appropriate operation and maintenance manuals but prior to the delivery of the spare parts, the Contractor shall prepare and submit an itemized tabulation of all spare parts to be provided. The tabulation shall include the name of the equipment for which the spare part is intended, type of spare part, manufacturer of spare part, manufacturer model or manufacturer identification number of spare part, quantity of spare part, and page in the appropriate operation and maintenance manual detailing the parts list.
- C. Spare parts shall be stored by the Contractor in a location approved by the Engineer. Unless otherwise directed by the Engineer, the Contractor shall deliver the spare parts to the Owner at the time of "Substantial Completion." Spare parts shall be stored in accordance with the manufacturer's written recommendations, and shall be protected against theft, vandalism, weather, and all other adverse conditions. Spare parts delivered to the Owner shall be in new, undamaged condition. Upon delivery to the Owner, spare parts shall be logged in against the above noted tabulation and inspected by the Contractor in the presence of the Engineer. Any missing or damaged spare parts shall be replaced by the Contractor at no expense to the Owner.

1.02 SPECIAL TOOLS

- A. Provide special tools required for operation, service, or maintenance of the products as specified or as needed, as determined by the manufacturer's representative.
- B. Pack items to protect them during storage. Tag items and containers to clearly identify them.

1.03 CONTRACT SPECIFIC REQUIREMENTS

- A. Specific requirements for spare parts for this contract are included in the technical specifications.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01751

LUBRICANTS

PART 1 GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall furnish and deliver to the Owner such oil, grease and any special lubricants that are necessary for proper operation of all equipment furnished under this contract. The quantity furnished shall be sufficient for one year's operation after the date of substantial completion. The grade of lubricants furnished shall be in accordance with the recommendations of the equipment manufacturers.
- B. Subsequent to the approval of the appropriate operation and maintenance manuals but prior to the delivery of the lubricants, the contractor shall prepare and submit an itemized tabulation of all lubricants to be provided. The tabulation shall include the name of the equipment for which the lubricant is intended, its tag number, type of lubricant, manufacturer of lubricant, frequency of lubrication, quantity of lubricant required for one year, and page in the appropriate operation and maintenance manual referencing the lubricant.
- C. All lubricants shall be delivered to the Owner prior to the start-up of the equipment. They shall be delivered in the manufacturer's unopened containers and shall be labeled with the equipment name for which it is to be used. At the time of delivery they shall be logged in against the above noted tabulation and inspected by the Contractor in the presence of the Engineer.
- D. The Contractor shall also furnish and deliver to the Engineer such grease guns and auxiliary lubricating devices as are required to conveniently maintain all equipment furnished. As a minimum, one grease gun and accessories will be furnished for each individual item of equipment requiring lubrication.
- E. Prior to substantial completion, the Contractor shall submit an "Equivalent Lubrication Table" which shall list equivalent products from at least four major oil companies for all lubricants that will be required for all the equipment provided under this Contract.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01800

MAINTENANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for maintaining work completed under this Contract.

1.02 MAINTENANCE PERIOD

- A. The general maintenance period for all construction or materials under this Contract shall be one (1) year subsequent to the date of the acceptance of the work by the Owner, or as provided by other sections of this Specification.
- B. If the Owner puts any structure or equipment to use prior to acceptance of all work under the Contract, the maintenance period for such structures or equipment shall be calculated from the time use begins.
- C. Contractor agrees to replace the material which does not conform to the Contract requirements, and to repair any damage of material or work without cost to the Owner, to satisfaction of Engineer, in conformance with Contract Documents provided orders for replacement and/or repairs are received in writing by the Contractor within the one year period.
- D. This Section shall in no way limit the duration of the Contractor's responsibility for the correction of any defect due to workmanship or materials provided by the Contractor which are not in compliance with the Contract Documents.

1.03 ABUSE OF WORK

- A. Contractor is not obligated to perform work of replacement or repair that he may prove is required because of abuse by parties other than the Contractor, after the date the Owner puts to continuous use the work requiring replacements or repair, or after date the Owner has approved the Certificate of Completion.

1.04 EMERGENCY REPAIRS

- A. If the Owner deems necessary, the Owner shall order replacement or repairs be undertaken within 24 hours.
- B. If the Contractor delays or fails to make the ordered replacement or repairs within the time specified, the Owner shall have the right to make such replacements or repairs and the expense shall be deducted from moneys due the Contractor, or moneys of the Contractor retained by the Owner.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01810

MAINTENANCE OF PLANT OPERATION AND SEQUENCE OF CONSTRUCTION

PART 1 GENERAL

1.01 GENERAL PROVISIONS

- A. The existing wastewater treatment facility will be maintained in continuous operation by the Contractor at all times during the entire construction period. The Contractor shall schedule his operations to conform with the requirements specified herein, and shall include in his construction progress schedule all events which will impact operation of the existing treatment facilities.
- B. The Contractor shall at all times conduct his operations so as to interfere as little as possible with existing works. The Contractor shall develop a program, in cooperation with the Engineer and interested officials, which shall provide for the construction and putting into service of the new works in the most orderly manner possible. This program shall be adhered to except as deviations there from are expressly permitted. All work of connecting with, cutting into, and reconstructing existing pipes or structures shall be planned to interfere with the operation of the existing facilities for the shortest possible time and when the demands on the facilities best permit such interference, even though it may be necessary to work outside of normal working hours to meet these requirements. Before starting work which will interfere with the operation of existing facilities, the Contractor shall perform all preparatory work and shall see that all labor, tools, materials, and equipment are made ready and at hand.
- C. The Contractor shall make minor modifications in the work relating to existing structures as may be necessary to satisfactorily complete the work, without additional compensation.
- D. The Contractor shall plan and conduct his work so that such work does not adversely impact the intended plant operation. The Contractor's operations shall in no way cause a reduction in the effluent quality or create any nuisance not normally attributable to such operation, unless approved by the Owner, Engineer and State regulatory agencies. It shall be the Contractor's responsibility to ensure complete compatibility with the plant operations in his working schedules.
- E. All costs associated with maintaining existing flows and plant operations, including providing, maintaining, operating, and removal of all equipment and required appurtenances, shall be considered part of the work being constructed. It being understood and agreed to by the Contractor that the cost to complete the work shall constitute full and complete compensation to the Contractor for providing all provisions necessary and/or required for maintaining flow during construction.

1.02 RELATED WORK

- A. Section 00700 - General Conditions
- B. Section 00800 - Supplementary Conditions
- C. Section 01010 - Summary of Work
- D. Section 01300 - Submittals
- E. Section 01310 - Construction Progress Schedule

- F. Section 01510 - Temporary Utilities
- G. Section 02050 - Demolition
- H. Section 02149 - Maintaining Existing Flow

1.03 SUBMITTALS

- A. Submit, in accordance with the provisions of Section 01300, complete descriptions of procedures to maintain facility operation to supplement the construction progress schedule developed in accordance with Section 01310. The description shall include step-by-step procedures, required duration, and specific procedures required to be performed by the Owner's personnel.

1.04 CONTRACTOR'S AND OWNER'S RESPONSIBILITIES AND LIMITATIONS

- A. The Contractor's construction activities shall not disrupt operation of the existing pumping station, nor the influent sewers, no matter how minor, without the approval of Plant operations personnel, the Engineer and Owner.
- B. The Contractor shall not operate or utilize any existing plant facilities. This includes the starting and stopping of equipment, the opening and closing of valves or the use of existing piping. Whenever the construction work requires action by the Owner, the Contractor shall so notify the Engineer as described below.
- C. The Contractor shall notify the Engineer in writing of any construction activity that will affect facility operations or require assistance from the Owner in operating any existing facilities. This notification shall be received at least one week prior to the planned construction work. The request shall clearly detail the Contractor's planned work, how his work will affect the operation of the existing facilities, the estimated duration of the work, and any assistance required of the Owner. The Contractor's request shall also explain why other construction methods, which may have less of an impact on treatment operations, are not feasible.
- D. It is emphasized that the operations of the existing facilities take precedence over all construction activities. Denials of requests from the Contractor for the Owner's assistance in modifying his plant operations shall not be a basis for any claim by the Contractor. Any approved assistance given to the Contractor from the Owner will be provided when the Owner's schedule and manpower permit. The Contractor shall also provide access for the Owner's personnel to all existing facilities at all times throughout the construction period.

1.05 SEQUENCE OF CONSTRUCTION

- A. The detailed schedule for construction shall be based upon the schedule submitted by the Contractor and approved by the Engineer as specified above. However, as a guide for the Contractor in the preparation of his schedule, scheduling requirements are described below for specific portions of the work.
- B. The order of construction shall be subject to the approval of the Engineer; such approval or direction, however, shall in no way relieve the Contractor's responsibility to perform the work in strict accordance with the Contract Documents. The construction plans and specifications have been developed to minimize the construction impacts on the operation of the Pumping Station, influent sewers and discharge force mains. The Contractor shall note the requirements of Section 01010 with regard to the operation of the pumping station and the phasing of

construction when developing his work sequence. The Contractor's work sequence must be specifically detailed in the CPM which is required under Section 01310.

- C. Whenever the Contractor's proposed work will require the Owner to deviate from the normal operation of the plant, the Contractor shall so notify the Engineer in writing. Such notification shall be submitted one week prior to the planned construction activity and shall include all information as described in Section 01010.
- D. Contractor should note that other construction activities being performed under separate contracts will be underway at the time this contract is awarded. Contractor shall coordinate activities, as required, to minimize conflicts with other construction activities being performed on the property.
- E. Construction requirements for various work items are presented below. Note that these are only general requirements. The Contractor may wish, or may find it necessary, to alter the sequence of construction. All necessary details and items of work are not purported to be included.

Gravity Thickeners:

A minimum of one (1) gravity thickener shall be online and operational at all times during construction.

Thickened Sludge Pumps:

- 1. A minimum of one (1) thickened sludge pump shall be maintained in operation at all times during construction

Sludge Dewatering:

- 1. A minimum of one (1) centrifuge shall remain in service until new Lime Silo is ready to be placed in service

END OF SECTION

DIVISION 02

SECTION 02050

DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for demolition of existing facilities and removal of equipment and materials for reuse or salvage.
- B. Buildings or areas scheduled for partial or selective demolition are shown on the Contract Drawings, as follows:

<u>Building Description</u>	<u>Description of Demolition</u>
1. Gravity Thickeners	Removal of Thickener Mechanisms and Covers (Sheet M-7.1)
2. Thickened Sludge Pump Station	Removal of existing thickened sludge pumps and piping (Sheet M-7.2)
3. Solids Handling Building First Floor	Removal of piping (Sheet M-7.3) Decommissioning of elevator***
4. Solids Handling Building Second Floor	Removal of existing solids handling equipment (Sheet M-7.4)

*****Decommissioning of the elevator shall be in accordance with the requirements of 524 CMR 11.00**

1.02 SUBMITTALS

- A. Shop Drawings
 - 1. In accordance with Specification SECTION 01300 1.03 Shop Drawings.
 - 2. Schedule of demolition included in and consistent with requirements of Specification SECTION 01300 1.02 Progress Schedules and SECTION 01310 Construction Progress Schedule.
- B. Quality Assurance/Control Submittals
 - 1. Methods of demolition and equipment proposed for use in demolition
 - 2. Copies of Permits required for demolition.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 PREPARATION

A. Equipment Salvage and Reuse

1. Do not remove equipment or materials without approval of Engineer.
2. Properly store and maintain equipment and materials to be reused in the Work.

3.02 SEQUENCE

- #### A. See SECTION 01810 Maintenance of Plant Operation and Sequence of Construction.

3.03 SAFETY

- #### A. Protect persons and property throughout progress of work.
- #### B. Have acceptable fire extinguishers available at all times where demolition by burning torches is being conducted.
- #### C. Burning of demolition debris not permitted on or near site.
- #### D. Explosives not to be used or brought to site without prior written permission by Engineer.
- #### E. Maintain circulation of traffic within area of demolition operations.
- #### F. Provide and maintain lights, barriers and temporary passageways for safe access within area of demolition operation.
- #### G. Take precautions to minimize spread of dust and flying particles. Keep work area wet down to prevent dust from rising.
- #### H. Provide maximum practical protection from inclement weather to materials, equipment and personnel in partially dismantled structures.

3.04 DEMOLITION

- #### A. Dismantle and remove appurtenances indicated without damaging existing structures, equipment and appurtenances to remain.
- #### B. Confine demolition work, new construction and operations to areas that will not interfere with continued use and operation of entire plant.
- #### C. On exposed surfaces, where there will be in the finish work a joint between old and new concrete, the existing concrete at the face shall be removed to a straight rather than a rough line.

3.05 REPAIR/RESTORATION

- A. Repair or remove and replace items not scheduled for demolition damaged by Contractors operations to original condition as directed by Engineer.
- B. The Contractor shall exercise extreme caution when removing sections of concrete from slabs or walls that are to be utilized as part of the new construction. Demolition shall be to the exact limits indicated on the Drawings. Over-excavated concrete shall be replaced at the Contractor's expense and to the satisfaction of the Engineer. Any damage to the remaining structure caused by the Contractor's operations shall be satisfactorily repaired at the Contractor's expense.

3.06 DISPOSAL

- A. Debris from structures, including concrete, masonry, steel or other rubble shall become the property of the Contractor, unless otherwise directed by the Engineer, and shall be promptly removed from site at the Contractor's expense.

3.07 CLEANING

- A. Leave affected areas of demolition in a clean, safe and orderly condition, ready to accept new work if proposed.

END OF SECTION

SECTION 02224

CONTROLLED DENSITY FILL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for controlled density fill (CDF) to be used in place of compacted soil for general backfill of trenches and/or excavations.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M 85 - Standard Specification for Portland Cement (Chemical and Physical)
2. AASHTO M 295, Class F - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

B. This specification makes reference to the requirements of additional specifications as listed. The Contractor shall obtain and familiarize himself with all requirements referenced by this specification prior to preparation and installation of any materials.

1. Massachusetts Department of Transportation Highway Division (massDOT), Standard Specifications for Highways and Bridges, 1988 Edition, including all addenda, issued by the State of Massachusetts Department of Transportation, (referred to as the Standard Specification).

1.03 DEFINITIONS

A. Controlled Density Fill, also known as "Flowable Fill" is a flowable, self-consolidating, rigid setting, low density material that can substitute for compacted gravel in backfills, fills and structural fills.

B. The two main categories of CDF's are Excavatable and Non-excavatable, with sub categories of flowable and very flowable.

C. Categories of CDF's:

1. Type 1 Very Flowable, non excavatable,
2. Type 1E Very Flowable, excavatable,
3. Type 2 Flowable, non excavatable,
4. Type 2E Flowable, excavatable.

D. Excavatable mixes shall be hand tool excavatable.

E. Very Flowable shall have very flowable characteristics for distances and small hard to reach areas.

1.04 DESIGN REQUIREMENTS

- A. Provide a mixture of Portland cement, aggregates, water and mineral admixtures with a low cement content and high slump to reduce strength development for possible removal and minimize settlement after placement.
- B. The proposed mix should maximize the flow characteristics of the material while producing the necessary strength.
- C. The mixes shall have the following design strengths:
 - 1. Non excavatable fill,
 - a. Type I (very flowable) and Type 2 (flowable),
 - b. Compressive strength at 28 days = 30 to 150 psi, 200 psi maximum at 90 days.
 - 2. Excavatable fill,
 - a. Type 1E (very flowable) and Type 2E (flowable),
 - b. Compressive strength at 28 days = 30 to 80 psi, 100 psi maximum at 90 days.
- D. Specific compressive strength(s) for structural applications are noted on the Contract Drawings.
- E. Slump
 - 1. Standard method = 10 to 12-inches.
 - 2. Modified method consisting of a six inch long by three inch inside diameter straight tube of non-porous material = 9 to 14-inches.

1.05 PERFORMANCE REQUIREMENTS

- A. Provide fill of homogeneous structure which when cured, will have the required strength, water tightness, and durability. To this end, it is essential that careful attention be given to the selection of materials, mixtures, placing and curing of the fill.

1.06 SUBMITTALS

- A. In accordance with Section 01300, submit the following,
 - 1. Mix design data not limited to, but including maximum and minimum strengths, air content, setting times, flowability and yield.
 - 2. Certification by the supplier stating compatibility with the project requirements and the Contractor's installation methods.

1.07 QUALITY ASSURANCE

- A. Furnish the supplier with information as to the intended use of the CDF.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Portland cement,

1. In accordance with AASHTO M85.
- B. Fly Ash (very flowable),
 1. In accordance with AASHTO M295, Type F.
- C. Sand,
 1. In accordance with Standard Specification M4.02.02
- D. Water,
 1. Clean and potable.
- E. Air entraining admixtures,
 1. In accordance with Standard Specification M4.02.05.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall follow the guideline set forth in ACI 229, except non standard materials shall not be used.

3.02 PREPARATION

- A. Pipes and all other members to be encased in CDF shall be temporarily secured in place to prevent displacement during fill placement.
- B. To reduce hydrostatic pressure and limit displacement potential, Contractor may use a high air generator in the fill mixture to lower unit weights.
- C. Pre-job test all pump applications prior to day of placement with actual equipment.
- D. Secure site during the placement for the CDF. Cautions include but are not limited to barricades, fences, lights and steel plates.
- E. Work shall be sequenced so as to keep traffic flowing within the project area.

3.03 INSTALLATION

- A. CDF shall be batched at concrete plants and hauled to job sites in ready-mix trucks with continuous agitating drums and be discharged with slumps as indicated.
- B. During waiting period prior to discharge, truck drums shall agitate mixture.
- C. CDF shall be installed in accordance with supplier's recommendations, be flowable and require no vibration.

3.04 FIELD QUALITY CONTROL

- A. All CDF to be used in the work shall be subject to testing to determine whether it conforms to the requirements of the specifications. The methods of testing shall be in accordance with the Standard Specification, and as approved by the Engineer.
- B. The place, time, frequency, and method of sampling will be determined by the Engineer in accordance with the particular conditions of this project.

3.05 PROTECTION

- A. Open excavations containing uncured CDF shall not be left uncovered overnight.

END OF SECTION

SECTION 02660

BIOFILTER

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. This specification covers the construction of the biofilter for odor control, including the installation of concrete walls, biofilter air piping, membrane, crushed stone, and biofilter media. Blowers, ductwork, and items outside of the biofilter are specified in other sections (see part 1.02 below)
- B. Work included: Furnish, install and test the biofilter complete with all appurtenances as shown on the drawings and specified herein.

1.02 RELATED SECTIONS

- A. SECTION 01300 – SUBMITTALS
- B. SECTION 01680 – EQUIPMENT AND SYSTEM CHECKOUT, CERTIFICATION AND TESTING
- C. SECTION 02200 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING
- D. SECTION 02215 – AGGREGATE MATERIALS
- E. SECTION 02620 – HIGH DENSITY POLYETHYLENE PIPE
- F. SECTION 11373 – ODOR CONTROL BLOWERS
- G. SECTION 15890 – STAINLESS STEEL DUCT FOR ODOR CONTROL

1.03 REFERENCES

- A. American Society for Testing and Materials
 - 1. D1593-99 Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300 and the General Conditions of the Construction Contract.
- B. Submit Manufacturer's "Certification of Conformance" that the pipe, fittings, insulation and soil and other appurtenances meet or exceed the requirements of these specifications.
- C. **Certification that all iron or steel concrete reinforcement, pipe, duct, and fittings are produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014**
- D. Samples
 - 1. The supplier shall prepare a sample of no less than one cubic foot of the media for approval by the engineer. A representative sample of the media shall be sent for analytical testing.

PART 2 – PRODUCTS

2.01 DESIGN

- A. The biofilter shall be constructed in three (3) sections, with separate headers from the headworks/grit chambers, sludge thickeners, and solids handling building. Media shall be installed in one continuous layer such that the biofilter acts as a single unit.

2.02 MATERIALS

A. Duct and Pipe

1. Above grade biofilter piping and fittings shall be either:
 - a. SDR 17 HDPE normal impact pipe (Specification Section 02620). OR
 - b. Fluoropolymer coated stainless steel duct (Specification Section 15890)
2. Below grade biofilter pipe and fittings shall be either:
 - a. SDR 17 HDPE normal impact pipe (Specification Section 02620). OR
 - b. SDR 35 PVC pipe (Specification Section 02622)
 - c. Perforated pipe for laterals and drains shall be shop drilled. Holes in each row are to be placed as shown on Drawings. Fittings shall be as shown on the drawings.

B. Crushed Stone

1. Shall be $\frac{3}{4}$ " washed stone, meeting the requirements of Specification Section 02215, Part 2.01(A). Stone shall be uniform material consisting of clean, hard, and durable particles or fragments, free from vegetable or other objectionable matter. Stone shall be free from a detrimental quantity of thin, flat, elongated, or other objectionable pieces. Stone shall be graded as shown on drawings.
2. The stone shall be reasonably free from clay, loam, or deleterious material and not more than 1.0 percent of satisfactory material passing a No. 200 sieve will be allowed to adhere to the crushed stone.
3. The engineer shall be notified of the location of the stone pile prior to shipment for inspection and testing.

C. Biofilter Walls

1. Biofilter walls shall be constructed of concrete, and may be either:
 - a. Precast concrete "ecology blocks". Ecology blocks shall be 2'x2'x4' (min) in size, must have an approximately 3" tongue-and-groove system, and an embedded rebar pick point for placement, as shown on drawings.OR
 - b. Reinforced cast-in-place concrete, in accordance with specification section 03300 and as detailed on drawings.

D. Biofilter Media

1. The Biofilter media shall be mixed at the volumetric ratio of 60% shredded wood to 40% bark mulch.
2. Shredded wood shall be obtained from fresh pine and spruce. The shredded wood material shall be uniformly sized and not contain more than 5% leaves, twigs,

- shavings, or other forms of fine wood particles. Shredded wood shall also be free from extraneous materials, stone, and other debris.
3. Bark mulch shall consist of pure bark species of fresh pine, spruce, and fir. Bark shall consist of fibrous pieces and shall not contain more than 30% wood by volume. Bark shall be ground to effectively remove all large pieces of raw bark. No more than 5% of bark grindings shall be larger than 3”.
 4. Biofilter media mixing shall be done either by bucket loader or by a screener. All mixing shall be done on a clean, flat, surface so that no ground contamination occurs. No separation of the wood and bark pieces shall occur in the finished biofilter media. Media shall be mixed off site and made available for inspection by the engineer prior to being shipped to the site. Prior to mixing the supplier shall provide the engineer with the date and mixing site so that the Engineer can inspect the mixing process.
 5. The supplier shall furnish the location(s) of all sources used in the preparation of the biofilter media to the Engineer. Supplier shall deliver to the engineer representative samples of the components that will be used to prepare the media. Analytical test results shall be provided for the compost showing that the compost meets specifications described above.
 6. Biofilter media as delivered to site may require moisture adjustment. As the media is placed the contractor shall add moisture to ensure that the media is consistently moist.
 7. The finished media shall conform to the following:

<u>Parameter</u>	<u>Allowable Range</u>
Moisture Content	35% to 70%
Filter media air filled pore space (at field capacity)	32% to 55%
Filter media pH	6.0 to 8.0

Particle Size Distribution

Sieve Size	% Finer By Weight
3”	90-100 %
2”	70-90%
1 ½”	60-80%
1”	50-70%
½”	40-50%
#4	20-30%
#10	10-20%
#20	5-15%
#40	1-5%
#200	<1%

E. Liner

1. The biofilter shall be lined with a 40 mil polyethylene sheet membrane. The membrane shall meet the requirements of ASTM D1593-99. Liner shall be RUFCO 4000B or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pipe, Fittings, and Crushed Stone

1. Prior to installation, lateral pipes shall have a series of holes shop drilled into the pipe according to the size, spacing and location shown on the Drawings. Pipes shall be installed with holes facing **down** as indicated.
2. Pipe and fittings shall be laid accurately to the lines and grades indicated on the Drawings and installed in accordance with the manufacturer's instructions. Pipe and fittings shall also be installed in compliance with the requirements of the applicable sections of Division 2. Care shall all be taken to ensure a good alignment both horizontally and vertically.
3. Stone shall be graded to provide firm, uniform and continuous support for the pipe. Stone shall be placed evenly around the pipe to the specified thickness and evenly graded prior to adding the next material layer. Mechanical compaction is permitted until the final depth of stone is achieve. Care must be taken to prevent damage to the pipe during compaction.
4. Prior to installing biofilter media, perform a smoke test for joint integrity and to demonstrate proper air distribution throughout the piping system. Replace broken or damaged pipe and fittings. Clean pipe and fittings in areas that are plugged and retest if necessary.

B. Biofilter Media

1. The components that make up the biofilter media shall be thoroughly mixed by blending or other suitable means so as to produce a homogeneous mixture. Mixing by hand will not be acceptable.
2. Cover the stone with media over the area and at the thickness shown on the Drawings. **DO NOT COMPACT.** Media thickness shall meet requirement shown on Drawings at one year from date of Substantial Completion. Install at sufficient thickness to account for consolidation during this period.

3.02 START UP TESTS

- A. The Biofilter System shall be tested after the startup and checkout of the Odor Control Blowers (Specification Section 11373)
- B. Following installation of the biofilter media, perform smoke test to demonstrate even air distribution. The Engineer shall serve as the sole judge of compliance with

distribution requirements. The Contractor shall adjust biofilter grade as necessary to provide even distribution, at no additional cost to Owner.

END OF SECTION

DIVISION 03

SECTION 03100

CONCRETE FORMWORK

PART 1 PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for forms to be used for all concrete masonry including footings, except as otherwise permitted.

B. Related Sections

1. Section 03200 - Concrete Reinforcement.
2. Section 03300 - Cast-In-Place Concrete.

1.02 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 318, Building Code Requirements for Structural Concrete.
2. ACI 347R, Guide to Formwork for Concrete.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Shop Drawings:

1. Layout of panel joints, tie hole pattern, and form liners.
2. Form Ties - Tapered Through-Bolts: Proposed method of sealing form tie hole; coordinate with details shown.

C. Samples: One each as follows:

1. Form liners.
2. Form ties.

D. Quality Control Submittals:

1. Statements of qualifications for formwork designer.
2. Manufacturer's Certificate of Proper Installation. (After installation)

1.04 QUALITY ASSURANCE

A. Qualifications: Formwork, falsework, and shoring designs prepared by an engineer licensed in the State of Massachusetts.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Surfaces to be given burlap-rubbed finish.

1. Form surface in contact with the concrete shall be made of heavy gage metal, new plywood (used plywood which, in the opinion of the Engineer, is substantially

- equal to new plywood may be used), tempered wood fiberboards with smooth surface, or similar materials.
2. Metal forms or form linings shall have square edges so that the concrete will not have fins or fluting. Joints between form panels shall be well fitted so as to be tight and result in substantially flush concrete surfaces on opposite sides of the joints.
 3. Forms shall not be pieced out by use of materials different from those in the adjacent form or in such manner as will detract from the uniformity of the finished surface.
- B. Surfaces other than those to be given burlap-rubbed finish.
1. Forms shall be made of wood, metal, or other acceptable material. Wooden forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots. Plywood shall be reasonable good, as accepted. Metal forms shall be of an acceptable type for the work involved. Edges of forms in contact with concrete shall be flush within 1/16 in.
- C. Forms shall be of suitable material, design, and construction as to be rigid, tight enough to prevent the passage of mortar, and plane surfaces shall be plane within 1/16 in. in 4 ft. Particular care shall be taken to ensure that forms are true to line where deviations in the concrete would be obvious or objectionable, as where building superstructures are to be built thereon, or where the tops of walls are exposed. All such deviations which may occur shall be corrected by, and at the expense of the contractor, as directed, even to the extent of tearing down and rebuilding the concrete.
- D. Forms for walls, columns, or piers shall have removable panels at the bottom for cleaning, inspection, and scrubbing-in of bonding grout. Forms for thin sections (such as walls or columns) of considerable height shall be arranged with suitable openings so that the concrete can be placed in a manner that will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the fresh concrete, unless special spouts are used to place concrete, and so that construction joints can be properly keyed and treated.
- E. Forms shall be sufficiently rigid to prevent displacement or sagging between supports, and so constructed that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for their adequacy.
- F. Wall Forms and Underside of Slabs and Beams:
1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in "new and undamaged" condition, of sufficient strength and surface smoothness to produce specified finish. Use in combination with form liners where required.
- G. All Other Forms: Materials as specified for wall forms.
- H. Form Sealer:
1. Material: Surface sealer will not bond with, stain, or adversely affect concrete

surfaces, and will not impair subsequent treatments of concrete surfaces, when applied to most forms of form liners. A ready-to-use water based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Environmentally safe, meeting local, state, and federal regulations and can be used in clean water treatment plants.

2. Manufacturer and Product: Master Builders, Inc.; Rheofinish; or Equal.
- I. Rustication Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces. Match the rustication grooves with the existing configuration and style located at the plant.

2.02 FORM TIES

A. Form ties to be encased in concrete shall not be made of through-bolts or commonwire, but shall be of a well-established type, so made and installed as to embody the following features:

1. After removal of the protruding part of the tie, there shall be no metal nearer than 1 in. to the face of the concrete.
2. The part of the tie which is to be removed shall be at least 1/2 in. in diameter, or if smaller, it shall be provided with a wood or metal cone 1 in. long placed against the inside of the forms. cones shall be carefully removed from the concrete after the forms have been stripped.
3. Ties which pass through walls subject to hydrostatic pressure shall be provided with acceptable water stops, such as washers, securely fastened to the ties.

B. Form Ties:

1. Material: Steel.
2. Spreader Inserts.
 - a. Conical or spherical type.
 - b. Design to maintain positive contact with forming material.
 - c. Furnish units that will leave no metal closer than 1 inch to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Flat bar ties for panel forms, furnish plastic or rubber inserts with minimum 1 inch depth and sufficient dimensions to permit patching of tie hole.
5. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:
 - a. Integral steel water stop 0.103-inch thick and 0.625 inch in diameter tightly and continuously welded to tie.
 - b. Neoprene water stop 3/16-inch thick and 15/16 inch in diameter whose center hole is 1/2 diameter of tie, or a molded plastic water stop of comparable size.
 - c. Water Stop: Oriented perpendicular to tie and symmetrical about center of tie.
 - d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.
6. Through-Bolts: Tapered minimum 1-inch diameter at smallest end.
7. Elastic Vinyl Plug: Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length, and diameter upon removal forming a watertight seal.
 - a. Manufacturer and Product: Dayton Superior Co., Miamisburg, OH; Dayton

Sure Plug, or equal.

PART 3 EXECUTION

3.01 SYSTEM DESIGN REQUIREMENTS

- A. Design formwork in accordance with ACI 347R and ACI 318 to provide the concrete finishes specified in Section 03300, CAST-IN-PLACE CONCRETE.
- B. Make joints in forms watertight.
- C. Limit panel deflection to 1/360 of each component span to achieve tolerances specified.

3.02 ERECTION

- A. General: Unless specified otherwise, follow the applicable recommendations of ACI347R.
- B. Forms shall be so constructed and placed that the resulting concrete will be of the shape, lines, dimensions, and to the elevations indicated on the drawings or specified, and exposed concrete will be substantially free from board or grain marks, poorly matched joints, and other irregularities or defects.
- C. Beveled Edges (Chamfer):
 - 1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
 - 2. Where beveled edges on existing adjacent structures are other than 3/4-inch, obtain ENGINEER's approval of size prior to placement of beveled edge.
- D. Wall Forms:
 - 1. Do not reuse forms with damaged surfaces.
 - 2. Locate form ties and joints in an uninterrupted pattern for smooth and uniform surface.
 - 3. Inspect form surfaces prior to installation to assure conformance with specified tolerances.
- E. Forms for Curbs, Sidewalks, and Driveways:
 - 1. Provide standard steel or wood forms to prevent movement.
 - 2. Set forms to true lines and grades, and securely stake in position.
- F. Form Tolerances: Provide forms in accordance with ACI 347R and ACI 318 and the following tolerances for finishes specified:
 - 1. Wall Tolerances:
 - a. Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
 - b. Plumb within 1/4-inch to 10-feet.
 - c. Depressions in Wall Surface: Maximum 5/16-inch when 10-foot straightedge is placed on high points in all directions.
 - d. Thicknesses: Maximum 1/4-inch minus or 1/2-inch plus from dimensions shown.
 - 2. Slab Tolerances:

- a. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
- b. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straight edge from resting on end blocks, nor low spots that allow a block of twice the tolerance in thickness to pass under the supported 10-foot straightedge.
- c. Steel gauge block 5/16-inch thick.
- d. Slab drainage.
 - 1) Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
 - 2) Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown, except where thickness tolerance will not affect slope, drainage, or slab elevation.

3.03 FORM SURFACE PREPARATION

- A. Thoroughly clean form surfaces in contact with concrete or previous concrete, dirt,
- B. Exposed Wood Forms in Contact with Concrete: Apply form sealer as recommended by the sealer material manufacturer.
- C. Steel Forms: Apply form sealer to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

3.04 FORM COATINGS

- A. All forms shall be oiled with an acceptable nonstaining oil or liquid form coating before reinforcement is placed.
- B. Before form material is reused, all surfaces that are in contact with the concrete shall be thoroughly cleaned, all damaged pieces repaired, and all projecting nails withdrawn.

3.05 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed until the concrete has aged for the following number of day-degrees*:
 - 1. Formwork not supporting weight of concrete, (i.e., sides of beams, walls, columns, and similar parts of the Work) may be removed after cumulatively curing at not less than a total of three 50-degree F days after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing protection operations are maintained.
 - 2. Leave forms and shoring for elevated structural slabs or beams in place, in accordance with ACI 318, Chapter 6, and until concrete has reached compressive strength equal to 80 percent of the specified 28-day compressive strength as determined by test cylinders.
 - 3. *Day-degree: total number of days times average daily air temperature at surface of concrete. For example, 5 days at a daily average temperature of 60 deg. F. equals 300 day-degrees.

3.06 MANUFACTURER'S SERVICES

- A. Provide form manufacturer's representative at site for installation assistance, and inspection.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for reinforcing steel bars, wire fabric and accessories as shown on the drawings, specified herein, and as needed for a complete and proper installation.

B. All concrete reinforcement specified in this section shall be produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

1.02 RELATED SECTIONS

- A. Section 03100 - Concrete Formwork.
- B. Section 03300 - Cast-In-Place Concrete.

1.03 REFERENCES

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

1. A82, Specification for Steel Wire, Plain for Concrete Reinforcement.
2. A185, Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
3. A497, Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
4. A615, Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
5. A706, Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
6. A775, Specification for Epoxy-Coated Reinforcing Steel Bars.

B. American Concrete Institute (ACI).

1. ACI 350, Code Requirements for Environmental Engineering Concrete Structures

1.04 SUBMITTALS

- A. In accordance with Section 01300 submit cutting and bending drawings and schedules for all reinforcement to be furnished.

B. Shop Drawings:

1. Prepare in accordance with Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice and ACI SP-66 Detailing Manual:
 - a. Bending lists.
 - b. Placing drawings.
2. Welded splice, Cadweld splice, and mechanical threaded splice.

C. Quality Control Submittals:

1. Lab test reports for reinforcing steel showing stress-strain curves and ultimate strengths.
2. Mechanical Threaded Connections:
 - a. Current International Conference of Building Officials (ICBO) Research Report or equivalent code agency report listing findings to include acceptance, special inspection requirements, and restrictions.
 - b. Manufacturer's instructions.
 - c. Verification that device threads have been checked and meet all requirements for thread quality, in accordance with manufacturer's published methods.
3. Epoxy-Coated Reinforcing Bars: Written certification in accordance with paragraph 4.2.1 of ASTM A775.
4. Welding Qualification: Prior to welding, submit welder qualifications and radiographic nondestructive testing procedures.
 - . Test results to field testing.

1.05 QUALITY ASSURANCE

- A. The steel shall be newly rolled stock substantially free from mill scale, rust, dirt, oil, grease, or other foreign matter. Bars shall be of billet steel and, unless otherwise indicated, shall be Grade 60 bars.
- B. Billet steel bars shall conform to ASTM A 615.
- C. All bars shall be rolled by an acceptable mill. The Contractor shall submit at his own expense certified copies of tests of the bars furnished. The tests shall be as specified in the appropriate ASTM Specification referred to above and shall be made by an acceptable laboratory.
- D. Welder Qualifications: Certified in accordance with AWS D1.4-79.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Unload, store, and handle bars in accordance with CRSI publication "Placing Reinforcing Bars."
- B. Coated Bars:
 1. Protect epoxy-coated bars contact areas from handling equipment.
 2. Lift bundles of coated bars at multiple pickup points to minimize bar-to-bar abrasion from sags in bundles.
 3. Do not drop or drag coated bars or bundles of coated bars.
 4. Store coated bars on protective cribbing.
 5. Color fading of coating is not cause for rejection of epoxy-coated reinforcing bars.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Deformed Billet-Steel Reinforcing Bars:
 - 1. Includes stirrups, ties, and spirals.
 - 2. ASTM A615, Grade 60, including Supplemental Requirements S1 where welding is not required.
 - 3. ASTM A706, Grade 60, including Supplemental Requirements for reinforcing to be welded.

- B. Splices and Mechanical Connections:
 - 1. Metal Sleeve: Furnish with cast filler metal, capable of developing, in tension or compression, 125 percent of minimum tensile strength of the bar.
 - 2. Mechanical Threaded Connections: Furnish metal coupling sleeve for splicing reinforcing in secondary members or in areas of low stress with internal threads engaging threaded ends of bars developing in tension or compression 125 percent of yield strength of bar.
 - a. Manufacturers and Products:
 - 1) Erico Products, Inc., Cleveland, OH; Lenton Reinforcing Steel Couplers.
 - 2) Richmond Screw Anchor Co., Inc. Fort Worth, TX; Richmond DB-SAE Dowel Bar Splicers.
 - 3) Or equal.

- C. Epoxy-Coated Reinforcing Bars: ASTM A775, deformed bars, with bond strength not less than 80 percent of uncoated bars.

- D. Welded Wire Fabric:
 - 1. ASTM A185, or A497, and ACI 318/318R, using ASTM A82, wire of 75 ksi minimum tensile strength.
 - 2. Furnish flat sheets only, rolled sheets not permitted.

- E. Reinforcement shall be accurately formed to the dimensions indicated on the drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than two times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than six times the minimum thickness except for bars larger than 1 in., in which case the bends shall be made around a pin of eight bar diameters. All bars shall be bent cold.

- F. Bars shall be shipped to the work site with bars of the same size and shape fastened in bundles with securely wired-on metal identification tags giving size and mark.

- G. Deformations on bars for concrete reinforcement shall conform to the requirements of the above-mentioned ASTM Specifications.

2.02 ACCESSORY MATERIALS

- A. Tie Wire:
 - 1. Black, soft-annealed 16-gauge wire.

2. Nylon-, epoxy-, or plastic-coated wire.
- B. Bar Supports and Spacers:
1. Precast concrete bar supports, cementitious fiber-reinforced bar supports, or all-plastic bar supports and side form spacers meeting the requirements of CRSI Manual of Standard Practice. Do not use other types of supports or spacers.
 2. In Beams, Columns, Walls, and Slabs Exposed to View After Stripping: Small rectangular concrete blocks made up of same color and strength as concrete being placed around them or all-plastic bar supports and side form spacers.
 3. Use supports made of dielectric material for epoxy-coated reinforcing bars supported from formwork.
 4. If epoxy-coated reinforcing is used, furnish epoxy-coated reinforcing bars for spreader bars.
 5. Precast concrete supports of same strength as concrete for reinforcing in concrete place don grade.
- C. Welded steel wire fabric shall conform to the ASTM A 185. The gage and spacing of wires shall be as indicated on the drawings.
- D. Soffit Clips: Made galvanized steel wire not lighter than No. 12 Stl. W.C. They shall be shared so that the greater portion of the wire is held about 1 in. from the flange of the steel beam, and shall be spaced not less than 9 in. on centers, the spacing being maintained by suitable longitudinal wires.

2.03 FABRICATION

- A. Follow CRSI Manual of Standard Practice.
- B. Bend all bars cold.

PART 3 EXECUTION

3.01 PREPARATION

- A. Notify ENGINEER when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.
- B. Repair epoxy coating damaged due to handling, shipment, and placing. Repair with patching material in accordance with ASTM A775, and manufacturer's recommendations.
- C. Clean metal reinforcement of loose mill scale, oil, earth, and other contaminants.
- D. Coat wire projecting from precast concrete bar supports with dielectric material, epoxy, or plastic.
- E. Before being placed in position, reinforcement shall be thoroughly cleaned of loose mill and rust scale, dirt, and other coatings, including ice, that tend to interfere with

development of proper bond. Where there is delay in depositing concrete after reinforcement is in place, bars shall be reinspected and cleaned when necessary.

- F. Reinforcement which is to be exposed for a considerable length of time after having been placed shall be painted with a heavy coat of cement grout, if required.

3.02 Reinforcing Bar Installation

- A. Bundle or space bars, instead of bending where construction access through reinforcing is necessary.

- B. Spacing and Positioning: Conform to ACI 350.

- C. Location Tolerances: In accordance with CRSI publication, "Placing Reinforcing Bars".

- D. Splicing:

1. Follow ACI 318/318R.
2. Use lap splices unless otherwise shown or permitted in writing by ENGINEER.
3. Welded Splices: Accomplish by full penetration groove welds and develop at least 125 percent of yield strength of bar.
4. Stagger splices in adjacent bars.
5. Metal sleeves may be used.

- E. Mechanical Splices and Connections:

1. Use only in areas specifically approved in writing by the ENGINEER.
2. Install as required by manufacturer with threads tightened and in accordance with ICBO Research Report.
3. Maintain minimum edge distance and concrete cover.

- F. Tying Deformed Reinforcing Bars:

1. Tie every other intersection on mats made up of Nos. 3, 4, 5, and 6 bars to hold them firmly at required spacing.
2. Bend all noncoated tie wire to prevent tie wire from being closer than 1 inch from the surface of concrete.
3. Epoxy-Coated Bars:
 - a. Use epoxy-coated or nonmetallic clips.
 - b. Repair coating damage at clipped or welded intersection.

- G. Reinforcement Around Openings: Place an equivalent area of steel bars or fabric around pipe or opening and extend as shown, on each side sufficiently to develop bond with each bar. See drawing details.

- H. Welding Reinforcement:

1. Only A706/A706M bars may be welded.
2. Do not perform welding until welder qualifications are approved.
3. Provide suitable ventilation when welding epoxy-coated reinforcing bars.

4. After completion of welding on epoxy-coated reinforcing bars, repair coating damage, welds, and steel splice members with same material as used for repair of coating damage.
- I. Straightening and Rebending: Field bending of reinforcing steel bars is not permitted.
- J. Unless permitted by Engineer, do not cut reinforcing bars in the field. When epoxy-coated reinforcing bars are cut in the field, coat ends of bars with same material used for repair of coating damage.
- K. Reinforcement shall be accurately positioned as indicated on the drawings, and secured against displacement by using annealed iron wire ties or suitable clips at intersections. Concrete blocks having a minimum bearing area of 2 in. by 2 in., and equal in quality to that specified for the slab, shall be used for supporting reinforcing bars for slabs on grade. Where the underside of slabs will be exposed to view in the finished work, stainless-steel supports shall be used
- L. Furnish and place all concrete reinforcement as indicated on the drawings and as herein specified. Concrete reinforcement in sizes No. 3 (3/8 in.) and larger shall be deformed steel bars of the shapes and sizes indicated on the drawings.

3.03 WELDED WIRE FABRIC INSTALLATION

- A. Extend fabric to within 2 inches of edges of slab, and lap splices at least 1-1/2 courses of fabric or minimum 8 inches.
- B. Tie laps and splices securely at ends and at least every 24 inches with tie wire.
- C. Place welded wire fabric on concrete blocks at correct distance as shown, above bottom of slab and rigidly support equal to that provide for reinforced bars. Do not use broken concrete, brick, or stone.
- D. Follow ACI 350 and current Manual of Standard Practice, Welded Wire Fabric.
- E. Do not use fabric that has been rolled. Install flat sheets only.

3.04 TESTS AND INSPECTION

- A. Test 10 percent of all welds using radiographic, nondestructive testing procedures referenced in AWS D1.4-79.
- B. Inspect each splice and verify each component is in accordance with manufacturer's instructions and ICBO Research Report.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for furnishing and installing forms, reinforcing steel, concrete and expansion and/or construction joints.
- B. **All concrete reinforcement shall be produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.**

1.02 RELATED SECTIONS

- A. Section 03100 – Formwork
- B. Section 03200 – Reinforcement
- C. Section 03250 – Expansion, Construction, And Control Joints

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. A185, Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - 2. A615, Specification for deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 3. C31, Practice for Making and Curing Concrete Test Cylinders in the Field.
 - 4. C33, Specification for Concrete Aggregates.
 - 5. C39, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 6. C42, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 7. C94, Specification for ready Mixed Concrete.
 - 8. C143, Test Method for Slump of Hydraulic Cement Concrete.
 - 9. C150, Specification for Portland Cement.
 - 10. C172, Practice for Sampling Freshly Mixed Concrete.
 - 11. C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 12. C260, Test Method for Air-Entraining Admixtures for Concrete.
 - 13. C494, Specification for Chemical Admixtures for Concrete.
 - 14. C920, Specification for Elastomeric Joint sealants.
 - 15. D994, Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
 - 16. D1056, Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 17. D1751, Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- B. American Concrete Institute (ACI):

1. ACI 301, Specification for Structural Concrete for Buildings.
 2. ACI 304, Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
 3. ACI 305, Recommended Practice for Hot Weather Concreting.
 4. ACI 306, Recommended Practice for Cold Weather Concreting.
 5. ACI 315, Building Code Requirements for Reinforced Concrete.
 6. ACI 347, Guide to Formwork for Concrete.
- C. Concrete Reinforcing Steel Institute (CRSI):
1. Manual of Standard Practice.

1.03 SUBMITTALS

- A. Submit Shop Drawings in accordance with SECTION 01300 for the following:
1. Reinforcing Steel
 - a. Furnish in detail and completeness that all fabrication and placement at the site can be accomplished without the use of contract drawings for reference.
 - b. Include number of pieces, sizes, and grade of reinforcing steel, accessories, and any other information required for fabrication and placement.
 - c. Show joint layout and design
 - d. Check structural and site drawings for anchor bolts, anchors, inserts, conduits, sleeves, and any other items which are required to be embedded in concrete, and make necessary provisions as required so that reinforcing steel will not interfere with the placement of such embedded items.
 2. Concrete mix designs.
 3. Grout manufacturer/design mix (if included in this section)
 4. Manufacturer's data for ancillary materials such as joint fillers and sealants, epoxy bonding compound.

1.04 QUALITY ASSURANCE

- A. Selection of testing laboratory in accordance with SECTION 01410.
- B. Sample and Test Concrete as follows:
1. Test Specimens: Make, cure and have tested, a minimum of one set of four test specimens from the concrete of each day's pour and for each fifty cubic yards of concrete cast in accordance with ASTM C172, C31 and C39. One cylinder shall be broken after seven days and three cylinders after twenty-eight day.
 2. Slump: A slump test shall be made for each truckload of concrete in accordance with ASTM C143. Slumps greater than design mix limit will be grounds for rejection of the concrete.
 3. Air Content: An air content test shall be made from each day's pour of concrete by the pressure method in accordance with ASTM C231. Air contents above or below the limits specified will be grounds for rejection of the concrete.
 4. In the event the compressive strength of the cylinders, when tested, is below the specified minimum, the Engineer may require test cores of the hardened structure to be taken by the Testing Laboratory in accordance with ASTM C42. If such test indicates that the core specimen is below the required strength, the concrete in

question shall be removed and replaced without cost to the Owner. Any other work damaged as a result of this concrete removal shall be replaced with new materials to the satisfaction of the Engineer at no additional cost to the Owner. The cost of coring will be deducted from the contract amount. Where the Testing Laboratory has taken core cylinders and the concrete proves to be satisfactory, core holes shall be filled in a manner satisfactory to the Engineer at no additional cost to the Owner.

5. The Contractor shall coordinate the date and location of tests with the Engineer before any concrete work is started.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Reinforcing steel.

1. Transport to the site, store, and cover in a manner which will ensure that no damage shall occur to it from moisture, dirt, grease, or any other cause that might impair bond to concrete, or chip protective epoxy coating if applicable.
2. Store on the site at all times, a supply of approved reinforcing steel to ensure that there will be no delay of the work.
3. Identification of steel shall be maintained after bundles are broken.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland Cement.

1. Portland Cement used for building footings, base slabs, foundation walls, columns, and beams shall be in accordance with ASTM C150, Type V of U.S. manufacture.
2. All other Portland Cement shall be in accordance with ASTM C150, Type II of U.S. manufacture.

B. Aggregates.

1. Fine aggregate, in accordance with ASTM C33, clean and graded from 1/4 inch to fines.
2. Coarse aggregate, in accordance with ASTM C33, clean and graded from 1/4 inch to maximum sizes hereinafter specified.

C. Air Entraining Agent.

1. In accordance with ASTM C260.

D. Water Reducing Agent.

1. In accordance with ASTM C494 Type A.

E. Microsilica Admixture.

1. Packaged in easily dispersing form.

F. Water.

1. Clean and potable,
2. Free of impurities detrimental to concrete.

G. Reinforcing Bars.

1. See Section 3200.
- H. Welded Wire Fabric
 1. See Section 3200.
- I. Accessories.
 1. See Section 3200.
- J. Tie wire.
 1. See Section 3200.
- K. Form Ties and Spreaders.
 1. See Section 3100.
- L. Form Coatings.
 1. Non-grain raising and non-staining type that will not leave residual matter on surface of concrete or adversely affect proper bonding of subsequent application of other material applied to concrete surface.
 2. "Nox-Crete Form Coating" as manufactured by Nox-Crete Company, or approved equal.
 3. Coatings containing mineral oils or the non-drying ingredients will not be permitted.
- M. Grout.
 1. See Section 3604.

2.02 CONCRETE STRENGTHS AND PROPORTIONS

- A. Cast-in-place concrete shall have the minimum compressive strength at 28 days as indicated on the Drawings.
- B. The exact proportions for the mix, including amounts admixture (if any), and water, shall be determined by the concrete supplier.
- C. The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement, but without permitting the materials to segregate or excess free water to collect on the surface.
- D. Air-Entrainment: The air content in all concrete shall be maintained at 5 to 7 percent.

2.03 PREMOLDED JOINT FILLER

- A. Bituminous Type.
 1. In accordance with ASTM D994 or D1751.
- B. Sponge Rubber Type.
 1. Neoprene, closed-cell, expanded in accordance with ASTM D1056, Type 2C5, with a compression deflection, 25 percent deflection (limits), 17 to 24 psi (119 to 168 kPa) minimum.

2.04 POURABLE JOINT FILLERS

A. Filler for Nonpotable Water Structures

1. Specific Gravity: Greater than 1.0 for cured, in-place filler.
2. Vertical and Sloped Joints: Furnish gun grade material that will remain as placed in joints and will not run down slope.
3. Suitable for continuous immersion and exposure to liquid being contained in the structure.

2.05 JOINT SEALANTS

A. In slabs.

1. In accordance with ASTM C920 for poured 2-component polyurethane sealant.
2. Sikaflex-2c, as manufactured by Sika Corporation or approved equivalent.

B. In walls.

1. Type II, Class A, compound conforming to Interim Federal Specification TT-S-00227E (3) (COM-NBS) for Sealing Compound; Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures).
2. Sikaflex-1a, as manufactured by Sika Corporation or approved equivalent.

2.06 EPOXY BONDING COMPOUND

- A. The epoxy bonding compound shall be a three-component, solvent-free, moisture-tolerant, epoxy modified, cementitious product specifically formulated as a bonding agent and anti-corrosion coating. The product shall have suitable contact time, fluidity, and application temperature for this type of application.

PART 3 EXECUTION

3.01 FORMWORK

1. See Section 3100.

3.02 REINFORCING STEEL

1. See Section 3200.

3.03 CONCRETE

A. Mixing of Concrete

1. All concrete shall be ready-mixed concrete, and shall be mixed and delivered in accordance with ASTM C 94. The batch plant of the concrete producer shall be certified for compliance with the standards established by the National Ready-Mixed Concrete Association.
2. In the event concrete is mixed at a central batching plant, the delivery shall be arranged so that intervals between batches are kept to a minimum, and in any event not more than thirty (30) minutes. Trucks shall be in first class condition and kept in constant rotation during delivery.
3. Concrete shall be placed within 90 minutes after cement has been mixed with aggregate or 45 minutes after addition of water and admixtures.

4. No admixtures, except those mentioned in paragraph 2.1 shall be used. Calcium chloride will not be permitted.
 5. Truck delivery slips of all concrete delivered to the job shall indicate the quantity and quality of concrete, additives, date and time of batching and delivery, and the location of placement. Delivery slips shall be forwarded to the Engineer at the end of each pour.
- B. Cold Weather Concreting.
1. In accordance with ACI 306.
 2. Concrete shall not be mixed or placed when the temperature is below 40 degrees F, or when conditions indicate that the temperature will fall below 40 degrees F within 72 hours unless precautions are taken to protect the concrete.
 3. Concrete temperature shall be maintained, when deposited, at not less than 60 degrees F. Reinforcement, forms, and ground which concrete will contact must be completely free of frost.
 4. Concrete and formwork must be kept at a temperature of not less than 50 degrees F. for not less than 96 hours after placing.
 5. Calcium chloride shall not be used.
- C. Hot Weather Concreting.
1. In accordance with ACI 305.
 2. The maximum temperature of the concrete, when deposited, shall be 85 degrees F. If the weather causes the placing temperature to exceed 85 degrees F., the mix shall be cooled by methods approved by the Engineer.
 3. No concrete shall be deposited when the air temperature is greater than 90 degrees F.
- D. Conveying and Placing Concrete.
1. In accordance with ACI 304.
 2. Notification: Before placing concrete, forms shall be thoroughly inspected. All chips, dirt, etc., shall be removed, all temporary bracing and cleats taken out, all openings for pipes, etc., properly boxed, all forms properly secured in their correct position and made tight, all reinforcement, anchors, and embedded items secured in their proper places. Concrete which may be on the forms or reinforcement, and which is set and dry, shall be cleaned off, and the forms and steel washed off before proceeding. Remove all foreign matter from forms and excavations.
 3. Water shall be removed from place of deposit before concrete is placed unless otherwise permitted by the Engineer. Any flow of water into an excavation shall be diverted through proper side drains into a sump, or shall be removed by other approved methods which will avoid washing away the freshly deposited concrete.
 4. Soil on which concrete will be poured shall be thoroughly wetted (except in freezing weather).
 5. Anchors and Embedded Items: Anchors, bolts, sleeves, inserts, wood blocking, and any other items to be embedded in concrete shall be accurately secured in position before the concrete is placed. Aluminum shall not be embedded in concrete.

E. Handling and Depositing

1. Before any concrete is placed, notify all whose work is in any way connected with or influenced by the concrete work, and give them reasonable time to complete all portions of their work that must be completed before concrete is deposited.
2. Immediately before concrete is placed, inspect all forms to insure that they are in proper position, sufficiently rigid, thoroughly clean, properly oiled and free from foreign materials, and that all reinforcement is in proper position.
3. Concreting, once started, shall be carried on as a continuous operation until the section of approved size and shape is completed.
4. Concrete shall be conveyed as rapidly as practicable from the mixer to the place of final deposit by methods that prevent the separation or loss of ingredients. It shall be deposited, as nearly as practicable, in its final position to avoid rehandling or flowing.
5. Concrete shall not be dropped freely where reinforcement will cause segregation, nor shall it be dropped freely more than six (6) feet. Concrete shall be deposited to maintain a plastic surface approximately horizontal.
6. Concrete that has partially hardened shall not be deposited in the work.

F. Pumping

1. Concrete may be placed by pumping if first approved in writing by the Engineer for the location proposed.
2. Equipment for pumping shall be of such size and design as to ensure a practically continuous flow of concrete at the delivery end without separation of materials.
3. The concrete mix shall be designed to the same requirements as herein before specified, and may be richer in lubricating components in order to allow proper pumping.
4. Concrete shall not be pumped through aluminum pipes.

G. Vibrating and Compacting

1. All concrete shall be thoroughly consolidated and compacted by suitable means during the operation of placing, and shall be thoroughly worked around reinforcement, embedded items, and into the corners of the forms. All concrete against forms shall be thoroughly spaded. Internal vibrators shall be used under experienced supervision, and shall be kept out of contact with reinforcement and wood forms. Vibrators shall not be used in a manner that forces mortar between individual form members.
2. Vibrators shall be flexible electric type or approved compressed air type, adequately powered and capable of transmitting to the concrete not less than seven thousand (7,000) impulses per minute. Vibration shall be sufficiently intense to cause the concrete to flow or settle readily into place without separation of the ingredients. A sufficient number of vibrators shall be employed so that complete compaction is secured throughout the entire volume of each layer of concrete. At least one (1) vibrator shall be kept in readiness as a spare for emergency use. Vibrators shall be such that the concrete becomes uniformly plastic with their use.
3. Vibration shall be close to the forms but shall not be continued at one spot to the extent that large areas of grout are formed or the heavier aggregates are caused to settle. Care shall be taken to not disturb concrete that has its initial set.

4. Where conditions make compacting difficult, or where the reinforcement is congested, batches of mortar containing the same proportions of cement to sand as used in the concrete shall first be deposited in the forms, to a depth of at least one inch.
5. The responsibility for providing fully filled out, smooth, clean, and properly aligned surfaces free from objectionable pockets shall rest entirely with the Contractor.

H. Construction Joints

1. Construction joints shall be located a maximum of 40 feet apart. If, for any reason, the contractor feels a change is necessary, he shall prepare a placing plan and submit it to the Engineer for approval.
2. Where a joint is to be made, the surface of the concrete shall be sandblasted or thoroughly picked, thoroughly cleaned, and all laitance removed. In addition to the foregoing, joints shall be thoroughly wetted, but not saturated, and slushed with a coat of grout immediately before the placing of new concrete.
3. Approved keys shall be used at all joints, unless detailed otherwise.
4. Forms shall be retightened before placing of concrete is continued. There shall be an interval of at least 48 hours between adjacent pours.

I. Bonding Concrete at Construction Joints

1. To new concrete construction joints:
 - a. Thoroughly clean and saturate joint with water.
 - b. Cover horizontal wall surfaces as specified in this Section, and immediately place concrete.
 - c. Limit concrete lift placed immediately on top of bonding compound to 12 inches thick.
 - d. Thoroughly vibrate to mix and consolidate bonding compound and concrete together.

J. Bonding new concrete to old concrete:

1. Mechanically roughen existing concrete surfaces to a clean, rough surface using appropriate mechanical means to remove the existing concrete surface, and provide a minimum roughness profile of ¼-inch.
2. Saturate surface with water for 24 hours, cover with epoxy bonding compound and place concrete as specified for new concrete.

K. Expansion Joints

1. Expansion joints shall be located as shown on contract drawings.
2. The joint shall include a joint filler, a bond breaker and joint sealant and installed as indicated on contract drawings.

L. Joint Sealants.

1. Prepare surface in accordance with manufacturers directions.
2. Apply primer as recommended by sealant manufacturer.
3. Install sealant with the proper tools and methods as directed by the sealant manufacturer.

M. Patching

1. Immediately after stripping forms, patch minor defects, form-tie holes, honeycombed areas, etc., before concrete is thoroughly dry.
2. Repair gravel pockets by cutting out to solid surface, form key, and thoroughly wet before placing patching mortar consisting of 1 part cement to 2 parts fine sand; compact into place and neatly finish. Honeycombed areas or gravel pockets which, in the Engineer's opinion are too large and unsatisfactory for mortar patching as described above, shall be cut out to solid surface, keyed, and packed solids with matching concrete to produce firm bond and surface.
3. The Contractor shall do all the cutting as required by himself or other trades. All such work shall be of the minimum size required. No excessive cutting will be permitted, or shall any structural members or reinforcement be cut.
4. The Contractor shall do all patching after work by other trades has been installed, where required, using Portland Cement Mortar 1:2 mix.

N. Protection and Curing

1. Protect concrete from injurious action of the elements and defacement of any nature during construction operations.
2. Keep concrete in a thoroughly moist condition from the time it is placed until it has cured, for at least (7) days.
3. Carefully protect exposed concrete corners from damage.
4. Allow no slabs to become dry at any time until curing operations are complete. In general, slabs shall be cured with non-staining curing paper, hosing or fog spray; vertical surfaces shall be curing with Burlene or fog spray or an approved curing compound.
5. Protect fresh concrete from drying winds, rain, damage, or spoiling. Curing paper shall be lapped 4 inches minimum at joints and sealed with waterproof tape.

O. Finishing Formed Surfaces

1. General: Addition of Material: The addition of cement, sand, water or mortar to slab surfaces while finishing concrete is strictly prohibited.
2. Rough-Formed Finish: This finish has an as-cast texture imparted by the form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding the limits specified by ACI 117 for the class of surface specified.
 - a. All surfaces that will be permanently concealed below grade shall have a Rough-Formed Finish.
3. Smooth-Formed Finish: This finish has an as-cast texture imparted by the form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove all fins and other projections.
 - a. Apply a Smooth-Formed Finish to all surfaces to be covered with a coating or covering material applied directly to the concrete such as waterproofing, dampproofing, veneer plaster or painting.
 - b. Apply to the interior surfaces of tanks holding process water.
 - c. Apply to baffle walls in the wet well.
 - d. Do not apply rubbed finish to smooth-formed finish.
4. Rubbed Finish:

- a. Smooth-Rubbed Finish: Not later than one day after form removal, moisten the concrete surfaces and rub with a silicon-carbide brick to produce a uniform color and texture. Do not apply cement grout other than that created by the rubbing process. Apply to the surfaces that will be permanently exposed to view.
 - b. Grout-Cleaned Finish: Wet the concrete surfaces and apply a grout of a consistency of thick paint to coat the surfaces and small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. When the grout whitens, rub the surface with clean burlap and keep the surface damp with a fog spray for at least 36 hours. Apply Grout-Cleaned Finish to the surfaces of all channels that will carry flowing process water. This requirement is applicable to the concrete surfaces of the wet well.
5. Related Unformed Surfaces:
- a. At tops of walls, horizontal offsets and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise specified.
6. Finishing Floors and Slabs
- a. General: Addition of Material: The addition of cement, sand, water, or mortar to slab surfaces while finishing concrete is strictly prohibited.
 - b. Comply with the recommendations of ACI 302.1R for screeding, restraighening and finishing operations for concrete surfaces.
 - c. Float Finish:
 - 1) Consolidate the surface with power-driven floats or by hand floating if the area is small or inaccessible to power-driven floats. Restraighten, cut down high spots and fill in low spots. Repeat float passes and restraighening until the surface is left with a uniform, smooth granular texture.
 - 2) Apply float finish surfaces to receive a trowel finish.
 - d. Trowel Finish:
 - 1) After applying float finish, apply first trowel finish and consolidate concrete by hand or power driven trowel. Continue troweling passes and restraighten until the surface is free of trowel marks and is uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 2) Apply a trowel finish to interior floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet or ceramic tile and the wet well trench floor.
 - 3) Finish surfaces to the following tolerances measured within 24 hours of troweling according to ASTM E 1155 for a randomly trafficked floor surface.
 - 4) Specified overall values of flatness, FF 25; and levelness, FL 20; with minimum local values of flatness, FF 17; and levelness, FL 15.
 - e. Broom Finish

- 1) Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom. Broom transverse to traffic or at right angles to the slope of the slab. Permit surface to harden sufficiently to retain the scoring or ridges.
- 2) Apply a broom finish to all exterior concrete pads, walkways and slabs on grade.

P. Defective Work

1. The following concrete work shall be considered defective and may be ordered by the Engineer to be removed and replaced at Contractor's expense:
 - a. Incorrectly formed.
 - b. Not plumb or level.
 - c. Not specified strength.
 - d. Containing rock pockets, voids, honeycomb, or cold joints.
 - e. Containing wood or foreign matter.
 - f. Otherwise not in accordance with the intent of the Drawings and Specifications.

END OF SECTION

SECTION 03604

NON-SHRINK CONSTRUCTION GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section specifies furnishing and installing non-shrink grout for interior and exterior use, as indicated.

1.02 REFERENCES

- A. U.S. Corps of Engineers CRP - C - 588
- B. ACI - 305, American Concrete Institute
- C. ACI - 306, American Concrete Institute

1.04 SUBMITTALS

- A. Product Data: Provide data on non-shrink grout.
- B. Submit certificate of compliance attesting to conformance of products to the requirements of this Section.
- C. Submit manufacturers' installation and application instructions for products.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, tightly sealed, polyethylene lined, multiple ply bags, clearly labeled with manufacturer's name, brand name and number, and batch number of the material.

1.06 JOBSITE CONDITIONS

- A. Ensure surfaces to be grouted or patched are clean and sound, and are not feathered at edges. Handle grout as concrete with regard to temperature and curing, as specified in Section 03300.
- B. Observe safety precautions as outlined in the manufacturer's literature and as printed on containers and labels.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Premixed grout comprised of blended portland cements, graded silica aggregates, special plasticizing agents and other ingredients.
- B. Conform to requirements of U.S. Corps of Engineers CRD-C-588 and to the following performance requirements listed in Article 2.02 when tested at the moderate fluidity, flowable, level.
- C. The grout shall exhibit a small but predictable amount of expansion sufficient to counteract the normal shrinkage of cement, and shall be dimensionally stable. The expansion shall occur after initial set to insure maximum contact between grout and base plates. The grout shall be extremely flowable at low water levels and shall not bleed at the moderate fluidity level specified nor exhibit segregation of aggregates.

At a highly flowable consistency, high compressive strength shall be attainable in a 24-hour period with continuous build-up for 28 days. The resulting cured material shall be very hard and highly resistant to penetration and breakdown by oils, water or vibration grout shall contain no iron particles, gypsum, gas forming agents, no added chloride, and shall not react with magnesium.

2.02 PERFORMANCE REQUIREMENTS

- A. When tested as provided herein, grout shall meet the following performance requirements:
 - 1. When tested as provided herein, grout shall meet the following performance requirements:
 - a) Expansion at 3, 14, and 28 days: 0.4 percent maximum at any of these ages.
 - b) Expansion at 3 and 14 days: not greater than expansion at 28 days.
 - c) Shrinkage at 28 days: none, these requirements will be met if expansion tests give a positive value at 28 days.
 - d) Compressive strength:
 - 1) At seven days: 2500 psi min.
 - 2) At 28 days: 5000 psi min.
 - 3) Time of final setting: eight hours max.
 - e) Moderate fluidity, flowable: 124-145 (flow table, 5 drops, CRDC-277).

2.03 DEGREASING AND ETCHING CHEMICAL

- A. Composition and Materials: Blend of organic and inorganic acids with a special solvent system incorporating wetting agents for emulsification.
- B. Color: Water White
- C. Flash Point: Above 150°F
- D. Weight per gallon: 9.0 Pounds

PART 3 EXECUTION

3.01 PREPARATION OF CONCRETE SURFACES

- A. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles, and disintegrated materials by mechanical abrasion methods such as sandblasting. Sandblast structural and reinforcing steel to remove loose material and expose sound metal.
- B. If the concrete surfaces are sound and it is only necessary to remove laitances, grease or dust, the Contractor may, with the prior written approval of the Engineer, forego sandblasting and wash the concrete with a degreasing and etching chemical applied in accordance with the manufacturer's written instructions and as specified herein.
- C. Application of Degreaser and Etching Compound. Prewet concrete surfaces with clean water. Brush concentrated cleaner onto concrete surface. Let stand three to four minutes and reapply, brushing stained areas vigorously. Rinse off with fresh water applied at a minimum pressure of 800 psi and a minimum volume of five gallons per minute.
- D. Construct appropriate sturdy forms to contain grout at the fluidity level at which it will be used. Saturate foundations and forms for a minimum of six hours prior to

grouting. Remove all standing water or puddles prior to application of grout. Take special care to eliminate water from bolt holes and other cavities.

3.02 MIXING

A. Mix only with cool, clean, drinkable water. Do not overwater grout. Do not mix more grout than can be properly placed within 20 minutes of mixing.

3.03 APPLICATION

- A. Place grout only from one side of base plates to avoid entrapping air. Provide adequate air vent holes in large base plates. Work or flow grout into place, filling all cavities. Shut down near-by equipment which may cause vibration. Allow adequate curing time for strength development before placing a load on the grout.
- B. Place grout within twenty minutes of the addition of water to the batch.
- C. Reinforce grout pads or applications three inches or more in thickness with wire mesh or reinforcement bars.
- D. Rodding or chaining is acceptable to assist in placement or consolidation of grout. Excessive mechanical vibration may cause segregation of aggregates and will not be permitted.
- E. Cool mixing water and grout when temperature exceeds 80°F. in the area to be grouted. Comply with ACI-305. Cure and seal exposed grout with epoxy membrane curing compound to prevent rapid surfacing drying, shrinkage and cracking, or damp cure the grout.
- F. Heat mixing water and grout when temperature falls below 50°F in the area to be grouted. Do not exceed 80°F. Comply with ACI-306. Do not add accelerators to grout.

3.04 AGGREGATE EXTENSIONS

- A. Where indicated, extend the yield of expansive-cement type grout by utilizing aggregate filler in the size range of 3/8 inch washed pea gravel. Run trial mixes verifying the acceptability of this extended grout mix to the Engineer prior to use.

END OF SECTION

SECTION 03930

CONCRETE REHABILITATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to perform all concrete repair work as shown on the drawings and as specified herein. All existing interior tank walls shall be thoroughly blast-cleaned and inspected for concrete spalls and cracks. It is the Contractors responsibility to field determine area of concrete rehabilitation once surfaces are clean and clearly visible. Areas of repair shall be identified and marked for repair by the Contractor for approved by the Engineer. Concrete repairs shall be performed in accordance with these specifications and the contract drawings.
- B. Work under this item shall apply to all existing interior concrete walls of the following tanks during the following Phases:
 - a. Solids Handling Improvements: Sludge Thickeners #1 and #2
 - b. Phase 1 Improvements: Primary Clarifiers #1, 2, and 3, and Chlorine Contact Chamber
 - c. Phase 2 Improvements: Aeration Tank 1, 2, and 3, Final Clarifiers #1, 2, 3, & 4
- C. The work shall include but not limited to the following:
 1. Concrete Removal
 - i. The removal and disposal of all deteriorated and spalled concrete for Shallow or Partial Depth Repair shall be included as part of this Item.
 - ii. Included under this Section are all costs in connection with the cleaning, cutting, and bending of the existing reinforcing steel designated to be retained in the proposed construction. Also included as incidental to this item shall be the roughening of existing concrete surfaces for the placement of new concrete as shown on the Plans or directed by the Engineer.
 2. Shallow Depth Repair
 - i. This repair consists of furnishing and placing a polymer-modified, cementitious, 2-component, fast-setting, trowel grade patching mortar to patch vertical, horizontal, and overhead surfaces on the existing structure in areas of spalled concrete. This Item does not include the repair of any horizontal or vertical spalls which exceed

1½ inches in depth. The repairs to those areas shall be made with 4000 PSI, 3/8 IN., 660 Cement Concrete.

3. Partial Depth Repair

- i. The work to be done under this repair shall consist of replacing concrete removed in deteriorated or spalled areas greater than 1½" deep. The work shall also consist of furnishing and placing 4,000 PSI, 3/8 IN., 660 Cement Concrete Masonry to repair as directed.
- ii. The Contractor shall have the approval of the Engineer certifying that the existing concrete has been removed to the required limits and that adequate surface preparation has been achieved before any concrete is placed.
- iii. Bonding Agent: Immediately prior to all concrete pours, the Contractor will apply an bonding agent approved by the Engineer to the excavated surfaces of the concrete. The bonding agent will be worked into the surfaces with stiff brushes or brooms. Bonding Agent will be considered incidental to this Item. Products to be used for this item shall be approved by the Engineer before the Contractor begins his operations. If the bonding compound prematurely hardens, additional bonding compound shall be applied, if allowed by the bonding compound manufacturer or the hardened bonding compound shall be addressed as per the bonding compound manufacturer's recommendations.

4. Replacement and Coating of steel reinforcing within concrete repair areas.

- i. Any steel that is unsuitable for further use through no fault of the Contractor shall be replaced and coated under this Item and in accordance with Section 03200 – Reinforcement. All reinforcing steel that is loose shall be tied tightly together using wire ties.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 - Reinforcement
- B. Section 03940 - Crack Repairs by Epoxy Injection
- C. Section 09880 - Concrete Protective Coating

1.02 REFERENCES

- A. American Society for testing and Materials (ASTM)
 1. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch Cube Specimens)
 2. ASTM C882 – Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear
- B. International Concrete Repair Institute (ICRI)

1. ICRI Guideline No. 310.1R-2008 Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion (formerly Guideline No. 03730)
 2. ICRI 03732 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coating, and Polymer Overlays
- C. The Society of Protective Coating
1. SSPC-SP13 – Surface Preparation of Concrete

1.03 SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation instructions for factory packaged products.
1. Manufacturer's recommendation and product data sheets for all products supplied under this Section.
 2. Safety Data Sheets (SDS) for any materials brought on-site including materials, solvents, and abrasive blast media.
 3. Storage requirements including temperature, humidity, and ventilation for coating system materials.
- B. A list of three of the Contractor's projects for which the types of repair specified herein were successfully completed. Including documentation of qualifications for specified works.

1.04 QUALITY ASSURANCE

- A. Field Examples: Prior to performing the Work of this Section, prepare a sample panel, or a portion of existing concrete which is to be repaired, to represent each type of rehabilitation work required. Approved samples will be used as quality standards for the Work. Maintain approved samples at the site until the Work is completed.
- B. Contractor qualifications. Complete a program of instruction in the application of the approved manufacturer's material and provide certification from the manufacturer attesting to their training and status as an approved applicator.
- C. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer.
- D. When removing materials or portions of existing structures, all precautions shall be taken and all necessary barriers, temporary support systems and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown or specified, line drilling will be required in cutting existing concrete.

- E. The Contractor's supervisor shall have attended a training program sponsored by the manufacturer supplying the materials approved for this project.
- F. A representative of the product manufacturer shall be present for the first three days of installation to give instructions to the installation crew.
- G. A representative of the product manufacturer shall make periodic site visits to ensure the product is being installed in accordance with published instructions.
- H. The Contractor shall make available all locations and phases of the work for access by the Engineer or other personnel designated by the Engineer. The Contractor shall provide ventilation and safe access to the work.
- I. The Contractor is solely responsible for the workmanship and quality of the modification work. Inspections by the manufacturer, the Engineer, or others do not limit the Contractor's responsibility for the quality of the work.
- J. Material Container Labels: Material containers shall bear the manufacturer's label indicating manufacturer's name, trade name of product, lot number, shelf life of product, and mix ratio (if applicable).

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver new and unopened materials to the site in original, sealed containers. Do not deliver materials that have exceeded shelf life limitation set forth by the manufacturer.
2. Containers shall be clearly labeled with the following information:
 - i. Manufacturer's name
 - ii. Name or title of material, and other product identification
 - iii. Manufacturer's stock number and batch number
 - iv. Date of manufacture
 - v. Instructions
 - vi. Expiration or "use by" date

B. Storage of Materials:

1. Store the products in accordance with the manufacturers' recommendations, and supplementary requirements below.
2. Restrict storage to repair materials and related equipment.
3. Comply with health and fire regulations including the requirements of the Occupational Safety and Health Administration (OSHA).

C. Handling of Materials:

1. Comply with manufacturer's printed instructions for storing and handling materials.

2. Handle materials carefully to prevent inclusion of foreign materials.
3. Do not open containers or mix components until necessary preparatory work has been completed and application work will start immediately.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with the product manufacturer's printed limitations and instructions.

1.07 WARRANTY

- A. The Contractor shall warrant, and shall obtain from the manufacturers their warranties, that the products used will be free from defects in materials and workmanship for a period of five years from the date of substantial completion. Said manufacturer's warranty shall be in a form acceptable to and for the benefit of the Owner and shall be submitted by the Contractor as a condition of final payment. The Contractor shall repair or replace, at the sole option of, and at no cost to, the Owner, any work found to be defective within said warranty period. Such repair or replacement shall include the cost of removal and reinstallation.

PART 2 PRODUCTS

2.01 COMPANIES

- A. The Euclid Chemical Company, 19218 Redwood Rd., Cleveland, OH 44110-2799, (800) 321-7628, www.euclidchemical.com.
- B. Sika Corporation, 201 Polito Ave., Lyndhurst, NJ 07071, (800) 933-7452, www.sikausa.com.
- C. Kaufman Products, Inc., 3811 Curtis Ave., Baltimore, MD 21226, (800) 637-6372, www.kaufmanproducts.net.
- D. L&M Construction Chemicals, Inc., 14851 Calhoun Rd., Omaha, NE 68152, (800) 362-3331, www.lmcc.com.
- E. Conproco Corp., 17 Production Dr., Dover, NH 03820, (800) 258-3500, www.conproco.com.
- F. BASF Building Systems, 889 Valley Park Dr., Shakopee, MN 55379, (800) 433-9517, www.buildingsystems.basf.com.

2.02 MATERIALS

- A. The following brand names are specified to establish product generic type and standard of quality. Other comparable products in the manufacturer's same product series may be required to closely fit the particular job conditions. Use appropriate product for depth of patch and temperature at time of application. More than one

product may be required for a particular type of patching mortar. When a color choice is available, select the color to match adjoining concrete as closely as practicable. A bonding agent/primer and/or sealer shall be used as recommended by the patching mortar manufacturer.

- B. Cement/Acrylic/Latex Base Patching Mortars for Shallow Depth Repair:
 - 1. Type C-2 Patching Mortar: “SikaTop 121 Plus”, “SikaTop 122 Plus” or “SikaTop 111 Plus” by Sika Corp.; “Patchwell Kit”, “Patchwell Deep”, “SureFlow 040”, or “SureFlow 042” by Kaufman Products, Inc.; “Thincoat” or “Concrete Coat” by The Euclid Chemical Company;
 - 2. Type E-3 Patching Mortar: High modulus, medium/low viscosity, moisture insensitive, epoxy resin and aggregate system; “Sikadur 35” or “Sikadur 52” by Sika Corporation, “Duralcrete” by The Euclid Chemical Company or “SurePoxy HM”, “SurePoxy HM, Class B”, “SurePoxy HMLV”, “SurePoxy HMLV, Class B”, “SurePoxy HMSLV”, “SurePoxy HiBild” by Kaufman Products, Inc.
- C. 4000 PSI, 3/8 Inch, 660 Cement Concrete for Partial Depth Repair shall be accordance with Section 03300.
- D. Steel Reinforcing shall be in accordance with Section 03200.
- E. Rebar Coating: “SurePoxy HMEPL” or SurePoxy HM 12” by Kaufman Products, Inc.; “ECB” by Conproco Corp.; or “MasterEmaco P122” or “MasterEmaco P124” by BASF Building Systems.
- F. Cleaning Agent, Bonding Agent/Primer, Sealer/Topcoat: As recommended by the patching mortar manufacturer, including primer for the reinforcing steel and primer for the concrete substrate.
- G. Concrete and Bonding Agent (for concrete): Normal weight cast-in-place concrete and adhesive bonding agent as specified in Section 03300.

PART 3 EXECUTION

3.01 INSPECTION OF CONCRETE SURFACES

- A. The locations, details, and limits are to be field-determined by the Contractors after blast-cleaning all interior concrete tank walls. Repair areas are to be confirmed by the Engineer prior to commencing work.
- B. The Contractor will perform his own investigations and will “evaluate” and mark out the surfaces of the concrete to determine the areas for repairs. Methods for evaluation shall include nondestructive methods such as visual observations and acoustic impact method using a hammer or chain drag (for horizontal surfaces only). The Contractor is referenced to ACI Report 201.1R-92 “Guide for Making a Condition Survey of Concrete in Surface” and ACI Report 364.1R-94 “Guide for Evaluation of Concrete Structures Prior to Rehabilitation” in regard to evaluation methods. Before any existing concrete is removed, the Contractor will provide the Engineer clear access to the areas designated for repair. During this time, the Engineer will perform an inspection of the

areas and will approve and/or designate the areas where concrete removal and repair will be required.

- C. It shall be the responsibility of the Contractor to inform the Engineer, in writing, of the date that a structure will be available for inspection operations. Notification shall be given to the Engineer at least seven (7) days prior to the date that the area in question will be in a condition acceptable to the Engineer.
- D. The Contractor will not be allowed to do any further repair work until all necessary inspection operations have been performed, unless given permission by the Engineer.
- E. The Contractor will include any costs related to this inspection in the general cost of work related to this Section.

3.02 PREPARATION

- A. Protection: Cover or otherwise protect adjacent surfaces not being repaired.
- B. Preparation for Concrete Removal
 - 1. Areas to be repaired must be clean, sound, and free of contaminants. All loose and deteriorated concrete shall be removed by mechanical means. Mechanically prepare the concrete substrate to obtain a surface profile of +/- 0.25 inches with a new exposed aggregate surface. Area to be patched shall not be less than ½ inch in depth for repairs using Cementitious Mortar for Patching and 1½ inches for repairs using 4000 PSI, 3/8", 660 Cement Concrete.
 - 2. If reinforcing steel is exposed, then clean by mechanical cleaning and then high pressure washing with water that does not contain detergents or any bond inhibiting chemicals. Where active corrosion has occurred that would inhibit bonding, abrasion blast steel to white metal finish.
 - 3. After removals and edge conditioning are complete, remove bond inhibiting materials (dirt, grease, loosely bonded aggregate) by oil-free compressed air, abrasion blasting, or high pressure water blasting with water that does not contain detergents or any bond inhibiting chemicals. Check the concrete surfaces after cleaning to insure that surface is free from additional loose aggregate or that additional delaminations are not present.
 - 4. After the surface preparation has been accepted, every effort should be made to thoroughly wet the concrete surface, and all porous surfaces to be in contact with new concrete, for 12 hours. This may be accomplished by continuous wetting with soaker hoses or the use of burlap/burlene, etc. where moisture can be maintained. If, in the opinion of the Engineer, conditions or the situation prohibits this, then the surfaces should be wetted for as long as

possible. Surfaces must be wetted by a means acceptable to the Engineer using potable water.

5. The Contractor shall remove any puddles of free standing water with oil-free compressed air, and protect the surfaces from drying, so the existing concrete remains in a clean, saturated surface dry condition until placement of the new concrete.

3.03 CONCRETE REMOVAL

A. Removal of Deteriorated Concrete:

1. All deteriorated concrete designated for removal under this Item shall be removed within the limits identified by the Contractor and approved by the Engineer. The lateral limits of each area to be repaired will be delineated by the Contractor and suitably marked and subsequently approved by the Engineer. Where several areas are to be repaired are very close together, the Engineer may combine these individual repairs into a larger area. The outlines of each such area shall first be cut to a depth of ½ inch with an approved power-saw capable of making straight cuts. In the event that reinforcing steel is encountered within the outer ½ inch depth during sawing operations, the depth of sawcut shall immediately be adjusted to a shallower depth so as not to damage the steel bars. If so directed by the Engineer, sawcutting shall again be carried down to the ½ inch depth at other locations of repair provided reinforcing steel is not again encountered. Where over-breakage occurs resulting in a featheredge, the featheredge shall be squared up to a vertical edge in an approved manner. Where sawing is impractical, the area shall be outlined by chisel or other approved means.
2. After completion of concrete removal, the sides of the patch shall be vertical down to the bottom of the patch.
3. The minimum depth of concrete removal shall not be less than the specified minimum thickness of repair material.
4. If removal of deteriorated concrete results in full or partial exposure of reinforcing steel, but less than 1" clearance exists between the sound concrete and the inside surface of exposed reinforcing steel, enough sound concrete as is necessary to achieve this 1" minimum clearance shall be removed.
5. Where the existing reinforcing steel is damaged or deteriorated it shall be supplemented with new reinforcing steel of the same size. Pneumatic tools shall not be placed in direct contact with reinforcing steel. Any sound reinforcing steel damaged during the concrete removal operations shall be repaired or replaced by the Contractor at his expense as directed by the Engineer. New steel shall be attached beside existing steel with a minimum splice length as indicated on the Plans, or as directed by the Engineer. The concrete shall be removed to a minimum depth of 1 inch below the new steel. New reinforcing steel for concrete repairs shall be included as part of this Section.

- i. During the prosecution of the Work, the Engineer may reject the use of any method or equipment, which causes undue vibration or possible damage to the structure or any part thereof. In no event shall any pneumatic hammers heavier than the nominal 25 Lbs. (Chicago Pneumatic No. 111 or equal) be used, unless approved by the Engineer. Also, no use of pneumatic or power driven chipping hammers over the nominal 15 Lbs. will be permitted to remove any concrete from below any reinforcing bar.
- ii. The Contractor shall take all precautions necessary so as not to damage reinforcing steel that is to remain. This includes determining the concrete cover to the steel bars at the edge of each patch prior to excavating concrete.
- iii. All excavations shall be squared off by sawcutting. Any sawcut and removal of reinforcement required shall be considered incidental to this item. The Contractor shall not remove any concrete beyond the specified limits unless ordered to do so by the Engineer. Any existing concrete designated to be retained during construction that is damaged by the Contractor's operation shall be replaced at the Contractor's expense as directed by the Engineer.
- iv. Immediately before preparation for placement of new concrete, the exposed area to be patched shall be free of foreign materials. These materials shall be removed by grit blasting or wire brushing and by use of compressed air. No grease, dust, rust, or laitance will be allowed to remain on reinforcing steel and exposed concrete surfaces.
- v. Surplus materials obtained from any type of excavation, and not needed for further use, as determined by the Engineer shall become the property of the Contractor and shall be disposed of by the Contractor outside the location subject to the regulations and requirements of all authorities governing the disposal of such materials, at no additional compensation.
- vi. The Contractor is required to broom clean all work site areas after the removal of excavated debris regardless of preexisting conditions. This includes areas under the excavated repair area such as pier caps, revetment areas, and bridge shielding areas. Removal of debris, site cleaning, and disposal of debris is incidental to the Contract and no additional payment will be made.

3.04 SHALLOW DEPTH REPAIR WITH CEMENTITIOUS MORTAR FOR PATCHING

- A. The polymer modified cementitious patching mortar shall be in accordance with Part 2.02 of this Section

B. Mixing

1. Mix manually or mechanically. The mortar shall be prepared in accordance with the Manufacturer's instructions.

C. Application Methods

1. At the time of application, surfaces should be damp (saturated surface dry) with no glistening water. Mortar must be worked into the substrate filling all pores and voids. Force the material against the edge of the repair, working towards the center. After filling, consolidate, then screed.
2. The maximum thickness of application in one pass shall be 1". If the depth of patch exceeds 1", the mortar shall be placed in two passes of approximate equal thickness. Before the first pass has achieved an initial set, the surface shall be prepared for the second pass by scratching with a trowel to form a grid of deformation on the surface.
3. Prime and work the mix into the substrate, filling all pores and voids. Avoid puddling of the primer on horizontal substrates.

D. Curing

1. Use of fine mist spray of water, wet burlap, or non-solvent approved curing compound if ambient conditions might cause premature surface drying, i.e., high temperature, low humidity, strong winds. If necessary, protect newly applied mortar from rain. To prevent freezing, the Contractor shall cover the application area with insulating material, to the satisfaction of the Engineer.

E. Manufacturers Field Representative

1. The Contractor shall arrange with the materials manufacturer or distributor to have the services of a competent field representative at the work site prior to any mixing of components to instruct the work crews in the proper mixing and application procedures. The field representative shall remain at the job site after work commences and continue to instruct until the representative and the Contractor, Inspector and/or Engineer are satisfied that the crew has mastered the technique of installing the system successfully. The representative shall make periodic visits to the project as the work progresses and shall confer on each visit with the Contractor, Inspector and/or Engineer.
2. The Manufacturer's field representative must be fully qualified to perform the work and shall be subject to the approval of the Engineer.
3. The Contractor shall be completely responsible for the expense of the services of the required field representative.

3.05 COATING REBAR

- A. Coat reinforcing as soon as possible after completion of surface preparation.
- B. Place reinforcement coating complying with manufacturers printed instructions.

3.06 PARTIAL DEPTH REPAIR WITH 4000 PSI, 3/8 INCH, 660 CEMENT CONCRETE

A. This specialized work includes, but is not limited to, the following:

1. Concrete and steel reinforcement placement shall be in accordance with Section 03300 and 03200, respectively.
2. Concrete Pump Truck: When so directed, the Contractor shall use an approved concrete pump truck to properly place the concrete and expedite work. Under no circumstances, will the pump truck be driven or parked on an existing tank.
3. Finishing Crew: When so directed, the Contractor will use a specialized finishing crew to properly finish the pours for exposed and visible repairs.
4. Any concrete cracks caused by shrinkage or temperature stresses during the curing of new concrete, poured under this item shall be sealed at no additional cost. This work includes:
 - i. Before sealing, the concrete must be dry, clean and free of contaminants. The concrete shall then be blown clean using oil free compress air immediately prior to applying the sealer.
 - ii. The cracks shall be v-notched to a minimum depth of 1/2 inch or a 1/4 inch bead of caulk shall be placed on both sides of the crack creating a trough. The crack sealer shall then be poured into the v-notch or trough. The crack shall then be observed for seepage of crack sealer and shall be refilled as necessary to ensure the crack is completely filled.
 - iii. During the application of the crack sealer, the Contractor will strictly adhere to all the manufacturer's instructions and specifications.
 - iv. The crack sealer to be used shall low viscosity, methacrylate crack sealer. The Contractors shall submit all applicable data sheets of the material to be used to the Engineer for approval.

B. Where reinforcing steel with active corrosion is encountered, the procedure shall be as follows:

1. Remove all contaminants and rust from exposed reinforcing steel.
2. When half of the diameter of the rebar is exposed, chip out behind the reinforcing steel, 1-in clear minimum.
3. The distance chipped behind the rebar shall be equal to or exceed the minimum placement depth of the material to be used.
4. Replacement of corroded refinement shall be in accordance with the Contract Drawings.

3.06 CLEANING

- A. Clean up spatters and droppings.

3.07 FIELD QUATITY CONTROL

- A. At completion of all repairs, the Contractor, Engineer, and installers of the materials used on the repairs shall inspect the work. Any leaky joints or cracks or repairs not in conformance with the Drawings and Specifications shall be repaired in accordance with the manufacturer's instructions at no additional cost to the Owner. At the completion of these repairs, the Contractor, Engineer, and installers of the materials shall inspect the repaired problem areas.

END OF SECTION

SECTION 03940

CRACK REPAIRS BY EPOXY INJECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to perform all concrete crack repair work as shown on the drawings and as specified herein. All existing interior tank walls shall be thoroughly blast-cleaned and inspected for concrete spalls and cracks. It is the Contractor's responsibility to field determine location of concrete cracking to be repaired once surfaces are clean and clearly visible. Areas of repair shall be identified and marked for repair by the Contractor for approved by the Engineer. Concrete crack repairs shall be performed in accordance with these specifications and the contract drawings.
- B. Existing cracks designated by the Contractor, and approved by the Engineer, to be repaired by pressure injection, shall be bonded by penetration with an epoxy adhesive injected under pressure with special equipment and in accordance with the epoxy manufacturer's recommendations.
- C. The work done under this Section consists of repairing cracks in sound concrete.
- D. Work under this item shall apply to all existing interior concrete walls of the following tanks during the following Phases:
 - a. Solids Handling Improvements: Sludge Thickeners #1 and #2
 - b. Phase 1 Improvements: Primary Clarifiers #1, 2, and 3, and Chlorine Contact Chamber
 - c. Phase 2 Improvements: Aeration Tank 1, 2, and 3, Final Clarifiers #1, 2, 3, & 4

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03930 - Concrete Rehabilitation
- B. Section 09880 - Concrete Protective Coating

1.03 PERFORMANCE REQUIREMENTS

- A. Seepage of water through cracks repaired under the Work of this Section will be regarded as defective Work subject to the one year guarantee required by the General Conditions.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's printed specifications and installation instructions for epoxy adhesive and surface seal material.

B. Quality Control Submittals:

1. Test Reports:

- i. Submit reports for tests specified under Source Quality Control.
- ii. If requested, submit test reports for all specified characteristics and properties of the epoxy adhesive materials from an Independent Testing Laboratory.
- iii. Certificates: Affidavit required under QUALITY ASSURANCE Article.
- iv. Installation Contractor's Qualifications Data:
 - a. Firm name, address, and telephone number.
 - b. Period of time firm has performed crack repairs by epoxy injection.
- v. Installer's Qualifications Data:
 - a. Name of each person who will be performing the Work and their employer's name, business address and telephone number.
 - b. Period of time installer has performed crack repairs by epoxy injection.
 - c. Proof of satisfactory completion of a program of instruction in the epoxy injection process.

1.05 QUALITY ASSURANCE

B. Qualifications:

1. Installation Contractor: The firm performing the Work of this Section shall have been regularly engaged in crack repairs by epoxy injection for a minimum of 5 years, shall be licensed or approved by the epoxy adhesive manufacturer to perform such work, and shall have completed 5 similar projects in the last 5 years.
 2. Installer: The person(s) performing the Work of this Section and their Supervisor shall be personally experienced in crack repair by epoxy injection and shall have been regularly employed by a Company performing crack repair by epoxy injection for a minimum of 2 years, and shall have satisfactorily completed a program of instruction in the epoxy injection process.
 - i. The instruction shall include this specific method of repairing cracks in concrete, the technical aspects of correct material use, and the operation, maintenance and checking of equipment.
- A. Testing Agency: Tests for all specified characteristics and properties of the epoxy adhesive materials shall have been performed by a qualified Independent Testing Laboratory and copies of the test results shall be available. Tests indicated under Source Quality Control shall be performed by the adhesive manufacturer.
- B. Source Quality Control: The following quality control tests shall be performed on each lot of epoxy adhesive materials supplied for this Project. Tests shall be conducted using the test methods indicated in Part 2.

1. Resin viscosity at 77 degrees F and epoxide equivalent weight.
 2. Hardener viscosity at 77 degrees F and amine value.
 3. Combined components pot life at 77 degrees F.
 4. Cured (for 7 days) adhesive ultimate tensile strength and tensile elongation at break; and slant shear strength for wet/wet concrete cured 3 days.
- C. Material Container Labels: Material containers shall bear a manufacturer's label indicating manufacturer's name, trade name of product, lot number, shelf life of product, and mix ratio by volume.
- D. Equipment for Injection: The injection equipment shall meter and mix the adhesive components, and inject the mixed adhesive into the cracks. Equipment shall be a portable, positive displacement type pump unit with interlock to insure exact ratio control of the two components at the nozzle. Unit shall have metering pumps, electrically or air powered, which will provide in-line metering and mixing of the adhesive components.
1. Discharge Pressure: The injection equipment shall have automatic pressure control capable of discharging the mixed adhesive at any pre-set pressure up to 200 psi (within a tolerance of plus or minus 5 psi), and shall be equipped with a manual pressure control override.
 2. Ratio Tolerance: The injection equipment shall have the capability of maintaining the volume ratio for the adhesive, as prescribed by the manufacturer of the adhesive, within a tolerance of plus or minus 5 percent by volume at any discharge pressure up to 200 psi.
 3. Automatic Shut-Off Control: The injection equipment shall have sensors on both component reservoirs that will automatically stop the machine when only one component is being pumped to the mixing head.
- E. Certificates: Affidavit from the epoxy adhesive manufacturer certifying that each batch of epoxy adhesive material shipped for this Project complies with the requirements of these specifications.
- F. The Contractor shall arrange with the materials manufacturer or distributor to have the services of a competent field representative at the work site prior to any mixing of components to instruct the work crews in the proper mixing and application procedures. The field representative shall remain at the job site after work commences and continue to instruct until the Engineer is satisfied that the crew has mastered the technique of installing the system successfully. The representative shall make periodic visits to the project as the work progresses and shall confer on each visit with the Contractor and the Engineer.
1. The manufacturer's field representative shall be fully qualified to perform the work and shall be subject to the approval by the Engineer.
 2. The Contractor shall be completely responsible for the expense of the services of the required field representative.

1.06 DELIVERY AND STORAGE

- A. Deliver materials to the site in original, sealed containers bearing manufacturer's label. Do not deliver materials which have exceeded shelf life limitation set forth by the manufacturer.
- B. Comply with manufacturer's printed instructions for storing materials in original, sealed containers at a temperature between 32 degrees F and 90 degrees F.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with manufacturer's recommendations for conditions under which materials can be applied.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Epoxy Adhesive: Two component, low viscosity, epoxy resin adhesive system containing 100 percent solids, with no solvents or non-reactive diluents, which meets the following characteristics and properties:
 - 1. Resin: Blend of epoxy resins.
 - ii. Viscosity at 40 + 3 degrees F, cps (Brookfield RVT Spindle No. 4 at 20 rpm): 6,000 - 8,000.
 - iii. Viscosity at 77 + 3 degrees F, cps (Brookfield RVT Spindle No. 2 at 20 rpm): 300 - 700.
 - iv. Epoxide Equivalent Weight (ASTM D 1652): 160 - 220.
 - v. Ash Content, percent (ASTM D 482): 1 maximum.
 - 2. Hardener: Blend of amine curing agents.
 - i. Viscosity at 40 + 3 degrees F, cps (Brookfield RVT Spindle No. 2 at 20 rpm): 700 - 1,400.
 - ii. Viscosity at 77 + 3 degrees F, cps (Brookfield RVT Spindle No. 2 at 20 rpm): 100 - 400.
 - iii. Amine Value, mg KOH/g (ASTM D 664): 490 - 560.
 - iv. Ash Content, percent (ASTM D 482): 1 maximum.
 - 3. Pot Life of the Combined Components: When mixed in the ratio recommended by the manufacturer for use, material shall have pot life as follows:
 - i. 60 g at 77 + 3 degrees F: 13 - 55 minutes.
 - 4. Properties of the Cured Adhesive: When cured for 7 days at 77 + 3 degrees F, material shall have the following properties:
 - i. Ultimate Tensile Strength, psi (ASTM D 638): 5,000 minimum.
 - ii. Tensile Elongation at Break, percent (ASTM D 638): 4 maximum.
 - iii. Flexural Strength, psi (ASTM D 790): 10,000 minimum.
 - iv. Compressive Yield Strength, psi (ASTM D 695): 10,000 minimum.
 - v. Slant Shear Strength, psi (AASHTO T 237, 5,000 psi compressive strength concrete):

5. Cured 3 days at 40 + 3 degrees F, wet/wet concrete: 3,500 minimum.
 6. Cured 7 days at 40 + 3 degrees F, wet/wet concrete: 4,000 minimum.
 7. Cured 1 day at 77 + 3 degrees F, dry/dry concrete: 5,000 minimum.
- B. Surface Seal: Material with adequate strength and adhesion to hold injection fittings firmly in place and to prevent leakage of epoxy adhesive during injection, and removable without damaging or defacing structure being repaired.
 - C. Finishing Patching Materials: As required to match color, texture, and performance of adjoining surfaces as closely as practicable.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean cracks and adjacent surfaces free of loose material, dust, dirt, grease, oil, efflorescence, and other foreign matter in accordance with epoxy adhesive manufacturer's printed instructions and as required for proper bonding of surface seal. Do not use acids or corrosives.
- B. Establish entry ports along each crack spaced at intervals not less than the thickness of the concrete member being repaired.
- C. Apply surface seal material to the face of each crack between the entry ports as required to prevent escape of injected epoxy adhesive. For cracks all the way through the concrete member, apply surface seal to both faces of cracks where accessible. Allow sufficient time for the surface seal material to gain adequate strength before proceeding with epoxy injection.
- D. If cracks extend into moving joints, plug or seal off the cracks at the joints.

3.02 EPOXY INJECTION

- A. Set up and check injection equipment and material in accordance with the manufacturer's instructions and as specified. Do not thin epoxy adhesive.
- B. Beginning at the lowest entry port in the crack, unless otherwise recommended by the installer because of the configuration of the crack, inject epoxy adhesive in the entry port until there is an appearance of adhesive at the next adjacent entry port. When epoxy adhesive travel is indicated at the next adjacent port, discontinue injection in the port, seal off the port, and resume injection in the next adjacent port. Continue this procedure until the crack has been injected full of epoxy adhesive for its entire length in one continuous operation. For horizontal cracks, proceed from one end of the crack to the other end in the same manner. Seal the last port, and allow the adhesive to cure.
- C. If port to port travel of epoxy adhesive does not result after a reasonable amount of pumping, stop injecting adhesive. Report abnormal conditions (if any) immediately to the Engineer and manufacturers field representative..

3.03 FINISHING

- A. Remove surface seal and entry port fittings when epoxy adhesive has sufficiently cured to allow removal without disturbing the adhesive.

- B. Fill the face of the crack out flush with the concrete surface plane with patching materials. Eliminate indentations and evidence of port fittings. Finish patches to match texture of adjoining concrete surface as closely as practicable.

3.04 FIELD QUALITY CONTROL

- A. Furnish equipment necessary to perform field testing.
- B. Pressure Test: The mixing head of the injection equipment shall be disconnected and the two supply lines shall be attached to a pressure check device. The pressure check device shall consist of two independently valved nozzles capable of controlling flow rate and pressure by opening or closing the valve. There shall be a pressure gauge capable of sensing the pressure build-up behind each valve. The valves on the pressure check device shall be closed and the injection equipment operated until the gauge pressure on each line reads 190 psi. The pumps shall be stopped and the gauge pressure shall not drop below 180 psi within 3 minutes.
- C. Ratio Tests: The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through a ratio check device. The ratio check device shall consist of two independently valved nozzles capable of controlling back pressure by opening or closing the valve. There shall be a pressure gauge capable of sensing the back pressure behind each valve. The discharge pressure shall be adjusted to 180 psi for both adhesive components, and then the components shall be simultaneously discharged into separate calibrated containers. The amounts discharged into the containers during the same time period shall be compared to determine the volumes and the ratio of the components. The test shall be repeated with the discharge pressure adjusted to 0 psi for both adhesive components.
- D. Frequency of Pressure and Ratio Tests: A pressure test and ratio tests shall be performed for each injection equipment unit at the beginning of each shift and after the meal break of each shift that the unit is used.
 - 1. Perform additional tests when directed by the Manufacturer's Representative.
- E. Records of Tests: Record the date and results of all tests, and furnish a copy of the test records to the Engineer.

3.05 CLEANING

- A. Remove adhesive runs and spills from existing surfaces by a method which will not deface the surfaces being cleaned.

END OF SECTION

DIVISION 04

SECTION 04100

MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements to furnish, prepare, and protect as a perishable material, mortar and grout, complete with specified admixtures for use in the installation of masonry structures.

B. Related Sections

1. Section 04200 – Unit Masonry
2. Section 04230 – Reinforced Unit Masonry

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. C144, Specification for Aggregate for Masonry Mortar.
2. C150, Specification for Portland Cement.
3. C207, Specification for Hydrated Lime for Masonry Purposes.
4. C270, Specification for Mortar for Unit Masonry.
5. C404, Specification for Aggregates for Masonry Grout.
6. C476, Specification for Grout for Masonry.
7. C780, Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

1.03 SUBMITTALS

A. In accordance with Section 01300.

B. Product Data

1. Submit manufacturer's product data for each product, including certification that each product complies with the specified requirements.

C. Samples

1. Before the start of work samples of sand shall be submitted to the Engineer for approval.

1.04 DELIVERY, STORAGE AND HANDLING

A. Store cementitious materials off the ground, under cover and in dry location. Store in their original containers, plainly marked with identification of material and maker. Materials in broken containers, or in packages showing water marks or other evidence of damage, shall not be used and shall be removed from the site.

B. All perishable materials included in this Section shall be delivered, stored and handled so as to prevent deterioration, intrusion of foreign matter or moisture, or damage of any nature.

PART 2 PRODUCTS

2.01 MANUFACTURES

A. Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

2.02 COMPONENTS

A. Portland Cement

1. ASTM C150, Type II. The same brand and color of cement shall be used throughout the job to ensure uniformity of color.

B. Hydrated Lime

1. ASTM Designation C207, Type S.

C. Aggregate for Mortar

1. ASTM Designation C144
2. Clean, durable particles, free from injurious amounts of organic matter.

D. Aggregate for Grout

1. ASTM Designation C404

E. Water

1. Clean and Potable

F. Mortar Color

1. Chemically inert, non-fading color, manufactured from alkali fast mineral oxides, finely ground and specifically prepared for use in cement and lime mortars. They shall be added to the mixture where so specified and used in accordance with the manufacturer's recommendations. Colored mortar shall be used on all new building face brick and, as standard of color only, shall be Davis Colors, 7011 Muirkirk Rd., Beltsville, MD 20705; "Chromix" L.M. Schofield Company, 6533 Bandini Blvd., Los Angeles, CA 90040; Solomon Grind-Chem Service, Springfield, Ill. 62705, or equal. Color shall match the existing mortar color.
2. Color of mortar joints on both new and existing masonry work is to be the same. Color shall be selected by the Engineer from the manufacturer's full range of standard colors.

2.03 MORTAR AND GROUT MIXES

A. General

1. No air-entraining admixtures or cementitious materials containing air-entraining admixtures shall be used in the mortar. No anti-freeze liquids, salts, or other substances shall be used in the mortar or grout to lower the freezing point. Calcium chloride or admixtures containing calcium chloride shall not be used in mortar or grout. Integral water-proofing compounds, accelerators, or other admixtures shall not be used in mortar or grout without approval in writing by the Engineer.

B. Grout

1. In accordance with ASTM Designation C476, for grout for use in construction of reinforced and nonreinforced masonry, and shall be mixed 2 1/2 cubic feet of sand to one bag of cement, adding only enough water to make a flowable consistency. Neat grout shall be composed of cement and water only. Non-staining cement shall be used for non-staining grout.
2. Use grout of the appropriate consistency (fine or course) as follows:
 - a. Fine grout in spaces less than 4 inches in any horizontal dimension.
 - b. Course grout in spaces greater than 4 inches in any horizontal dimension.

C. Mortar

1. In accordance with ASTM C270. (Proportional Specification)
2. The mortar mixtures hereinafter tabulated are standard mixtures for which measurement shall be by volume. For the purposes of these Specifications, the

weight of one cubic foot of the respective materials used as ingredients in the mortar shall be as follows:

<u>Materials</u>	<u>Weight, lb per cu ft (kg/m³)</u>
Portland Cement	94(1504)
Hydrated Lime	40(640)
Sand, damp and loose	80(1280) dry sand

- The Contractor shall use mortar Type M for all masonry work. Quantities of materials in parts by volume shall be in accordance with ASTM C-270.

<u>Mortar Type</u>	<u>Portland Cement</u>	<u>Hydrated Lime</u>	<u>Sand, Measured in a Damp, Loose Condition</u>
S1	1	½	No less than 2 1/4 and not more than 3 times the sum of volumes of cement and lime used.

- Mortar ingredients shall be accurately measured by volume in boxes especially constructed for the purpose by the Contractor, or by other method approved in writing by the Engineer. Measurement by shovel will not be allowed.
- Mortar shall be machine mixed in an approved type of mixer in which the quantity of water can be accurately and uniformly controlled. The mixing time shall not be less than 5 minutes, approximately two minutes of which shall be for mixing the dry materials and not less than three minutes for continuing the mixing after the water has been added. Where hydrated lime is used for mortar requiring a lime content, the Contractor will have the option of using the dry-mix method or first converting the hydrated lime into a lime putty as specified below. Where the dry-mix method is employed, the materials for each batch shall be well turned over together until the even color of the mixed, dry materials indicates that cementitious material has been thoroughly distributed throughout the mass, after which the water shall be gradually added until a thoroughly mixed mortar of the required plasticity is obtained.
- All mortar shall be freshly mixed and the quantity of each batch shall not be in excess of the amount that will be used before the same has started to set. Mortar that has begun to set shall not be used. Retempering will not be permitted. Mixer drums shall be entirely emptied of a batch before charging with a succeeding batch. Mortar boxes shall be cleaned out at the end of each day's work, and all tools shall be kept clean.

PART 3 EXECUTION

3.01 MIXING

- Cementitious materials and aggregate shall be mixed between 3 and 5 minutes in a mechanical batch mixer with the maximum amount of water to produce a workable consistency.

3.02 PLACING MORTAR

- In accordance with the requirements of Section 04200.

3.03 GROUTING MASONRY CELLS

- In accordance with Section 04230.

3.04 TESTING

- A. Construction-site-prepared mortar shall be tested in accordance with ASTM C780
- B. Samples tested during the progress of the work may be accepted on the basis of the 7 day test. The right is reserved to rescind such acceptance if the mortar fails on the 28 day test.
- C. Costs for testing shall be in accordance with Section 01410.

END OF SECTION

SECTION 04200

UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for furnishing all required labor, materials, accessories, tools, apparatus and equipment for the masonry work shown on the Drawings and described in the Specifications.
2. Requirements of this section apply to masonry work specified in Section 02430 – Reinforced Unit Masonry.

B. Related Sections

1. Section 04100 - Mortar and Masonry Grout
2. Section 04230 – Reinforced Unit Masonry
3. Section 07600 - Flashing and Sheet Metal Work

1.02 REFERENCES

A. American Society for Testing Materials (ASTM)

1. A82, Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. A153, Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
3. C90, Specification for Loadbearing Concrete Masonry Units.
4. C55, Specification for Concrete Brick.
5. C216, Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
6. C331, Specification for Lightweight Aggregates for Concrete Masonry Units.
7. D226, Specification for Asphalt Saturated Organic Felt Used in Roofing and Waterproofing.
8. D1056, Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
9. D2287, Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

1.03 SUBMITTALS

A. In accordance with Section 01300.

B. Product Data

1. Submit manufacturer's technical data sheets for approval of each of the items in this Section of the specifications.

C. Samples

1. No brick or masonry unit shall be ordered or delivered until the following samples have been approved in writing by the Engineer.
 - a. Concrete masonry units, labeled showing the name of the manufacturer.
 - b. Face brick, representing the complete range of colors and sizes of brick to be supplied, labeled showing the name of the manufacturer and the kind of brick.
2. Submit samples of all accessories.

1.04 QUALITY ASSURANCE

A. Field Constructed Mock-up

1. Construct prior to installation of masonry work.

2. Panel to represent completed masonry work for qualities of appearance, all materials and methods of construction.
 3. Locate mock-up in location indicated on the Drawings, if not indicated as directed by the Engineer.
 4. Build a mock-up in size approximately 6 feet long by 4 feet high by full thickness, including all elements of construction for each of the following:
 - a. Typical exterior concrete masonry wall.
 - b. Typical interior partition of concrete masonry units.
- B. Pre-Installation Meeting
1. The General Contractor is to coordinate a meeting with the Masonry Subcontractor, Resident Field Engineer and the Design Engineer to discuss the construction sequencing of the masonry work, reinforcing installation and the placement of the grout.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver masonry materials to site undamaged.
- B. Store and handle masonry units to prevent their deterioration or damage.
- C. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Obtain masonry units of similar type to be exposed from one manufacturer for each different product required for each continuous surface or visually related surfaces in order to provide uniform texture and color.

2.02 MATERIALS

- A. Mortar
 1. In accordance with Section 04100.
- B. Face Brick
 1. Face brick shall be extruded brick conforming to the applicable requirements of ASTM Designation C216 for Grade SW, Type FBS and shall be "A" quality having a clear face and two clear ends.
 2. Face brick shall be modular size, 2-1/4 inches by 7-5/8 inches face by 3-5/8 inches depth except where special brick is noted on drawings.
 3. As standard of color and texture only, color and texture shall match the existing brick of adjacent buildings.
 4. Brick will be solid, and shall conform in all respects to the requirements of applicable building codes.
 5. Lip bricks shall be provided as shown on Drawing.
 6. Brick with absorption greater than 8 percent by weight shall not be accepted.
- C. Concrete Masonry Units (CMU)
 1. Concrete Masonry Units shall conform to the requirements of ASTM Designation C90, hollow units of 8 inches by 16 inches nominal face size and bed dimension as shown on the Drawings. CMU for bearing walls shall be load bearing. CMU shall be of lightweight aggregates conforming to ASTM C331, and having a minimum

ultimate compressive strength of 2500 psi in the net cross-sectional area. The weight of each CMU shall not exceed the following:

Bed Dimension Maximum Weight, lbs/unit

4-in.	20
6-in.	23
8-in.	30
10-in.	38
12-in.	45

2. CMU shall be free from substances that will cause staining or pop-outs and shall have a fine and even texture with straight and true edges. All CMU shall have been wet steam cured for at least 18 hours and then air-cured in covered storage for not less than 28 days before delivery. CMU, when received at the building site, shall be stacked as to provide air circulation and shall be protected from the weather. Moisture content of blocks when laid shall not exceed 35 percent of total absorption. CMU are to be two (2) cell unless otherwise noted.
3. Provide special block required by the Drawings, including, but not necessarily limited to, solid, corner, lintel and jamb units.
4. Finish of CMU shall have exposed surfaces plane and free from noticeable cracks, pits, damaged corners, and other imperfections.

D. Concrete Brick

1. In accordance with ASTM C55.
2. Grade and type to be same as approved CMU.
3. Weight Classification: Normal weight.
4. Size: 3 1/8 inches x 2 1/4 inches x 7 5/8 inches.

E. Sound Block

1. Sound Block shall be the sound absorbing concrete masonry units and shall be manufactured to meet ASTM C90.
2. Units shall be 8 inches x 16 inches nominal face size.
3. Color and pattern shall be selected by the Engineer from the manufacturer's full range of standard colors and patterns.
4. Products shall be as manufactured by:
 - a. Trenwyth Industries, Inc.- "Acousta-Wal, Type IVRF"
 - b. The Proudfoot Co., Inc.- "Soundblox, Type RSC/RF"
 - c. Or approved equal.

2.03 JOINT REINFORCEMENT

- A. All masonry walls shall be reinforced as noted on the Drawings.
- B. Horizontal joint reinforcement for cavity walls.
 1. Reinforcement shall be as indicated on the Structural Drawings.
 2. Galvanized in accordance with ASTM A153, Class B-2, 1.5 oz. per sq. ft. of wire surface.
 3. Adjustable assembly with the eye sections welded to the truss section at 16-inches on centers. Single wythe and multiple wythe walls shall be ladder type located 8" on center (every block course).

4. Widths approximately two (2) inches less than the nominal width of walls and patricians as required to provide mortar coverage of not less then 5/8 inches on joint faces exposed to the exterior and ½ inch elsewhere or as indicated on the Drawings.
5. Product to be Dur-O-Eye as manufactured by Dur-O-Wall, Inc., or equal.

2.04 VERTICAL REINFORCEMENT

A. In accordance with Section 04230

1. Size and spacing indicated on the Structural Drawings.
2. All vertical reinforcing shall be installed using vertical bar positioners, as manufactured by Dur-O-Wall or equal, for locating the reinforcement in the center of the cells.

2.05 ACCESSORIES

A. Compound masonry anchors shall be equal to "Star Slugin" manufactured by Star Expansion Industries, or equal product manufactured by Rawls, Phillips Drill Company. No less than two anchor units shall be used on any installation. Iron or steel shall be attached to concrete or masonry with steel machine bolts unless specifically noted otherwise. Furnish anchor units complete with bolts and nuts as specified and plate washers where indicated.

B. Anchorage to concrete formwork with Dovetail Slots and Anchors

1. 22 gage hot dip galvanized channel slots, with filler strips.
 - a. Bar type anchor, Manufacturers standard hot dip galvanized anchor with dovetail anchor section formed from 16 gage sheet metal, 7/8 inches wide, corrugated, turned up ¼ inch at end.
 - b. Wire type anchor, 6 gage wire, triangular shaped.
2. Length shall be as shown on drawings.
3. Manufactured by Dur-O-Wall, Inc. or equal.

C. Anchorage to steel framework

1. Manufactures standard anchors with crimped ¼ inch diameter hot dipped galvanized wire anchor section for welding to steel and 0.187 inch diameter triangular shaped wire tie sections.
2. Length shall be as shown on drawings.
3. Manufactured by Dur-O-Wall, Inc. or equal.

D. Corrugated veneer ties

1. 22 gage, 7/8 inches wide, 6 inches long, galvanized.

E. Rigid anchors for intersecting bearing walls

1. 1 ½ inches wide by ¼ inch thick by minimum 24 inches long.
2. Turn up ends minimum 2 inches or provide cross pins.

F. Flashing

1. In accordance with Section 07600.

G. Expansion Joints

1. In accordance with ASTM D1056, Grade RE41E1.
2. Premolded, flexible cellular neoprene rubber filler strips.
3. Capable of compression up to 35 percent.

H. Control Joints

1. Designed to fit standard sash block and maintain lateral stability in masonry wall.

2. Polyvinyl chloride in accordance with ASTM D2287, General Purpose Grade, Designation PVC-63506.
 3. Size and configuration as shown on the drawings.
- I. Bond Breaker
1. Asphalt saturated organic roofing felt in accordance with ASTM D226, Type I (No. 15 asphalt felt).
- J. Weep Holes
1. Plastic Tubing, medium density polyethylene.
 2. Nominal size 1/4" inch wide x 3 inches long x 2 inches high.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection

1. During construction of the masonry, securely cover top of walls with waterproof sheeting at end of each days work and at stoppages due to inclement weather.
2. Do not apply floor, roof or other concentrated loads to areas which will affect the masonry work for at least three (3) days after constructing the work.
3. Immediately remove grout or mortar from face of masonry to be left exposed.
4. Protect sills, ledges and other work from droppings of mortar and grout.

3.02 INSTALLATION

A. General

1. Install all items furnished under this Section in the finished work including items to be imbedded in concrete or masonry. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown on the Drawings. Fastening to wood plugs in masonry will not be permitted. All dimensions shall be verified at the site before fabrication is started.
2. No masonry shall be laid when the temperature is below 32 deg F, unless adequate means are provided for maintaining a temperature above 32 deg F during and for 48 hours subsequent to laying. The requirements for wetting brick shall also apply under these conditions. No frozen work shall be built upon. No masonry units having a film of frost on their surface shall be laid in the wall.
3. Both interior and exterior brickwork, concrete masonry units, shall be laid from scaffolds on the sides of walls from which the material is being laid. No overhead work will be permitted. Scaffolding shall be constructed and maintained in strict accordance with OSHA standards.
4. The Contractor shall familiarize the masons with the specifications of other trades that connect with their work and shall otherwise assure that proper cooperation is obtained.
5. The construction of exterior walls and partitions of rooms shall be scheduled to permit delivery and installation of all equipment, and the continuous operation of the facility without any interruption due to the construction.
6. All aluminum and steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instruction prior to installation.

B. Horizontal Joint Reinforcement

1. Horizontal reinforcement of masonry joints shall be every 8-in. vertically which is equivalent to every course in block masonry and every third course in brick. Reinforcement shall act as ties where anchoring one type of masonry to another except as specified below.
 2. Place as the work progresses.
 3. Minimum cover of 5/8 inches on exterior faces and 1/2 inch at other locations.
 4. Lap units ends at 6 inches minimum.
 5. Use prefabricated "T" and "L" sections at corners and intersections.
 6. Field fit sections only as recommended by the manufacturer.
 7. Anchor as detailed on the Drawings.
- C. Vertical wall reinforcement
1. Install in accordance with Section 04230.
- D. Concrete Masonry Units (CMU)
1. Concrete masonry shall be laid up in Class M mortar as specified in Section 04100 and in the manner indicated on the Drawings
 2. Where required by the Drawings, CMU partitions shall be built of units of thickness as shown. The partitions shall be built straight and plumb and in perfect alignment with cores set vertically with broken joints and carefully bedded in cement mortar. Except as otherwise shown on the Drawings, partition walls shall extend from floor construction to within 3/8 inch minimum of the slab or other construction above. Partitions shall be anchored to adjacent construction as indicated and as hereinafter specified.
 3. Care shall be exercised in setting concrete masonry units around door bucks and window frames in order not to bulge the sides or change the position of the frames.
 4. Before starting walls, pipe coverings or other projections shall be plumbed so that the full thickness of web of units will occur at all such projections. Walls shall be plumb and true to line.
 5. Concrete masonry walls shall be laid out with one stretcher course of the units to define the spaces, location of doors and other openings, and to serve as a guide for other trades in the installation of their work. Sufficient opportunity shall be given to the various trades to install built-in work before proceeding with the walls, leaving openings where required for testing, etc., such openings to be closed up later. The first course of all partition walls shall rest directly on the structural slab and hollow units shall be set with cells vertical and filled with mortar to one-half the height of the block.
- E. Sound Block
1. Installed by the masonry contractor using the best concrete masonry practices.
 2. Laid in running bond in a full horizontal bed of mortar with the closed tops up. Slots shall face toward the room or area where sound absorption is required as shown on the Drawings. Slots shall be kept free of mortar and debris and the exposed mortar at the bottom of each slot shall be neatly tooled.
 3. Joints shall be tooled and concave.
 4. No broken, chipped or cracked units shall be used. Only quality units shall be installed. All defective units shall be rejected.
- F. Brick Work
1. Brick masonry shall be laid up in Class M mortar as specified in Section 04100. The same class of mortar shall be used for face brick throughout the job to ensure uniformity of color.

2. Brick shall be laid in the manner indicated on the Drawings. The horizontal bed joints shall be completely filled with mortar and shall not be furrowed with the ends of the trowel. The cross joints shall be filled with mortar applied against the end of the brick, which shall then be laid on the full, unfurrowed bed of mortar, and the brick shall be shoved tight up against the next brick already in place. The striking of the joints shall be done in such a way that they will be completely filled, leaving a smooth, hard, compact surface. A jointing tool shall then be used and the mortar shoved with force, so as to pack the mortar tight against the brick. Tooling shall form a slightly concave joint flush with the edges of the adjoining bricks.
3. To close the space between two other bricks, already laid, a trowel of fresh mortar shall be thrown against the end of each of these bricks, also on the flat brick, and the closure brick shall then be racked into place. The intention is to get a completely filled bed and cross-joint.
4. Holes in joints caused by nails used for holding the line or from any other cause shall be filled before joint is struck or finished.
5. Courses of brick work shall be kept level, and the bond shall be accurately preserved. When necessary to bring any work to a required height, joints shall be adjusted uniformly to suit the conditions. Brickwork shall be laid to line and kept plumb and square.
6. At all times, up to the time that face bricks are ready to be laid, they shall be handled with brick tongs or by hand. Wheel-barrows shall be of the flat type. Bricks shall not be loosely dumped into barrows or onto scaffolds. Damaged brick shall not be used in exposed wall surfaces.
7. Joints, unless otherwise indicated, shall be as nearly as possible of one size and shall be approximately 3/8 inch wide. After the mortar has taken its initial set, the joints shall be tooled to a slightly concave surface with a jointer which shall make a smooth, even joint without discoloration.
8. Unfinished work shall be stepped back for joining with new work; tothing may be resorted to only when specifically approved by the Engineer. Before new work is started, all loose mortar shall be removed and the exposed joint thoroughly wetted not less than 12 hours before laying new work.

G. Accessories

1. Anchors and Ties.
 - a. As the brickwork proceeds, make provisions for the installation of all anchors, ties, reinforcing, and dowels as hereinafter specified, as shown on the Drawings, required for this trade.
 - b. Build-in all similar items required for and furnished by other trades, strictly in accordance with the instructions of those for whose use they are provided.
 - c. Anchors except for strap anchors shall be as shown on the Drawings.
 - d. Corrugated wall ties shall be provided for bonding face brick to brick and tile backing, except where brick reinforcement or bonders are used. One tie shall be placed on each brick in every sixth course.
 - e. Concrete masonry unit walls shall be bonded with approved metal ties in alternate courses, spaced 24 inches horizontally. The ends of ties shall be set so that they overlap 3 inches beyond ties set below.
 - f. Dovetail anchors shall be set in galvanized dovetail slot. Anchor shall be installed at 16 inches O.C. vertical.

2. Flashing
 - a. As the brickwork and backup proceeds, make provision for the installation of flashing. Carefully follow the Drawings and recommendations of the manufacturer for this procedure. All headers and bonding are to be arranged and carried out as required to provide for the proper installation of the flashing as shown. A smooth mortar surface shall be provided to receive all flashing.
 - b. Flashings and cap flashings shall be built-in and pointed upward. Cutting chases for flashing will not be permitted. Masonry work built without required built-in flashing shall be demolished and built properly.
 3. Premoulded Joint Filler
 - a. Joint filler shall be placed in masonry walls at control joints and elsewhere as shown for the masonry on the Drawings.
 - b. Thickness shall be as shown on the Drawings.
 - c. Caulking for sealing joint filler is specified elsewhere in these Specifications.
 4. Weep Holes
 - a. Install in the vertical mortar joints of the facing brickwork on 24-in. centers just above lintel angles and at the bottom of the cavity.
 - b. The weep holes shall be installed by placing preformed plastic weep holes in the vertical joints.
- H. Chases and Recesses
1. Chases for pipes or ducts shall be provided as shown on the Drawings or as directed. These shall not be covered until all tests are completed. Where pipes are enclosed, masonry shall be kept clear of pipes and fittings in order to allow free movement of pipe work. The Contractor shall obtain the approval of the Engineer in writing before building or cutting any chase in excess of 4 inches deep and 8 inches wide, except where shown on the Drawings.
 2. Recesses shall be provided in all brick work for cabinets, outlets, grilles and other miscellaneous appurtenant work where shown on the Drawings or directed by the Engineer. Work, including that furnished and installed by others, which comes within the brick work shall be neatly built-in having all brick fitted about such work.
- I. Opening for Ducts
1. Where ducts pass through brick walls or pass through masonry unit partitions, the steel lintels shall be set over the openings before proceeding with the work over openings.
 2. Where outlets for registers, radiator enclosures, grilles and other similar work branch out of walls, shafts and vertical ducts, the frames furnished under another Section of these Specifications shall be built-in. Partitions shall not be cut to receive the register or other frames.
- J. Door Frames and Bucks
1. Before building any work around or against bucks or frames, the Contractor shall check and inspect the frames and bucks to determine the following:
 - a. Units are set plumb, square and in proper position.
 - b. Proper anchors are fastened in place for building into masonry.
 - c. Electric conduits are not housed in bucks in a manner that would prevent full extension of buck anchors.
 2. Joints between masonry and bucks shall be completely filled with mortar. All anchors shall be securely set into the masonry and thoroughly slushed with mortar.

If bucks or steel frames are loose after being set, holes shall be drilled in units at heads, over lines of jambs, and voids in jambs completely filled with cement grout.

3. Point neatly around all door and sash frames and other trim.

K. Setting louvers and frames

1. Louvers and frames shall be set plumb and square. The braces or stays shall not be removed until the frames are built-in and properly secured in the walls. All louvers shall be built-in with the brickwork where possible. Masonry openings shall be plumb, square, true to line and of proper dimensions for louvers. Proper slots at jambs and heads shall be provided to receive louver jamb plates. All necessary mortar pointing around window frames shall be done after they are installed, leaving them in condition ready for caulking.

L. Steelwork

1. Loose lintels, templates, and other miscellaneous steel shall be built into masonry in accordance with details on the Drawings and as required by the trade furnishing said work.

M. Blocking

1. Wood strips and blocking for fastening flashing or other metal work shall be placed strictly in accordance with details on the Drawings and the instructions of the trade for whom they are required.

N. Cutting and Patching

1. No masonry work shall be cut or patched without the permission of the Engineer.
2. Patching and replacing of masonry work shall be carefully done.

3.03 CLEANING

- A. All mortar shall be allowed to thoroughly cure before cleaning. Adequate water supply shall be available to assure thorough presoaking and thorough rinsing of the surface. All surrounding non-masonry surfaces shall be tested and/or protected from exposure to the cleaning compound.
- B. All traces of excess mortar/grout, efflorescence, and other construction stains shall be removed from all exposed masonry surfaces.
- C. Masonry cleaning compound shall be SURE KLEAN No. 600 Detergent as manufactured by ProSoCo Inc., Kansas City, KA, or equal. Use shall be in strict accordance with manufacturers printed instructions.
- D. Avoid using hydrochloric (muriatic) acid containing cleaners which discolor the mortar.
- E. As the cleaning work progresses, all joints shall be examined to locate cracks, holes, or other defects, and all such shall be carefully pointed up and filled with mortar. Where necessary, in the opinion of the Engineer, the joints shall be cut out and repointed with setting mortar of the same color as that of the original and adjoining work

END OF SECTION

SECTION 04230

REINFORCED UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for furnishing all required labor, materials, accessories, tools, apparatus and equipment for the reinforced masonry work shown on the Drawings and described in the Specifications.
2. Requirements of Section 04200 – Unit Masonry apply to work in this section.

B. Related Sections

1. Section 04100 - Mortar and Masonry Grout
2. Section 04200 – Unit Masonry

1.02 REFERENCES

A. American Society for Testing Materials (ASTM)

1. A615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
2. C476, Specification for Grout for Masonry.

1.03 SUBMITTALS

A. In accordance with Section 01300.

1. Submit Shop Drawings for fabrication, bending and placement of reinforcement bars.
2. Comply with ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures”

PART 2 PRODUCTS

2.01 MATERIALS

A. General

1. Refer to Section 04200 for masonry materials not included in this section.

B. Reinforcing Bars

1. In accordance with ASTM A615, Grade 60, unless indicated otherwise on the Drawings.
2. Size and spacing as indicated on the Structural Drawings.
3. Shop fabricate reinforcing bars which are shown to be bent or hooked.
4. All vertical reinforcing shall be installed using vertical bar positioners, as manufactured by Dur-O-Wall or equal, for locating the reinforcement in the center of the cells.

C. Mortar and Grout in accordance with Section 04100.

PART 3 EXECUTION

3.01 INSTALLATION OF REINFORCEMENT

A. General

1. Clean reinforcement of loose rust, scale, earth, ice or other deleterious material.
2. Do not use reinforcement which is deformed, severely rusted or not as shown on the approved shop drawings.

B. Positioning Reinforcement

1. Position reinforcement accurately as indicated on the Drawings.
2. Securely support bars to avoid displacement during grouting operation.
3. Minimum clearances, unless indicated on Drawings are as follows:
 - a. Where vertical bars are in close proximity, provide a minimum of 1 inch or a nominal bar diameter between bars, whichever is greater.
 - b. Where vertical bars are placed for columns, piers and pilasters, provide a minimum of 1 ½ inches or a 1 ½ times the nominal bar diameter between bars, whichever is greater.

C. Splicing

1. Locations as indicated on the Drawings.
2. Provide laps as indicated.

D. Horizontal Joint Reinforcement

1. Place as the work progresses.
2. Minimum cover of 5/8 inches on exterior faces and ½ inch at other locations.
3. Lap units ends at 6 inches minimum.
4. Use prefabricated "T" and "L" sections at corners and intersections.
5. Field fit sections only as recommended by the manufacturer.
6. Anchor as detailed on the Drawings.

E. Vertical wall reinforcement

1. Place reinforcement before grouting.
2. Installed using in one of two methods as the wall progresses.
 - a. The first method, the vertical reinforcing bars may be installed into the masonry cells after each of 4' of wall is placed, but before grouting, this method will require the bars to pass through a minimum of two bar positioners in the 4' lift.
 - b. The second method requires the upper bars to be installed tied to the lower bars, or foundation dowels, with tie wire as specified under Section 03200 and pass through only one vertical bar positioner located at the bottom of the last course for each lift. The Contractor's attention is directed to the fact that with the second method the masonry blocks will need to be lifted over the rods already in position. Vertical wall reinforcing shall be lapped a minimum of 48 bar diameters (# 5's - 30"; # 6's - 36"; #7's - 42"). Grouting of the masonry cells shall conform to this Section using grout as specified in Section 04100. Masonry wall reinforcing shall be supplied in lengths equal to the maximum grout lift (4') plus the required lap lengths as specified above.

3.02 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY (CMU)

A. General

1. Install CMU dry without wetting.
2. Lay CMU with full face mortar bed.

3. Fill joints between CMU solidly with mortar.
 4. Solidly bed cross-webs of starting courses in mortar.
 5. Head and bed joint width to be 3/8 inched unless indicated otherwise on the Drawings.
- B. Walls
1. Lay CMU wall units in 1/2 running bond with vertical joints in each course centered with courses above and below unless indicated otherwise on the Drawings.
 2. Maintain alignment of cells which are to be reinforced and grouted, Provide minimum clearance dimensions indicated, solidly bed webs in mortar where adjacent to reinforced cores. Keep cavities to be grouted free of mortar.
 3. Interlock corners and intersections.
 4. Use special shaped units as required for jambs, sashes, joints, lintels, bond beams or as otherwise indicated on the drawings.
- C. Columns, Piers, Pilasters
1. Use CMU of the size and shape indicated on the Drawings. If not shown use units which provide minimum clearances for the size of reinforcement shown.
 2. Where bonded pilaster construction is indicated, lay wall and pilaster units together.
- D. Grout Selection
1. Use fine grout (ASTM C476) for filling cavities 4 inches or less in any horizontal direction.
 2. Use course grout (ASTM C476) for filling cavities greater than 4 inches in any horizontal direction.
- E. Grout Method
1. Prior to placing grout.
 - a. Inspect and clean cavities to receive grout.
 - b. Clean and adjust reinforcement.
 - c. Clean surface of structural member supporting the masonry to ensure bond with grout.
 - d. Close cleanout holes, and brace to resist grout pressure.
 2. Placing grout will not be allowed until the masonry has attained sufficient strength.
 3. Grout to be placed by pumping unless an alternate method is approved by the Engineer.
 4. The Contractor has the option of using either low-lift or high-lift grouting procedures in accordance with this specification as approved by the Engineer.
 - a. Low Lift Grouting
 - 1) Requires minimum clear dimension of 2 inches and clear area of 8 sq. inches in vertical cores to be grouted
 - 2) Vertical reinforcement to be placed prior to laying CMU. Extend above pour height to allow splicing as required. Support bars at maximum 10 foot intervals.
 - 3) Lay CMU to pour height not to exceed 4 feet or below bond beam, which ever is less.
 - 4) Pour grout using delivery system appropriate for the job, minimizing spillage. Rod or vibrate grout during placement, Place in continuous operation. Fill CMU to 1 1/2 inches below top of course.

- 5) After grouted masonry has cured, lay masonry and place reinforcement for the next pour before grouting. Repeat as required.
- b. High Lift Grouting
- 1) Requires minimum clear dimension of 3 inches and clear area of 10 sq. inches in vertical cores to be grouted
 - 2) Provide clean out holes in first course of all cavities to be filled with grout.
 - 3) Construct wall to full height of grout pour as allowed.
 - 4) Place grout in 5 foot lifts maximum to a total height of 24 feet for single wythe hollow concrete masonry walls unless indicated otherwise.
 - 5) Allow not less than 30 minutes or more than 1 hour between lifts.
 - 6) Pour grout using delivery system appropriate for the job, minimizing spillage. Rod or vibrate grout during placement, Place in continuous operation. Fill CMU to 1 ½ inches below top of course.
- F. Bond Beams
1. Pour grout to 1 ½ inches below bond beam course.
 2. Place horizontal reinforcement in bond beams lapping corners and intersections.
 3. Place grout in bond beam before filling vertical cores above bond beam.

END OF SECTION

DIVISION 05

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes the following items:

1. Aluminum covers
2. Aluminum extrusions.
3. Aluminum grating.
4. Aluminum framing and supports for covers and grating.
5. Aluminum stop gates.
6. Stainless steel angle, for weirs.
7. Stainless steel fasteners for framing connections.
8. Pipe bollards

1.02 RELATED SECTIONS

SECTION 05510 – Aluminum Stairs and Ladders

SECTION 05520 – Aluminum Handrails and Railings

1.03 SUBMITTALS

A. All submittals shall be made in accordance with the provisions of SECTION 01300 SUBMITTALS.

B. Product Data: Submit manufacturer's technical data sheets for the following:
Delete items below for which Product Data is not required.

1. Paint products, including bitumastic coating.
2. Grout.

C. Shop Drawings: The fabrication and erection of each metal fabrication indicated shall be detailed. Plans, elevations, sections, and details of metal fabrications and their connections shall be included. Anchorage and accessory items shall be shown. The shop drawings shall furnish the required information in sufficient detail and completeness that the work may be accomplished without the use of the Contract Drawings as a reference.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Qualification Data: Firms and persons specified in the "Quality Assurance" Article shall demonstrate their capabilities and experience. Firms shall include

a list of at least three (3) recently completed projects with project names and addresses. The name, address, and phone number of a contact (architect, engineer, or owner) shall be provided for each project in the list, as well as any other required information hereinafter or hereinbefore specified.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: The firm shall be experienced in the production of metal fabrications similar to those indicated for this Project, with a record of successful in-service performance, and shall have sufficient production capacity to produce the work required and complete the work within the duration of the contract.
- B. Welding: Procedures and personnel shall be qualified according to the latest revisions of the following:
 - 1. AWS D1.1, "Structural Welding Code—Steel."
 - 2. AWS D1.2 "Structural Welding Code—Aluminum."
 - 3. AWS D1.6 "Structural Welding Code—Stainless Steel."
 - 4. Certification shall be provided stating that each welder has passed the AWS qualification tests for the welding processes involved and has maintained that certification as required by AWS.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit within reinforced concrete walls and other construction, dimensions shall be verified by field measurements before fabrication. The fabrication schedule shall be coordinated with the construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, proceed with fabricating metal fabrications upon receipt of Engineer reviewed and approved shop drawings, without field measurements. Consideration shall be made for extra material which will be required for trimming and fitting.

1.06 COORDINATION

- A. Installation of anchorages for metal fabrications shall be coordinated with the Contractor. Setting drawings, templates, and instructions for installing anchorages, including sleeves, concrete inserts, anchor bolts, items with integral anchors, and any items that are to be embedded in concrete shall be provided to the Contractor. Items to be embedded in concrete shall be delivered to Project site sufficiently in advance to allow time for installation, as determined by the Contractor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Mill City Steel Corp., Westport, MA
- B. Acceptable alternate.

2.02 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, materials shall be provided with smooth, flat surfaces without blemishes. Materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness shall not be used.

2.03 FERROUS METALS

- A. Structural Stainless Steel Plates, Shapes, and Bars: Shall conform to ASTM A 276, type 316.
- B. Welding Rods and Bare Electrodes: Shall be compatible with the material to be welded per the AWS D1.6 specifications.

2.04 ALUMINUM ALLOYS

- A. Structural Aluminum Shapes: Shall conform to ASTM B 308, 6061-T6, with a mill finish and shall be shipped in accordance with ASTM B 660, complying with the commercial packing and preservation requirements.
- B. Aluminum Extrusions: Shall conform to ASTM B 221, 6061-T6, with a mill finish and shall be shipped in accordance with ASTM B 660, complying with the commercial packing and preservation requirements.
- C. Structural Aluminum Plates: Shall conform to ASTM B 209, 6061-T6, with a mill finish and shall be shipped in accordance with ASTM B 660, complying with the commercial packing and preservation requirements.
- D. Aluminum Tread Plate: Shall conform to ASTM B 632, 6061-T6, a clear, Class II, anodized finish per Aluminum Association Designation AA-A31, 0.4 mils thick minimum, and shall be shipped in accordance with ASTM B 660, complying with the commercial packing and preservation requirements.
- E. Structural Aluminum Tubes: Shall conform to ASTM B 429, 6063-T52, with a mill finish and shall be shipped in accordance with ASTM B 660, complying with the commercial packing and preservation requirements.

- F. Welding Rods and Bare Electrodes: Shall be compatible with the material to be welded per the AWS D1.2 specifications. Aluminum items to be anodized shall not be welded using 4043 weld rod.
- 2.05 PAINT
- A. Bitumastic Coating/Paint: Shall be a paint-on epoxy type suitable for embedment in, or surface mounting to, concrete to prevent adverse reaction between aluminum and concrete surfaces. Acceptable products are TC Wet Bond Flexible Epoxy Mastic as manufactured by Tapecoat of Evanston, IL, and Bitumastic 300M as manufactured by Carbolite of St. Louis, MO, or engineer approved equivalent.
- 2.06 GROUT
- A. Grout: Shall be provided per Section 03600 – GROUT.
- 2.07 FASTENERS
- A. Bolts: Stainless steel fasteners conforming to ASTM F 593, Alloy Group 2, Type 316, CW with hexagonal heads shall be provided for connections.
- B. Nuts: Stainless steel nuts conforming to ASTM F 594, Alloy Group 2, Type 316, CW with hexagonal heads, and thread designation to match stainless steel bolts shall be provided for connections.
- C. Washers: Stainless steel washers shall conform to ASTM F 436, Circular except that the material shall be Type 316 stainless steel conforming with ASTM A 276.
- D. Machine Screws: Stainless steel machine screws shall conform to ASME B18.6.3, and shall be Type 316 stainless steel.
- 2.08 ALUMINUM COVERS
- A. Shall be composed of aluminum tread plate, 1/4" thickness as specified on the Drawings.
- 2.09 ALUMINUM EXTRUSIONS
- A. Shall perform the basic function as indicated on the Drawings. All surfaces embedded in concrete shall be bitumastic coated.
- 2.10 ALUMINUM GRATING
- A. Shall be aluminum, swage locked, rectangular bar grating conforming to ASTM B221, 6061-T6 with a clear, Class II, anodized finish per Aluminum Association Designation AA-A31, 0.4 mils thick minimum. Grating layout

shall be as indicated on the Drawings. Bearing Bars shall be of the depth noted on the drawings and shall be spaced at 1-3/16" on center. Cross bars shall be spaced at 4" on center. Individual grating panels shall be banded around their edges and clipped to framing members with the grating manufacturer's standard fastening devices. A serrated surface shall be provided where indicated on the Drawings.

- B. Grating shall be 19-SG-4 as manufactured by Ohio Gratings, Inc. of Canton, OH, Type BS as manufactured by IKG Borden of Paramus, NJ, or Engineer approved equal.

2.11 ALUMINUM FRAMING AND SUPPORTS FOR COVERS AND GRATING

- A. Shall be fabricated from structural aluminum shapes, structural aluminum tubes, and aluminum extrusions, of the size and quantity as indicated on the Drawings.

2.12 STAINLESS STEEL FASTENERS FOR FRAMING CONNECTIONS

- A. Shall be fabricated from bolts, nuts, and washers of the size and quantity as indicated on the Drawings. One nut shall be provided per each bolt unless otherwise indicated on the Drawings. A washer shall be provided at the contact surface between framing members or clips and the heads of bolts and nuts, minimum two (2) washers per bolt.
- B. Stainless Steel fasteners shall conform to the requirements of the American Iron and Steel Act.

2.13 PIPE BOLLARDS

- A. Pipe bollards shall be fabricated from Schedule 40, welded, galvanized steel pipe in accordance with the provisions of ASTM A53 of the size and quantity indicated on the Drawings.

2.14 FINISHES, GENERAL

- A. Aluminum finishes are specified in this section per the Aluminum Association's Designation system for aluminum finishes. Finishes shall conform to the Specification for Anodized Architectural Aluminum (611-98), as published by the American Architectural Manufacturer's Association.
- B. Fabrications shall be finished after shop assembly.
- C. Anodized finishes damaged in the field during installation or transit shall be repaired using brush anodizing to restore the coating to its specified Class and thickness.

PART 3 EXECUTION

3.01 FABRICATION, GENERAL

- A. Shop Assembly: Items shall be preassembled in shop to greatest extent possible to minimize field splicing and assembly. Units shall be disassembled only as necessary for shipping and handling limitations. Connections shall maintain the structural value of joined pieces through the use of properly sized holes, proper spacing and gage distances, tolerances, and other requirements as determined in the applicable codes listed elsewhere in this specification. Units shall be clearly marked for reassembly and coordinated installation.
- B. Metals shall be sheared and punched cleanly and accurately. Burrs shall be removed.
- C. Exposed edges shall be rounded to a radius of approximately 1/32 inch, unless otherwise indicated. Bent-metal corners shall be formed to the smallest radius possible without causing grain separation or otherwise impairing the work.
- D. Corners and seams shall be welded continuously to comply with the following:
 - 1. Materials and methods shall be used that minimize distortion and develop strength and corrosion resistance of the base metals.
 - 2. Fusion shall be obtained without undercut or overlap.
 - 3. Welding flux shall be removed immediately.
 - 4. At exposed connections, exposed welds and surfaces shall be finished smooth and blended so that no roughness is apparent and the contour of the welded surface matches that of the adjacent surface.
- E. Anchorage of the type indicated in the Contract Documents shall be provided for and coordinated with supporting structure. Anchoring devices shall be fabricated and spaced to secure metal fabrications in place and to support indicated loads.
- F. Metal fabrications shall be cut, reinforced, drilled, and tapped cleanly and accurately to receive finish hardware, screws, and similar items.
- G. Joints that will be exposed to weather shall be fabricated in a manner to exclude water. Drain holes shall be provided where water may accumulate.
- H. Exposed work shall be formed true to line and level, with accurate angles and surfaces, and straight rounded edges.
- I. Sharp or rough areas shall be removed on exposed traffic surfaces.
- J. Exposed connections shall be formed with hairline joints, flush and smooth, using concealed fasteners where possible. Exposed fasteners of type indicated

on the Drawings shall be used; when not indicated, Phillips flat-head (countersunk) screws or bolts shall be used. Joints shall be located where least conspicuous.

3.02 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Anchorage devices and fasteners shall be provided where necessary for securing metal fabrications to in-place construction. Refer to SECTION 03300 – CAST-IN-PLACE CONCRETE for information on approved anchorage devices.
- B. Cutting, Fitting, and Placement: Cutting, drilling, and fitting for the installation of metal fabrications shall be performed as required. Metal fabrications shall be set accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Temporary bracing or anchors shall be provided in formwork for items that are to be built into concrete.
- D. Exposed connections shall fit together to form hairline joints. Welded connections that can not be made in the shop due to shipping limitations shall be made in the field. Do not weld, cut, or abrade surfaces of exterior units that have been anodized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
 - 1. Materials and methods shall be used that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Fusion shall be obtained without undercut or overlap.
 - 3. Welding flux shall be removed immediately.
 - 4. At exposed connections, welds and surfaces shall be finished smooth and blended so that no roughness shows after finishing and the contour of the welded surface matches that of adjacent surface.

3.03 SETTING BEARING AND LEVELING PLATES

- A. Concrete bearing surfaces shall be cleaned of bond-reducing materials, and roughened to improve bond to surfaces. The bottom surface of plates shall be cleaned.
- B. Bearing and leveling plates shall be set on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, anchor bolts shall be tightened. Wedges and shims shall not be removed but, if protruding, shall be cut off flush with the edge of bearing plate before packing with grout.
 - 1. Provide grout per the requirements of SECTION 03600 – GROUT.

2. Grout shall be solidly packed between bearing surfaces and plates to ensure that no voids remain.

3.04 INSTALLING PIPE BOLLARDS

- A. Bollards shall be anchored in place with concrete footings as detailed in the Contract Drawings. Bollards shall be supported and braced in position until their footings are cured.
- B. Fill bollards solidly with 3,000 psi concrete, mounding the top surface.
- C. Paint bollards Safety Yellow in accordance with:
 1. Exterior Steel - Non-Immersion
 - a. Shop Surface Preparation: SSPC SP6 Commercial Blast Cleaning
 - b. Shop Primer Coat: Series 91-K97 Organic Zinc
 - 1) Dry Film Thickness: 2.5 to 3.5 mils
 - c. Full Field Prime Coat: Series 66-color Hi-Build Epoxoline
 - 1) Dry Film Thickness: 3.0 to 5.0 mils
 - d. Finish Coat: Series 73-color Endura-Shield
 - 1) Dry Film Thickness: 2.5 to 5.0 mils
 - e. Total Dry Film Thickness: 8.0 to 13.5 mils.

3.05 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting."
- B. Anodized Surfaces: Clean field welds, bolted connections, and abraded areas and repair anodizing to match the quality of the coating provided by the shop.

END OF SECTION 05500

SECTION 05510

ALUMINUM STAIRS AND LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section Includes requirements for the fabrication and installation of aluminum stair and ladder systems.

1.02 SUMMARY

A. Related Sections

- 1. Section 05500 – Metal Fabrications
- 2. Section 05520 - Aluminum Handrails and Railings.
- 3. Section 05530 – Metal Grating

1.03 SYSTEM DESCRIPTION

A. Design Requirements

- 1. Comply with the provisions of the following codes, standards, and specifications, except as otherwise shown or specified.

- a. The Aluminum Association Designations:

Structural rolled or extruded shapes	6061-T6
Extruded shapes	6063-T5
Plates	6061-T6
Gratings (bearing bars)	6061-T6
(crimp bars)	6063-T6
Sheets	Alcad 3003-H14 and 3003
Bolts and nuts	2024-T4

B. Performance Requirements

- 1. Stairs are to be fabricated to support a live load of 100 lbs. /sq. ft. and a moving concentrated load of not less than 300 lbs.

1.04 SUBMITTALS

A. In accordance with Section 01300 submit the following:

- 1. Complete shop drawings and design computations, stamped by a Professional Engineer registered in the State of Massachusetts who is experienced in this type of work. All computations shall be in conformance with the Specifications for Aluminum Structures, (SAS) 30, by the American Aluminum Association. This submission will be reviewed by the Engineer but design responsibility remains with the Contractor and the Contractor's Engineer and under no circumstances, does the Engineer assume responsibility for the means, methods, sequences, procedures or techniques in connection with the performance of any of the work of the Contractor.
- 2. Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchorage, anchor, details and installation instructions for products to be used in the fabrication of aluminum stair work, include coating products. Transmit copy of instructions to the installer.

3. Shop drawings for the fabrication and erection of aluminum stair assemblies and ladders. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale. Show anchorage and accessory items.
4. Mill certificates and a signed statement from the fabricator that all aluminum work furnished is of the proper alloys as specified herein.

1.05 SEQUENCING

A. Inserts and Anchorages:

1. Furnish inserts and anchoring devices which must be set in concrete or built into masonry for the installation of the stairs, handrails, and railings work.
2. Provide setting drawings, templates, instructions and directions for installation of anchorage devices.
3. Coordinate delivery with other work to avoid delay.

PART 2 PRODUCTS

2.01 STAIR SYSTEMS

A. Aluminum stairs

1. Provide structural aluminum channel stringers and supports, aluminum tread plate treads and platforms, sheet aluminum risers, grating treads and platforms as indicated on the Drawings and in the details.

B. Plate treads

1. Formed from ¼ inch thick aluminum tread plate and the risers shall be formed from 0.080-inch thick sheet aluminum.
2. Treads shall be supported by and attached to 1-1/4 inch by 1-1/4 inch by 3/16 inch aluminum carrier angles bolted to the stringers.
3. Treads shall be the widths indicated.
4. Risers shall be bolted to the treads.

C. Plate platforms

1. Fabricated of ¼ inch thick aluminum tread plate and shall be supported on the edges by structural aluminum angles and at the mid spans by structural aluminum tees.

D. Aluminum tread plate for treads and platforms shall have an acceptable nonskid pattern surface.

E. Provide all structural aluminum angle hangers, struts, rod hangers, closure plates, and brackets indicated or necessary to complete the stairs as indicated.

F. Grating stair treads

1. In accordance with SECTION 05530 and the following:
2. Welded aluminum safety treads with 1-1/4 inch abrasive or extruded aluminum corrugated nosings.
3. Punched and slotted integral carrier plates for attaching to the channel stringers.

G. Grating platforms

1. In accordance with SECTION 05530 and the following:
2. Constructed of the specified aluminum grating and shall have the same nosings as the treads.

3. Supported at the ends on structural aluminum angles and at the mid spans by structural aluminum tees.

2.02 LADDERS

- A. Constructed of pipe uprights with solid round rod rungs mortised and welded to the uprights. Securely anchor to the wall with angles or bent plates, as indicated, welded to the uprights and expansion bolted to the wall. All welds shall be ground smooth.
- B. Interior ladders shall be secured to the floor slabs with floor flanges as indicated.
- C. The uprights of ladders to roofs or platforms shall widen at the top, extend above the roof or platform level, and shall be turned back to form guard rails.
- D. Construct from 1-1/2 inch IPS, Schedule 40 aluminum pipe uprights and 1 inch solid round aluminum rod rungs unless otherwise indicated on the drawings. After fabrication, the aluminum ladders shall be given an Aluminum Association Standard Finish, Designation M12C22A31 followed by a shop coat of methacrylate lacquer.

2.03 HANDRAILS

- A. In accordance with Specification SECTION 05520.

2.04 SHIP LADDER

- A. Constructed of aluminum channel stringers, aluminum pipe handrails and aluminum riveted grating treads. The treads to be Type K manufactured by Borden Metal products Co., Elizabeth, NJ; Reticuline Type M manufactured by IKG Industries, Long Island City, NY; Type KM manufactured by Kerrigan Iron Works, Inc., Nashville, TN; or acceptable equivalent product.
- B. Bearing bars of treads to be 3/16 inch thick by 1-1/4 inch deep and be fabricated of 6061-T6 aluminum alloy.
- C. Crimp bars to be fabricated of 6063-T5 aluminum alloy, riveted on 7 inch centers, and raised slightly above the bearing bars and serrated.
- D. Treads to be provided with integral slotted and punched end plates for attaching to stringers. Treads to be provided with 1-1/4 inch abrasive or extruded aluminum corrugated nosings.
- E. Provide structural aluminum clip angles, brackets and fasteners to complete the ship ladders as detailed on the Drawings.

2.05 FASTENERS

- A. Stainless steel in accordance with SECTION 05500.

2.06 FABRICATION

- A. Shop Assembly
 1. Use materials of the size and thickness shown, or if not show, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Work to conform to the dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use the type of materials shown or specified for the various components of work.
 2. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 of an inch unless otherwise shown. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

3. Weld corners and seams continuously in accordance with the recommendations of the American Welding Society. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces.
4. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type shown, or if not shown, use Phillips flathead (countersunk) screws or bolts.
5. Provide for anchorage of the type shown, coordinated with the supporting structure. Fabricate and space anchoring devices as shown and as required to provide adequate support for the intended use of the work.
6. Pre-assemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Anchorages

1. Furnish setting drawings, diagrams, templates instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors.
2. Install inserts and anchorage devices in accordance with Section 05500.
3. The use of impact imbedded fasteners will not be allowed.

3.02 FASTENING TO IN-PLACE CONSTRUCTION

- #### A. Provide anchorage devices and fasteners where necessary for securing stair items to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required.

3.03 CUTTING, FITTING AND PLACEMENT

- #### A. Perform all cutting, drilling and fitting required for the installation of the miscellaneous metal items. Set the work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in framework for items which are to be built into concrete, masonry or similar construction.
- #### B. Fit exposed connections accurately together for form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop-welded because of shipping size limitations.

3.04 FIELD WELDING

- #### A. Comply with AWS Code for the procedures of manual shielded metalarc welding, the appearance and quality of welds made, and the methods used in correcting welding work.

3.05 ALUMINUM WORK PROTECTION

- #### A. Aluminum surfaces be in contact with concrete or masonry to be protected by a coat of Coal Tar 46-465 H. B. Tnemecol manufactured by Tnemec Company, North Kansas City, MO; or an acceptable equivalent product.

- B. Areas where the paint has been damaged by abrasion or other cause shall be cleaned and repainted as directed so that the aluminum will have a complete protective paint film when brought into contact with the material against which it is being protected. Before application of coating, the surface shall be cleaned of all dirt, heavy deposits of grease or oil, and other foreign substances, and shall be immersed in or swabbed with an acceptable solvent. Next, the surfaces shall be rinsed with clear water and thoroughly dried.
- C. Protect against electrolysis where aluminum is to be used in conjunction with dissimilar metals.
- D. Where a shop coating of methacrylate lacquer has been specified on aluminum work to protect the surface from stain, the protective coating of lacquer worn off due to handling or erection shall be replaced in the field by a new coating of lacquer of the same type.
- E. During construction, care shall be taken to prevent damage to the aluminum work from splashing or by the accumulation of paint, concrete, mortar, or other similar materials.

3.06 CLEANING ALUMINUM WORK

- A. After aluminum has been erected, it shall be cleaned with mild soap and water, followed by a clear water rinse.

END OF SECTION

SECTION 05520

ALUMINUM HANDRAILS AND RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section Includes requirements for fabrication and installation of aluminum handrails and railing.

1.02 PERFORMANCE REQUIREMENTS

- A. Railing assembly including anchoring of posts and framing members shall be capable of withstanding a minimum load of at least 200 lb. applied in any direction at any point on the top rail.

1.03 SUBMITTALS

- A. In accordance with Section 01300 submit the following:
 1. Manufacturer's specifications, dimension diagrams, anchor details and installation instructions for products to be used in the fabrication of handrails and railings, include coating products. Transmit copy of instructions to the installer.
 2. Shop drawings for the fabrication and erection of handrail and railing assemblies. Include plans and elevations, and include details of sections and connections. Show anchorage and accessory items.
 3. **Certification that all iron or steel brackets, hardware, fittings or other components are produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014**

1.04 PROJECT CONDITIONS

- A. Field Measurements.
 1. Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting of the work to existing features and work completed under this Contract.
 2. Coordinate fabrication with Construction Schedule.

1.05 SEQUENCING

- A. Inserts and Anchorages:
 1. Furnish inserts and anchoring devices which must be set in concrete or built into masonry for the installation of the handrails and railings work.
 2. Provide setting drawings, templates, instructions and directions for installation of anchorage devices.
 3. Coordinate delivery with other work to avoid delay.

PART 2 PRODUCTS

2.01 HANDRAILS AND RAILINGS

A. Handrail systems shall be:

1. Series 500 by R&B Wagner, Inc., Milwaukee, WI
2. Aluminum Smooth Lite by Modular Railing Systems, Houston, TX
3. Approved equal.

B. General

1. Non-welded modular construction.
2. Fabricated as indicated on the Drawings.
3. Stanchions to be 1-1/2 inch IPS, Schedule 80 aluminum pipe, alloy 6063-T6
4. Top and intermediate rails and returns to be 1-1/2 inch Schedule 40 aluminum pipe.
5. Provide stainless steel anchor bolts and fasteners in accordance with SECTION 05500.

Certification that all iron or steel brackets, hardware, fittings or other components are produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014

C. Removable pipe railings

1. Fabricated in the same manner as fixed railings.
2. Installed as indicated.

D. Brackets for wall-mounted handrails

1. Cast aluminum pipe rail brackets with curved tops.
2. 3 inch projection from wall to the center of the handrail.

E. Brackets for floor mounted stanchions

1. Cast aluminum of the round, flat base flange configuration.
2. Designed to withstand the required loading and to support and reinforce the post.

F. Brackets for side-mounted stanchions

1. Aluminum brackets as detailed on the Drawings.
2. Provide a 1-3/8 inch projection from wall to the center of the stanchion.

2.02 HANDICAPPED PROVISIONS

- #### A. Provide knurled, abrasive or other textured finish on portions of handrails, a distance of 4 feet from stairs and other openings, to indicate a danger signal in accordance with applicable ADA requirements.

2.03 FABRICATION

A. Shop Assembly:

1. Form exposed work true to line and elevation with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 of an inch, unless otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.
2. Provide for anchorage of the type shown, coordinated with the supporting structure. Fabricate and space anchoring devices as shown and as required to provide adequate support.

3. After fabrication, all aluminum pipe railings shall receive an Aluminum Association Standard Anodic Finish, Designation M12C22A31.

PART 3 EXECUTION

3.01 INSTALLATION

A. Anchorages

1. Furnish setting drawings, diagrams, templates instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors.
2. Install inserts and anchorage devices in accordance with Section 05500.
3. The use of impact imbedded fasteners will not be allowed.

3.02 FASTENING TO IN-PLACE CONSTRUCTION

A. Provide anchorage devices and fasteners where necessary to secure handrails and railings to in place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wedge anchors and other connectors as required.

3.03 CUTTING, FITTING AND PLACEMENT

- A. Perform all cutting, drilling and fitting required for the installation. Set the work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in framework for items which are to be built into concrete, masonry or similar construction.
- B. Fit exposed connections accurately together to form tight hairline joints.
- C. Adjust railings prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 8 feet on centers, unless otherwise shown. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
1. Handrail stanchions shall be mounted on the top of stair stringers as indicated on the drawings.
 2. The stanchions set into concrete curbs shall be set into preformed holes and secured in place with non-shrinking grout. The holes shall be at least $\frac{3}{4}$ inches greater in diameter than the outside diameter of the stanchions and shall be a minimum of 5 inches deep.
 3. Products offered by manufacturers to comply with the requirements for hydraulic cement include the following:
 - a. Embeco; Master Builder's
 - b. Ferrolith G; Sonneborn Bldg. Products, Inc.
 - c. Por-Rok; Halemite Mfg. Co.
 4. The stanchions to be side-mounted to structure walls shall be attached to brackets anchored to the structure wall with wedge anchors or suitable fasteners providing a system capable of withstanding the minimum load as specified.
- D. Secure handrails to walls as shown, or by means of wall brackets, and wall return fitting at handrail ends.
- E. Provide brackets with not less than 3 inch projection from the finish wall surface to the center of the pipe handrail, and with the wall plate portion of the bracket drilled to receive on $\frac{3}{8}$ inch bolt. Locate brackets not more than 60 inches on center. Provide flush-type wall return fittings with the same projection as that specified for wall brackets. Secure wall brackets and wall return fittings to building construction as follows:

1. For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.
2. For hollow masonry anchorage use toggle bolts having square heads.

3.04 ALUMINUM WORK PROTECTION

- A. Aluminum surfaces be in contact with concrete or masonry to be protected by a coat of Coal Tar 46-465 H.B. Tnemecol manufactured by Tnemec Company, North Kansas City, MO; or an acceptable equivalent product.
- B. Areas where the paint has been damaged by abrasion or other cause shall be cleaned and repainted as directed so that the aluminum will have a complete protective paint film when brought into contact with the material against which it is being protected. Before application of coating, the surface shall be cleaned of all dirt, heavy deposits of grease or oil, and other foreign substances, and shall be immersed in or swabbed with an acceptable solvent. Next, the surfaces shall be rinsed with clear water and thoroughly dried.
- C. Protect against electrolysis where aluminum is to be used in conjunction with dissimilar metals.
- D. During construction, care shall be taken to prevent damage to the aluminum work from splashing or by the accumulation of paint, concrete, mortar, or other similar materials.

3.05 CLEANING ALUMINUM WORK

- A. After aluminum has been erected it shall be cleaned with mild soap and water followed by a clear water rinse.

END OF SECTION

DIVISION 06

SECTION 06600

FIBERGLASS REINFORCED PLASTIC PRODUCTS AND FABRICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements to furnish all labor, materials, equipment and incidentals necessary to install the fiberglass reinforced plastic (FRP) pultruded gratings and frames as specified herein.

1.04 QUALITY ASSURANCE

- A. The material covered by these specifications shall be furnished by a reputable and qualified manufacturer of proven ability who has regularly engaged in the manufacture and installation of FRP systems.
- B. Substitution of any component or modification of system shall be made only when approved by the Engineer.
- C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.
- D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.05 DESIGN CRITERIA

- A. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.
- B. Design live loads of FRP molded grating shall be in accordance with the following design loads based on the latest adopted International Building Code:
 - 60 psf live load (non-emergency exit walkways)
 - 300 lb concentrated load
- C. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than $L/180$ of span for structural members. Connections shall be designed to transfer the loads.

1.06 SUBMITTALS

- A. Shop drawings of all FRP fabrications shall be submitted to the Engineer for approval in accordance with the requirements of Section 01300.
- B. Manufacturer's catalog data showing:
 - 1. Dimensions, spacings, and construction of grating
 - 2. Design tables showing limits for span length and deflection under various uniform and concentrated loads
 - 3. Materials of construction
- C. Detail shop drawings showing:
 - 1. Dimensions
 - 2. Sectional assembly
 - 3. Location and identification mark
 - 4. Size and type of supporting frames required
- D. Samples of each type of product proposed shall be submitted for approval prior to placement of purchase orders.

1.07 SHIPPING AND STORAGE INSTRUCTIONS

- A. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- B. All materials and equipment necessary for the fabrication and installation of the grating shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Engineer, has become damaged so as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.
- C. Identify and match-mark all materials, items, and fabrications for installation and field assembly.

PART 2 PRODUCTS

2.01 GENERAL

- A. Materials used in the manufacture of the FRP products shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.
- B. All materials shall be of the kind and quality specified, and where the quality is not specified, it shall be the best of the respective kinds and suitable for the purpose intended.

- C. All FRP products noted in Part 1.02 shall be manufactured using a pultruded process utilizing either an isophthalic polyester or a vinyl ester resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic surface veil shall be the outermost layer covering the exterior surface. The FRP shapes shall achieve a flame spread of 25 or less in accordance with ASTM test method E-84. (Isophthalic polyester resin is available without flame retardant and UV inhibitor additives.)
- D. After fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating to prevent intrusion of moisture.
- E. FRP products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a one mil minimum U.V. coating can be applied.
- F. All exposed surfaces shall be smooth and true to form.
- G. Acceptable Manufacturers
 - 1. Strongwell
 - 2. Approved alternative

2.02 GRATINGS AND TREADS

- A. General
 - 1. Grating shall be shipped from the manufacturer, palletized and banded with exposed edges protected by cardboard to prevent damage in shipment.
 - 2. Each piece shall be clearly marked showing manufacturer's applicable drawing number.
 - 3. Grating shall be DURADEK® or DURAGRID® as manufactured by Strongwell- Chatfield Division, Chatfield, MN, or approved equal.
- B. Design
 - 1. The panels shall be 1-1/2 inches deep and sustain a deflection of no more than 0.25 inches under a uniform distributed load of 100 psf for the span lengths shown on the plans.
 - 2. The bearing bars shall be joined into panels by passing continuous length fiberglass pultruded cross rods through the web of each bearing bar. The pultruded cross rod assembly shall consist of two cross rod spacers that have notches cut into them at 6 inches on center to fit the distance between the web of each bearing bar. A continuous fiberglass pultruded bar shaped section shall be wedged between the two cross rod spacers mechanically locking the notches in the cross rod spacers to the web of the bearing bars. Continuous chemical bonding shall be achieved between the cross rod spacers and the bearing web and between the bar shaped wedge and the

two cross rod spacers locking the entire panel together to give a panel that resists twist and prevents internal movement of the bearing bars.

4. The top surface of all panels shall have a non-skid grit affixed to the surface by an epoxy resin followed by a top coat of epoxy resin.
5. Panels shall be fabricated to the sizes shown on the drawings.
6. Hold down clamps shall be type 316L stainless steel saddle clips. A minimum of 4 each per panel.
7. Color shall be high visibility yellow.
8. All bearing bars that are to be exposed to UV shall be coated with polyurethane coating of a minimum thickness of 1 mil.

C. Products

1. The FRP grating shall be fabricated from bearing bars and cross rod manufactured by the pultrusion process. The bearing bars shall be 1.5 inches deep with a 0.6 inch wide top flange, a 0.6 inch wide bottom flange and a web thickness of 0.16 inch. The glass fiber reinforcement for the bearing bars shall be a core of continuous glass strand rovings wrapped with continuous strand glass mat. A synthetic surface veil shall be the outermost layer covering the exterior surfaces.
2. FRP Grating shall be made from a premium grade chemical resistant, fire retardant vinyl ester resin system with antimony trioxide added to meet the flame rating of 25 or less in accordance with ASTM E-84 testing and meet the self-extinguishing requirements of ASTM D-635. U. V. inhibitors are added to the resin.
4. All cut and machined edges, holes and abrasions shall be sealed with a resin compatible with the resin matrix used in the bearing bars and cross rods.
5. All panels shall be fabricated to the sizes shown on the approved shop drawing.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.02 INSPECTION AND TESTING

- A. The Engineer shall have the right to inspect and test all materials to be furnished under these specifications prior to their shipment from the point of manufacture.
- B. All labor, power, materials, equipment and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

3.03 INSTALLATION, GENERAL

- A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required.
- B. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

3.04 ALL FRP INSTALLATION

- A. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.
- B. Install items specified as indicated and in accordance with manufacturer's instructions.

END OF SECTION

DIVISION 08

SECTION 08331

OVERHEAD COILING DOORS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Aluminum overhead coiling doors with electrically operated operating hardware.
- B. Wiring from electric circuit disconnect to door operator to control station for electrical operation.

1.02. RELATED SECTIONS

- A. SECTION 03300 - CAST-IN-PLACE CONCRETE
- B. SECTION 04810 - UNIT MASONRY ASSEMBLIES
- C. SECTION 05500 - MISCELLANEOUS FABRICATIONS
- D. SECTION 07900 - JOINT SEALANTS
- E. SECTION 09900 - PAINTING

1.03. REFERENCES

AAMA 2605	Specification for High Performance Organic Coatings on Architectural Extrusions and Panels
AAMA A611	Voluntary Standards for Anodized Architectural Aluminum
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
NEMA ICS	National Electrical Manufacturer's Association Industrial Control and Systems
UL	Underwriters Laboratories, Inc.

1.04. SYSTEM DESCRIPTION

- A. Electric motor-operated unit with manual override in case of power failure.
 - 1. Provide explosionproof motor and controls where area is described as "hazardous."
- B. Drive assembly shall be surface mounted and covered with factory hood or housing of aluminum.

1.05. DESIGN REQUIREMENTS

- A. Design door assembly to withstand loads as shown on the Structural Design Criteria Table on Drawings without damage to door and assembly components.
- B. Insulation Value - Minimum R of 6.25.

1.06. SUBMITTALS

A. Shop Drawings - Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

1. Provide electrical wiring diagram, showing wiring from unit components to junction box.

B. Product Data - Provide general construction, component connections and details, and color of panels.

1.07. MAINTENANCE DATA

A. Maintenance Data - Indicate lubrication requirements and frequency, periodic adjustments required, and general care information.

1.08. REGULATORY REQUIREMENTS

A. Provide certificate of compliance from authority having jurisdiction indicating approval of door and operating hardware assembly.

B. Electrical Components - UL listed.

1.09. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated and instructed by the manufacturer.

1.10. COORDINATION

A. Coordinate the work with installation of electric power, locations and size of conduit, and alarms.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Overhead Door Corporation - Model 625.

B. The Cookson Company - Model: FMWI Insulated with No. 44 slat.

C. Cornell Iron Works, Inc., Mountaintop, PA - Model ESD-20 Thermiser insulated rolling service door.

D. Or equal.

2.02. MATERIALS

A. Curtain - Interlocking slats. End locks shall be attached to each end of alternating slats. Conform to the following:

1. Slats - Interlocking, minimum 0.032-inch exterior and 0.24-inch interior panel thickness of ASTM B221 aluminum alloy Type 6063; sandwich slat construction with insulated core of polyurethane insulation.

2. Curtain Bottom

- a. Two aluminum angles.
 - b. Thickness per manufacturer's standard and as required by curtain width.
 - c. Mill finish.
3. Provide wind locks as required by manufacturer.
- B. Guides – Stainless Steel, continuous. Manufacturer's standard thickness and guide configuration
- C. Mounting Brackets – Manufacturer's standard thickness and configuration; galvanized steel, hot dip galvanized ASTM A123, grade 85, after fabrication. Color coated to match curtain finish
- D. Roller Shaft Counterbalance - Oil tempered (steel) torsion spring system, capable of producing torque sufficient to assure smooth operation of curtain from any position; with adjustable spring tension.
- E. Hood - Minimum 0.032-thick aluminum with intermediate support brackets as required. High-performance organic coating with color coat matching curtain finish.
- F. Weather Seals - Neoprene bottom seal (reference paragraph 2.03.F), vinyl exterior and interior guide seals at each jamb and internal hood baffle seal.
- G. Manual (Emergency) Operations - Chain hoist.
- 1. Locking - Chain keeper locks for chain hoist operation.

2.03. ELECTRIC OPERATOR

- A. Standard Electric Operator (non-explosion proof)
- 1. Motor Rating - 1-1/2 HP; continuous duty.
 - 2. Motor Voltage - 460-volt, three-phase, 60 Hertz.
 - 3. Motor Controller - Full voltage, reversing magnetic motor starter.
 - 4. Door Speed – 8 inches per second minimum, 12 inches per second maximum.
 - 5. Brake - Adjustable friction clutch type, activated by motor controller.
 - 6. Gearing to be self-locking.
- B. Explosionproof Electric Operator
- 1. Explosionproof Motor – NEMA MG1 Type 1; open drip proof or NEMA TENV type.
 - 2. Motor Rating - Heavy duty, minimum 1 HP, maximum 3 HP sized for door to be operated.
 - 3. Motor Voltage - 460-volt, 3 phase, 60 Hertz.
 - 4. Motor Controller - NEMA ICS 12, full voltage, reversing magnetic motor starter; explosionproof.
 - 5. Door Speed - 12 inches per second maximum.

6. Brake - Adjustable friction clutch type, activated by motor controller; explosionproof.
7. Gearing to be self-locking.
8. Electrical Enclosures
 - a. At Interior Class I, Division 1, Group D Areas - Door operator and remote, reverse starter shall be a NEMA 7 explosion-proof enclosure. All electrical work shall be suitable for use in an interior Class I, Division 1, Group D area. All external control components shall be UL listed as “intrinsically safe control circuit,” suitable for use in a Class I, Division 1, Group D area.
 - b. In Wet Areas - All controls shall be suitable for use in a “wet area” and be housed in NEMA 4X stainless steel enclosures up to 8 feet above floor. Above 8 feet AFF, NEMA 12 is acceptable.
- C. Interior Control Station - Standard three button (open-close-stop) control for each operator; 120 volts or less circuit; surface mounted. Provide explosionproof enclosure where electrical circuitry is not intrinsically safe.
- D. Exterior Control Station - Three-position key control to accept interchangeable key core.
- E. Mount centerline of control box 4 feet 4 inches above slab, unless noted otherwise on drawings.
- F. Safety Edge (Non-Pneumatic) - Located at door bottom, full width, wired to reverse door upon striking object.
 1. Wireless sensing edge shall not require a travelling electric cord connection between bottom bar sensing edge device and motor operator.
 2. Hazardous areas that demand explosion-proof design require non-explosion-proof electrical components be mounted 18 inches or more above floor.
- G. Motor Enclosure - Minimum 0.032-thick aluminum to completely house drive assembly.

2.04. FINISHES

- A. High Performance Organic Coating
 1. Meets or exceeds requirements of AAMA 2605.
 2. Color - As required by exterior color and finish schedule on the Drawings. A custom color may be required.
- B. Concealed Steel Items - Stainless steel.
- C. Apply protective coating or tape to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that opening sizes, tolerances, and conditions are acceptable.

3.02. INSTALLATION

- A. Install door unit assembly in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Electrical Sections. Complete wiring from disconnect to unit components and from fire alarm system to door operator.
- F. Install slat enclosure and drive assembly enclosure.
- G. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07900, Joint Sealers.
- H. Install perimeter trim, closures, and weatherstripping.

3.03. ERECTION TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb - 1/16-inch.
- C. Maximum Variation From Level - 1/16-inch.
- D. Longitudinal or Diagonal Warp - +1/8-inch per 10-foot straight edge.

3.04. ADJUSTING

- A. Following completion of installation, including related work by others, lubricate, test, and adjust door, hardware, and operating assemblies. Operation of installation shall be free from warp, twist, or distortion of door, frame, or structure.

3.05. CLEANING

- A. Clean door and components.
- B. Remove labels and visible markings.

3.06. DEMONSTRATION

- A. Demonstrate proper operation to Owner's representative.
- B. Instruct Owner's representative in maintenance procedure.

END OF SECTION

DIVISION 09

SECTION 09880

CONCRETE PROTECTIVE COATING

PART 1 GENERAL

1.01 SUMMARY

- A. This specification describes the coating of substrates with a non-vapor barrier, protective waterproofing, polymer-modified, portland cement slurry.
- B. Work under this item shall apply to all existing interior concrete walls to the following tanks during the following Phases:
 - a. Solids Handling Improvements: Sludge Thickeners #1 and #2
 - b. Phase 1 Improvements: Primary Clarifiers #1, #2, and #3, and Chlorine Contact Chamber
 - c. Phase 2 Improvements: Aeration Tank 1, 2, and 3, Final Clarifiers #1, 2, 3, & 4
- C. Work paid under this item shall include all tools, labor, equipment, and incidental items associated with application of the concrete protective coating.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03930 - Concrete Rehabilitation
- B. Section 03940 - Crack Repairs by Epoxy Injection.

1.03 QUALITY ASSURANCE

- A. Manufacturing qualifications: The manufacturer of the specified product shall be ISO 9001 certified and have in existence a recognized ongoing quality assurance program independently audited on a regular basis.
- B. Contractor qualifications: Contractor shall be qualified in the field of concrete repair and protection with a successful track record of 5 years or more. Contractor shall maintain qualified personnel who have received product training by manufacturer's representative.
- C. Install materials in accordance with all safety and weather conditions required by manufacturer or as modified by applicable rules and regulations of local, state and federal authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All materials must be delivered in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers. Damaged material must be removed from the site immediately.
- B. Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.
- C. Condition the specified product as recommended by the manufacturer.

1.06 PROJECT CONDITIONS

- A. Environmental Conditions: Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature 40°F (5°C) and rising.
- B. Protection: Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified material.

1.07 SUBMITTALS

- A. Submit two copies of manufacturer's literature, to include: Product Data Sheets, and appropriate Material Safety Data Sheets (MSDS).
- B. Submit copy of Certificate of Approved Contractor status by manufacturer.

1.08 WARRANTY

- A. Provide a written warranty from the manufacturer against defects of materials for a period of one (1) year, beginning with date of substantial completion of the project.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Sika Corporation; SikaTop Seal 107 is considered to conform to the requirements of this specification.
- B. Approved equal

2.02 MATERIALS

- A. Polymer-modified portland cement coating:
 - 1. Component "A" shall be a liquid polymer emulsion of an acrylic co-polymer base and additives.
 - 2. Component "B" shall be a blend of selected portland cements, specially graded aggregates, and admixtures to control setting time and workability.
 - 3. The ratio of Component A: Component B shall be:

- a. Slurry 1:4 by weight
- b. Mortar 1:4.5 by weight

The material shall be non-combustible, either before or after cure.

2.03 PERFORMANCE CRITERIA

A. Properties of the mixed polymer-modified portland cement coating:

- 1. Pot Life: Approx. 60 minutes at 68F
Approx. 30 minutes at 86F
- 2. Color: gray or white

B. Properties of the cured polymer-modified portland cement coating:

- 1. Tensile Strength (ASTM C-307) 28 days
 - a. Type White: 870 psi (Min.)
 - b. Type Gray: 990 psi (Min.)
- 2. Bond Strength (ACI 503R-30 Modified): Pull-off test
28 days: 180 psi (Min.)
- 3. Moisture Vapor permeability (ASTM E96)
28 days: 18 perms
- 4. Compressive Strength (ASTM D-695) at 28 days
 - a. Type White: 3000 psi (Min.)
 - b. Type Gray 3400 psi (Min.)
- 5. Flexibility (ASTM D522 Modified)
Approximately 25%
- 6. Carbon Dioxide Diffusion
Coefficient (uCO2) Approx. 35,000 equivalents to 6inches of concrete
- 7. Watertightness under Hydrostatic Pressure (DIN 1048 Mod.)

Water Pressure		Penetrated Water		Water Absorption	
Feet	(bar)	grains	(grams)	grains	(grams)
				Ft.2 * hours	m2 * hours
16	(0.5)	0	(0)	0	(0)
33	(1)	15	(1)	3	(2)
99	(3)	31	(3)	10	(7)

Rendering mortars absorbing less than 91 grains/ft.² * h (64 grams/m² *h) are considered watertight.

8. The material shall not produce a vapor barrier.
9. The material meets the chemical requirements in accordance with ANSI/NSF Standard 61- potable water approval.
10. The material shall be thermally compatible with portland cement mortar and concrete.

Note: Tests above were performed with the material and curing conditions @ 71oF – 75oF and 45-55%relative humidity.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

- A. If substrate contains spalls, cracks, or other forms of concrete deterioration, such areas shall be repaired prior to commencing work under this item. Shallow and deep repairs shall be performed and paid in accordance with Item 03930. Crack repairs shall be performed and paid under Item 03940.
- B. Substrate must be clean, sound, and free of surface contaminants. Remove dust, laitance, grease, oils, curing compounds, form release agents and all foreign particles by mechanical means. An open-textured, sandpaper-like substrate is ideal. Substrate shall be in accordance with ICRI Guideline No. 03732 for coatings and fall within CSP4. All surfaces must be saturated surface dry (SSD), with no standing water at time of application.

3.02 MIXING AND APPLICATION

- A. **Mixing:** Under normal circumstances, full quantities of both components are mixed together, a slurry consistency will result. For a trowelable consistency use only 90% of component A. Mix in a clean container by slowly adding the powder component to the liquid component and mixing with a slow speed (400-600rpm) drill and mixing paddle.
- B. **Coating Application:** Apply trowel, notched trowel, stiff bristle brush, or spray equipment. Work material into the prepared substrates, filling all pores and voids.

For brush grade: Apply first coat, with horizontal brush strokes and leave to harden (4 to 8 hours). Apply second coat with vertical brush strokes.

For trowel consistency: Apply the first coat with a notched trowel and leave to harden (4 to 8 hours). Apply the second coat with a flat trowel.

For spray application: Use a hopper gun spray equipment, textured sprayer (e.g. Texspray E110c by Graco), or a rotor/stator pump equipment. Allow the first coat to

harden (4 to 8 hours) prior to the application of the second coat. As soon as the mortar layer starts to set, a uniform surface with a fine sponge or a plastic trowel.

- C. When applying the coating, never stop the application until the entire surface has been coated. Always stop application at an edge, corner, or joint. Never let a previously coated film dry; always coat into a wet film. Always apply the coating at a 45o angle to an edge, corner, or joint.
- D. Adhere to all limitations and cautions for the polymer-modified cement coating in the manufacturer's printed literature.

3.04 CLEANING

- A. The uncured polymer-modified portland cement coating can be cleaned from tools with water. The cured polymer-modified portland cement coating can only be removed mechanically.
- B. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for preparation and finishing of surfaces to be painted.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM).
 - 1. D16, Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products
- B. Steel Structures Painting Council (SSPC).
 - 1. SP-1, Solvent Cleaning.
 - 2. SP-2, Hand Tool Cleaning.
 - 3. SP-3, Power Tool Cleaning.
 - 4. SP-5, White Metal Blast Cleaning.
 - 5. SP-6, Commercial Blast Cleaning.
 - 6. SP-7, Brush-Off Blast Cleaning.
 - 7. SP-10, Near-White Blast Cleaning.

1.03 DEFINITIONS

- A. In accordance with ASTM-D16.
- B. Wherever the words “solvent cleaning”, “hand tool cleaning”, “wire brushing”, or “blast cleaning”, or words of similar intent are used in these specifications, it shall be understood to refer to the applicable SSPC Specification.
- C. The term “paint” or “coating” as used in this specification includes emulsions, enamels, paints, stains, varnishes, sealers, and other coatings, organic or inorganic, used as prime, intermediate or finish coats.

1.04 SUBMITTALS

- A. Shop Drawings
 - 1. Submit product data and manufacturers application instructions in accordance with SECTION 01300.
- B. Samples
 - 1. Colors as required.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer specializing in the production of paint and coatings for 10 years, minimum.
2. Applicator specializing in commercial, industrial and municipal painting for 5 years, minimum.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading

1. In accordance with manufacturers recommendations.

B. Acceptance at Site

1. Products to be delivered to site in sealed, labeled and unopened containers.
2. Labels to include Name, type, code, coverage, surface preparation, drying time, color, clean up procedure, and mixing and reducing instructions.
3. Remove unacceptable products immediately.

C. Storage and Protection

1. Store materials between minimum ambient temperature of 45 degrees F. and a maximum of 90 degrees F.
2. Storage area to be well ventilated, or as required by manufacturer.

1.07 PROJECT/SITE CONDITIONS

A. Environmental Requirements

1. Provide continuous ventilation and maintain ambient temperature above 45 degrees F., for 24 hours before, during, and 48 hours after application of finishes, unless otherwise required by coating manufacturer.
2. Do not apply coatings when exposed to rain or snow, or when relative humidity is above 50 percent.
3. Minimum application temperature for Latex paints:
 - a. 45 degrees F. for interiors.
 - b. 50 degrees F., for exteriors
4. Minimum application temperatures for other coatings:
 - a. 65 degrees for interior and exterior.
5. Lighting levels to be 80 ft. candles, measured mid height at substrate surface.

1.08 MAINTENANCE

A. Extra Materials

1. Provide 1 gallon each color to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Paints by the Thnec Company, Kansas City, Missouri have been used as the basis for the paint schedule, other manufactures considered equal:
 - 1. Valspar Coatings,
 - 2. Carboline.
 - 3. or product deemed equivalent by the Engineer.

2.02 MATERIALS

- A. Coatings
 - 1. Ready Mixed, except field catalyzed coatings.
 - 2. Process pigments to a soft paste like consistency, capable of being dispersed to a uniform coating.
 - 3. Readily applied by spray or brush.
 - 4. Dry free of streaks or sags.
- B. Accessories
 - 1. Linseed Oil, Shellac, Turpentine, Thinners to be of commercial quality, compatible to coatings used.

2.03 COLORS AND FINISHES

- A. Colors selected by the Owner from color chips submitted by the Contractor for review. The selection shall be in the form of a color schedule indicating the colors to be used on the various surfaces. The colors used in the final Work shall match the selected color chips.
- B. In general the finish coat shall be gloss or semi-gloss on metal work and flat finish on masonry, wood and drywall surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions
 - 1. Verify surfaces are ready to receive work in accordance with manufacturers recommendations.
 - 2. Report conditions which may affect proper application to Engineer.
 - 3. Measure moisture content of substrates.
 - 4. Do not apply coatings when moisture exceeds levels below:
 - a. Plaster and Gypsum wallboards 12 percent.
 - b. Masonry and Concrete 12 percent
 - c. Wood 14 percent

3.02 PREPARATION

A. Protection

1. Protect elements surrounding the Work required by this section from damage or marking.
2. Repair damage to other surfaces caused by Work of this section.
3. Furnish drop cloths, shields, and protective methods to prevent spray or paint spatter from disfiguring other surfaces.

B. Preparation of surfaces to be coated

1. General
 - a. Remove electrical plates, light fixtures, hardware, and fittings.
 - b. Correct minor defects and clean surfaces.
 - c. Seal marks which may bleed through surface finish.
2. Impervious Surfaces
 - a. Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach.
 - b. Rinse with clean water.
 - c. Allow to dry.
3. Aluminum
 - a. Remove surface contamination by steam or high pressure water.
 - b. Remove oxidation by sanding and solvent washing.
4. Insulated coverings
 - a. Remove dirt, grease, and oil from canvas and cotton.
5. Concrete
 - a. Blast-trak or brush blast.
6. Wood
 - a. Remove dirt, oil, and other soil with scrapers, mineral spirits, and sand paper.
 - b. Sand surfaces exposed to view, and remove all sanding dust.
7. Gypsum board
 - a. Fill minor defects with latex fill.
 - b. Prime repaired areas.
8. Galvanized surfaces
 - a. Remove contamination and oils with solvent wash.
 - b. Sand and remove sanding dust.
9. Masonry and Concrete
 - a. Allow 28 days curing prior to coating application.
 - b. Remove dirt, loose mortar, scale, salt, alkali powder or other foreign matter.
 - c. Remove oil and grease with solution of tri-sodium phosphate.
 - d. Rinse with water.
 - e. Allow to dry.
 - f. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water.
 - g. Allow to dry.
10. Uncoated steel and iron
 - a. Remove grease, scale, dirt and rust.
 - b. Remove heavy scale and rust with wire brushing or sandblasting.
 - c. Clean by washing with solvent.
 - d. Apply treatment of phosphoric acid solution.
 - e. Clean welds, bolts and nuts in a similar fashion.
 - f. Spot prime repaired areas.
11. Shop primed steel

- a. Remove loose primer and rust by sanding or scraping.
 - b. Feather edges to make touch-up patches inconspicuous.
 - c. Clean surfaces with solvent.
 - d. Prime bare steel.
12. Stainless steel surfaces shall not be painted.

3.03 COATING APPLICATION

A. General

- 1. Apply in accordance with manufacturers recommendations.
- 2. Apply each coat to uniform finish.
- 3. Apply each coat slightly darker than preceding coat, unless instructed otherwise by the Engineer.
- 4. Sand lightly between coats.
- 5. Allow preceding coat to dry prior to application of next coat.
- 6. Prime back surfaces of all woodwork.

3.04 MECHANICAL AND ELECTRICAL EQUIPMENT

A. General

- 1. Paint shop primed equipment with compatible finish coat.
- 2. Remove or mask items not to be painted.
- 3. Prime and finish all associated pipes, and ducts, both insulated and exposed, all hangers, brackets, collars and supports, unless items are pre finished.
- 4. Do not paint identification markings or tags on equipment.
- 5. Paint exposed conduit and piping in finished areas.
- 6. Paint both sides and edges of plywood mounting boards.
- 7. Reinstall all trim, fittings, plates ect. After painting is complete.

B. Color Code

- 1. Piping and equipment in accordance with Article 3.06 of this specification.

C. Identification

- 1. Label piping by contents and arrows indicating direction of flow.
- 2. Labels to be twenty feet (20) apart maximum, and within each space through which pipe line passes.
- 3. Adjacent to each side of walls which pipeline penetrate.
- 4. Adjacent to valves, equipment, and pumps.
- 5. Locate labels where they are unobstructed from view and visible from valves.
- 6. Colors to be white or black as appropriate for the substrate.
- 7. Letters, numbers and flow arrows to be stenciled to pipeline and equipment or die cut from vinyl film as approved by the Engineer.

8. Lettering size as follows:	Pipe Diameter in Inches	Size of Letters in Inches
	3/4 to 1-1/4	1/2
	1-1/2 to 2	3/4
	2-1/2 to 6	1-1/2
	8 to 10	2-1/2
	Over 10	3

D. Metal tags

1. Pipelines smaller than 3/4 inches in diameter and for valves, securely fasten brass tags, 2-1/2 inches x 1/2 inches, with etched lettering filled with enamel paint.

3.05 CLEANING

- A. Promptly remove spilled, splashed and/or spattered paint.
- B. Maintain premises free of clutter, tools, equipment and material.
- C. Collect waste cloths and material which may constitute a fire hazard and remove daily from site.

3.06 COLOR SCHEDULES

A. Architectural

1. Chosen by Owner.

B. Piping

- | | |
|-------------------|-------------------------------------|
| 1. Water lines | Raw.....Olive Green |
| | Settled or Clarified.....Aqua |
| | Finished or Potable.....Dark Blue |
| 2. Chemical Lines | Chlorine..... Yellow |
| | Polymers.....Orange with Green Band |
| | Sodium Bisulfite.....Grey |
| | Lime Slurry.....Violet |
| 3. Waste Lines | Raw.....Gray |
| | Sludge.....Brown |
| 4. Miscellaneous | Compressed Air.....Dark Green |
| | Fuel Oil.....Red |

3.07 EXTERIOR COATING SYSTEM SCHEDULE

A. Miscellaneous Ferrous Metal Items

1. Shop surface preparation: SSPC-SP-10, Blast profile 1.5 - 2.5 mils.
2. 1st coat; (Shop applied)-Tnemec Hydro-Zinc 2000, DFT 2.5-3.0 mils.
3. 2nd coat (Field applied)-Tnemec Series 66 Epoxoline, DFT 4.0-6.0 mils.
4. 3rd coat (Field applied)-Tnemec Series 66 Epoxoline 66, DFT 4.0 to 6.0 mils.

B. Ferrous Metals Scheduled for Immersion Service

1. Shop surface preparation: SSPC-SP-10, Blast profile 1.5 - 2.0 mils.
2. 1st coat; (Shop applied)-Tnemec 66-1211 Red Primer, DFT 3.0 mils.
3. 2nd coat (Field applied)-Tnemec 104 H.S. Epoxy, DFT 6.0 to 10.0 mils.
Scarify 1st coat prior to 2nd coat application.
4. 3rd coat (Field applied)- Tnemec 104 H.S. Epoxy, DFT 6.0 to 10.0 mils.

C. Ferrous Metals Scheduled for Immersion Service in Potable Water, NSF approved

1. Surface preparation: SSPC-SP-10, Blast profile 1.5 - 2.0 mils.
2. 1st coat; (Shop applied)-Tnemec Hydro-Zinc 2000, DFT 2.5 to 3.5 mils.
3. 2nd coat (Field applied)-Tnemec Series 20-1255 Beige, DFT 3.0 to 5.0 mils.
4. 3rd coat (Field applied)- Tnemec Series 20-AA90 White, DFT 3.0 to 5.0 mils.

D. Galvanized Metal

1. Surface preparation: lightly scarify surface, solvent clean using Tnemec 41-4 solvent.
2. 1st coat: 66 Hi-Build Epoxyline, DFT 2.0 to 4.0 mils.
3. 2nd coat: 73 Endurashield, DFT 1.5 to 3.0 mils.

E. Concrete, and Concrete Block Masonry (New)

1. 1st coat: Tnemec Series 52 Tnemecrete, DFT 8.0 mils.
2. 2nd coat: Tnemec Series 52 Tnemecrete, DFT 8.0 mils.

F. Concrete, and Concrete Block Masonry (New), (Clear finish)

1. 1st coat: Tnemec Acrylic Sealer.
2. 2nd coat: Tnemec Acrylic Sealer.

G. Asphalt

1. 1 coat Traffic Marking Paint.

3.08 INTERIOR COATING SYSTEM SCHEDULE

A. Concrete Block

1. 1st coat: Tnemec 130-6602 Spray then back roll.
2. 2nd coat: Tnemec 83 Ceramlon II Epoxy, DFT 6.0 mils.
3. 3rd coat: Tnemec 83 Ceramlon II Epoxy, DFT 6.0 mils.

B. Concrete Walls and Ceilings

1. 1st coat: Tnemec 83 Ceramlon II Epoxy, DFT 6.0 mils.
2. 2nd coat: Tnemec 83 Ceramlon II Epoxy, DFT 6.0 mils.

C. Drywall

1. 1st coat: Tnemec 51-792 Sealer
2. 2nd coat: Tnemec Series 23 Enduratone.
3. 3rd coat: Tnemec Series 23 Enduratone.

D. Wood (to be painted)

1. 1st coat: Tnemec 36-603 Undercoat.
2. 2nd coat: Tnemec Series 23 Enduratone.
3. 3rd coat: Tnemec Series 23 Enduratone.

E. Metals, Structural Steel, Piping, Railways, Equipment, ect.

1. Shop surface preparation: SSPC-SP-6, Blast profile 1.5 - 2.0 mils.
2. 1st coat; (Shop applied)-Tnemec 66-1211 Red Primer, DFT 3.0 mils.
3. 2nd coat (Field applied)-Tnemec Series 66 Epoxoline, DFT 3.0 to 4.0 mils.
4. 3rd coat (Field applied)-Tnemec Series 73 Endura Shield, DFT 1.5 to 2.5 mils.

F. PVC Piping

1. Surface preparation: Scarify prior to coating.
2. 1st coat: Tnemec Series 66 Epoxoline, DFT 1.5 to 2.0 mils.
3. 2nd coat: Tnemec Series 66 Epoxoline, DFT 1.5 to 2.0 mils.

G. Non-ferrous Metals (Galvanized, Copper, ect.)

1. Surface preparation: Lightly scarify surface, solvent clean using Tnemec 41-4 solvent.
2. 1st coat: Tnemec 66 Epoxoline, DFT 1.5 to 3.0 mils.
3. 2nd coat: Tnemec 73 Endurashield, DFT 2.0 to 3.0 mils.

H. Canvas and Cotton Insulation Coverings.

1. 1st coat: Tnemec 51-792 Sealer.
2. 2nd coat: Tnemec Series 6 Tnemec Cryl.
3. 3rd coat: Tnemec Series 6 or Series 7 Tnemec Cryl.

I. Interior concrete tanks in contact with potable water.

1. Surface preparation: SSPC-SP-7 (Acid etching not allowed).
2. 1st coat: Fill large voids with Tnemec 63-1500 Filler/Surfacer.
3. 2nd coat: Tnemec Series 20-1255 Beige, DFT 3.0 to 5.0 mils.
4. 3rd coat: Tnemec Series 20-AA90 White, DFT 3.0 to 5.0 mils.

3.09 CHEMICAL MIXING, FEED AND STORAGE AREA

A. Concrete Containment walls, tank pads and floors.

1. Surface preparation: SSPC-SP-7 (Acid etching not allowed).
2. 1st coat: Fill large voids with Tnemec 120-5003 Filler/Surfacer.
3. 2nd coat: Prime all surfaces with Tnemec Series 120-5002 DFT 12.0 to 18.0.
3. 3rd coat: Tnemec Series 120-5001 Gray DFT 12.0 to 18.0.

3.10 PIPING COATING SYSTEM SCHEDULE

A. Ductile Iron

1. Surface preparation: Immersion Service-SSPC-SP-10
2. 1st coat: (Shop Applied) Tnemec Series 66-1211, DFT. 3.0 mils.
3. 2nd coat: (Field Applied) Tnemec 66, Color, DFT 4.0 mils.
4. 3rd coat (Field Applied) Tnemec Series 66 Color DFT 4.0 mils.

B. PVC

1. Surface preparation: Clean and dry.
2. 1st coat: Tnemec series 66, Hi-Build Epoxoline, DFT 4.0 to 6.0 mils.

C. Carbon Steel

1. Surface preparation: Immersion Service- SSPC-SP-10.
2. 1st coat: (Shop Applied) Tnemec Series 66-1211, DFT. 3.0 mils.
3. 2nd coat: (Field Applied) Tnemec 66, Color, DFT 4.0 mils.
4. 3rd coat (Field Applied) Tnemec Series 66 Color DFT 4.0 mils.

END OF SECTION

DIVISION 11

SECTION 11305

THICKENED SLUDGE PERISTALTIC HOSE PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification covers the supply and installation of two (2) thickened sludge hose pumps.

1.02 RELATED SECTIONS

- A. SECTION 01300 – SUBMITTALS
- B. SECTION 01665 – SERVICES OF MANUFACTURER’S REPRESENTATIVE
- C. SECTION 01680 – EQUIPMENT AND SYSTEM CHECKOUT, CERTIFICATION, AND TESTING
- D. SECTION 01730 – OPERATION AND MAINTENANCE MANUALS
- E. SECTION 13321 – INSTRUMENTATION AND CONTROL SYSTEM

1.03 REFERENCES

- A. ASTM A48 STANDARD SPECIFICATION FOR GRAY IRON CASTINGS

1.04 SUBMITTALS

- A. Shop Drawings in accordance with specification Section 01300.
- B. Operation and Maintenance Manual in accordance with specification Section 01730.

1.05 MARKING, DELIVERY, STORAGE, AND HANDLING

- A. Special Instructions here (if applicable).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Watson-Marlow Bredel, Wilmington, MA
- B. Prominent Fluid Controls, Inc., Pittsburgh, PA
- C. Approved equal.

2.02 DESIGN

- A. Each peristaltic hose pump shall be capable of continuous duty of 140 gpm @ 50’ TDH and intermittent duty of 190 gpm @ 50’ TDH.
- B. Pump
 - 1. General

- a. Horizontal, Positive displacement, peristaltic hose pump
 - b. Capable of operating in either direction without flow variation
 - c. Capable of running dry without damage to pump or hose
 - d. Capable of pulling 95% of full vacuum
 - e. Repeatability: $\pm 1\%$ accurate
 - f. Valveless/Glandless design with no dynamic seals in contact with the pumped product.
 - g. Pump shall be capable of being rotated in 90-degree increments for four (4) different port-mounting configurations.
 - h. Direct Coupled gear drive arrangement as specified herein.
2. Hose and Lubricant
- a. Hose shall be manufactured of three-layer elastomer with an extruded inner wetted layer compatible with the process fluid, four layers of nylon reinforcement for 25mm-100mm hoses and two layers of nylon reinforcement for 10mm -20mm, and a Natural Rubber outer layer. Hose outside diameter shall be machined to maintain a wall thickness within ± 0.25 mm tolerance for 25mm-100mm and ± 0.4 mm for the 10mm -20mm hoses. The hose external surface shall have a surface roughness of $Ra 8 \pm 4\mu$. Hoses must have a smooth extruded internal surface and have tolerance controlled through machining. Hoses that do not meet these minimum requirements are not acceptable.
 - b. Minimum Static Burst Pressure rating of 800 psi for the 25mm-100mm hoses and 1090 psi for the 10mm -20mm hoses.
 - c. 53-68 shore A durometer.
 - d. Hose must be replaceable without cover or pump removal.
 - e. Pump housing shall contain a NSF-listed food-grade glycerin based hose lubricant blended to provide a medium for cooling and lubrication.
3. Pump Housing , Rotor, and Internal Bearing Frame
- a. Housing construction: Pump housing shall be ASTM A48 Class 25 cast iron and shall be supplied with an internal bearing hub to support the rotor on its own bearings. Provide a threaded drain plug at the lowest point of the pumping chamber to allow complete drainage of lubricant.
 - b. Pump rotor
 - 1. Rotor shall be cast iron with two pressing shoes located 180 degrees apart. To perfectly match the pump to the process conditions and eliminate slip, shoe occlusion must be adjustable. Rotors incorporating rollers or fixed occlusion shoes are unacceptable.
 - 2. Cast Iron rotor ASTM A48 Class 25 with adjustable, shimmable shoes constructed of epoxy or extruded aluminum as recommended by the manufacturer. Shims shall be constructed of 316 Stainless Steel with a shim thickness of 0.5mm. The specified manufacturing tolerance of the hose, when compressed, shall not exceed the occlusion setting of one shim.
 - c. Internal Bearing Frame
 - 1. Pump rotor shall be independently supported on its own set of heavy duty ball bearings such that the bearings are located directly under the rotor's

load. Bearings shall be supported by the bearing hub located within the pump housing and shall be sealed via a dynamic seal. Bearings shall be sealed and greased for life. Pumps which use pump lubricant to lubricate the bearings, external bearing frames which allow overhung loading and require long coupling configurations, or close coupling where the rotor is not supported by pump bearings are not acceptable.

2. Gearing shall be direct coupled to the back of the pump housing and shall be completely isolated from the process fluid and pump fluid through the sealed bearing hub. Gear unit and drive components shall be serviceable without removal of the pump rotor.

4. Flanged Connectors

- a. Supply pump with flanged inlet and outlet to ANSI/ASA 150# standards with wetted inserts compatible with the process fluid as indicated in the Process Pump Schedule. Flange construction: 15 micron min 316 stainless steel
- b. Pump hose shall extend from the pumping chamber to allow visual confirmation of hose/flange insert connection. Flange insert shall be secured to the pump hose via a single band clamp. Securing the hose using multiple clamps or internal compression fittings that cannot be visually verified as secure without disassembly of the pump is not acceptable.
- c. Flange supports shall be of one piece construction and shall secure to the pump housing via two or four bolts to maintain a compression seal between the pump housing and hose. Flange support construction: 15 micron min 316 stainless steel

5. Pump Cover

- a. Pump cover shall be constructed of ASTM A48 class 36 Cast Iron
- b. Viewing Window: Equip cover with a viewing window constructed of PMMA to allow clear visual confirmation of direction of rotation. Window shall be marked with a minimum lubricant registration mark for proper indication of lubricant level when pump is stationary. For pumps with adjustable shoes, the window shall be large enough to replace pressing shoes and allow shim adjustment without removing pump cover.
- c. Cover Mounting: pump covers shall be bolted along the perimeter to the pump housing and shall seal via a captive quad-ring seal.

6. Frame

- a. Support frame shall be torsion free and constructed of formed hot dipped galvanized steel with a coating thickness of 15 microns. Welded steel or modular adjustable frames are not acceptable.

7. High lubricant leak detector

- a. Provide a float type magnetic reed switch located near the top of the pump to detect leakage of pumped product into the pump housing.
- b. Supply sensor Normally Closed with the ability for field adjustment to Normally Open
- c. Pump manufacturer to supply switch only. Contractor is responsible for alarm and relay to turn pump off unless otherwise specified herein.
- d. Float switch shall be rated to the following maxima:

$$V_{\max} = 240\text{VAC}, I_{\max} = 1 \text{ Amp}, P_{\max} = 50\text{VA}$$

C. Pump Drive System - Direct Coupled Gearing with Fully Protected Drive mounting

1. Provide gearing with Fully Protected Drive direct-coupled mounting to the pump housing.
 - a. The gearbox shall bolt directly to the pump housing which shall include a buffer zone between the gearing and pump head to prevent gearbox contamination from pump fluid or lubricant in the event of a hose lubricant seal failure. The pump's internal bearing hub shall be vented through the rear of the pump housing to allow visual detection in the event of a hose lubricant seal failure.
 - b. Close coupled pump designs which utilize the gearbox to seal the pump housing and expose the gearbox to lubricant or pumpage are not acceptable.
 - c. Long coupled pumps which require external couplings, coupling alignment, and coupling guards are not acceptable.
2. Design gear reduction to match output speed requirement of the pump using two or three-stage gearing and matching torque rating of pumping equipment. Gearing shall be classified for continuous heavy shock duty, 24 hr duty with a minimum of 1.4 service factor.
 - a. 40-100 mm pumps: ultra compact, high torque planetary gearing with cast iron housing

D. Motors

1. Provide premium efficient, inverter duty TEFC or TENV, squirrel-cage induction motors, NEMA C face, conforming to the latest applicable requirements of NEMA, IEEE, ANSI, and NEC standards.
2. Provide motor HP in accordance with Process Pump Schedule.
3. Motors are to be designed for continuous duty for 3-phase, 230/460VAC operation, NEMA Design B with torque and starting currents in accordance with NEMA MG1-1993-12.35 and 12.38. Ratings to be based on a 40 degree C ambient 3,300 feet altitude or lower operation with a maximum temperature rise of 80 degree by resistance C at 1.0 service factor (and 90 degree C rise 1.15 service factor).
4. Motors shall be furnished with Class F insulation utilizing materials and insulation systems evaluated in accordance with IEEE 117 classification tests. Motors shall have 1.15 service factor but shall be selected for operation within their full load rating without applying the service factor.
5. Bearings shall be selected to provide L10 rating of 100,000 hrs minimum for C-face flexible coupled applications. For frame sizes 56-140, bearings shall be permanently lubricated. For frame sizes 180 and larger, proved capped grease fitting.
6. For frame sizes 180 and larger, motor enclosure including frame, end brackets locking bearing inner caps, fan guard, and conduit box and cover shall be cast iron, ASTM Type A48, Class 25 or better. Conduit box shall be diagonally split with tapped NPT threaded conduit entrance hole, neoprene conduit box cover gasket, neoprene lead seal gasket between box and motor frame, and ground lug. For frame sizes 56-140, motor enclosure, fan guard, conduit box, and cover shall be carbon steel. End shield shall be constructed of aluminum. Conduit box shall be top mounted with F1/F2 conduit entrance holes, grounding lug, and neoprene conduit box gasket between box and motor frame.

7. External cooling fan on TEFC motors shall be corrosion resistant, non-sparking, bi-directional, keyed, clamped, and shouldered on the motor shaft.
8. Motor rotor construction shall be die cast aluminum, fabricated copper, or their respective alloys. Motor shall have copper windings.
9. Motor leads shall be nonwicking type permanently numbered for identification.
10. All motors shall be premium efficient with minimum efficiencies exceeding NEMA MG1-1993 Table 12-10. Motor efficiency shall be determined in accordance with NEMA MG1-1993-12.58.1 and full load efficiency labeled on motor nameplate in accordance with NEMA MG1-1993-12.58.2
11. Motors shall suitable for use with PWM type variable frequency drives. Motors frame size 56-180 shall be rated for 10:1 constant torque continuous duty over 6-60 Hz. Larger frame motors shall be rated for 4:1 constant torque continuous duty over 15-60 Hz.
12. Acceptable Manufacturers –Baldor or approved equal.

2.03 ACCESSORIES

- A. Pressure gauges, tank hatches, specialty valves, level sensors

2.04 CONTROLS

- A. Control panels to be supplied with equipment? Communication with SCADA (4-20mA output)

2.05 PAINTING/FINISHING

- A. Provide pump assembly painted with manufacturer's standard paint specification
 1. Single coat of a two component acrylate
 2. Dry thickness 60-80 micron
 3. Color- RAL 3011 brown red

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the drawings and the manufacturer's instructions.
- B. Install in coordination with sludge dewatering equipment and demolition of existing thickened sludge pumping so as to maintain thickened sludge pumping and/or sludge disposal capabilities at all times.
- C. Pumps shall be installed on concrete pads

3.02 TESTING

- A. Shop Testing
 1. Test assembled Pump running on air.

2. Run test for a minimum of 30 seconds and record vacuum reading which must meet or exceed 28" Hg Vacuum.
 3. In the event that specified tests indicate that the pump does not meet specifications, Engineer has the right to require complete tests for the pump at no additional cost to the owner.
 4. Repeat tests until specified results are obtained.
 5. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.
- B. Field Testing
1. After installation of pumping equipment, and after inspection, operation, testing, and adjustment have been completed by the Contractor in the presence of the Manufacturer's Field Service Technician, Contractor shall conduct running test for each pump in the presence of the Engineer to determine its ability to operate within the performance limits specified and to deliver its rated capacity within the pressure requirements specified. Contractor shall provide labor, piping, equipment, and materials necessary for conducting all field tests

3.03 STARTUP

- A. Provide startup services in accordance with Specification Section 01665
- B. Startup checkout procedures, operator training

3.04 SPARE PARTS

- A. Provide spare parts that are identical to and interchangeable with parts installed. Furnish and deliver the following spare parts for each pump:
 1. Two replacement hoses
 2. Two hose lubricant refills

END OF SECTION

SECTION 11326

SLUDGE THICKENER EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION

- A. Furnish, Install and Test two (2) thickener mechanisms for installation in existing concrete basins as shown on the contract drawings. Each basin shall be 50 feet in diameter with a side water depth of 14 feet, a freeboard of a minimum 18 inches and a floor slope of 1-3/4 inch to 12 inches.
- B. Each mechanism shall be supported on the walkway spanning the tank with the flow entering the side of the tank and flowing into the feedwell through two (2) influent pipes. Effluent will be collected in a peripheral launder and a center drive mechanism shall be provided for rotation of the two rake arms with rake blades.
- C. The equipment shall be designed to effectively settle and thicken both primary and secondary sludge solids and scrape the settled solids from the basin floor to the central sludge withdrawal sump as shown on the drawings. The clarified effluent shall be collected uniformly by the peripheral launder and returned to the primary distribution box.
- D. The equipment furnished for each thickener mechanism shall include but not be limited to: walkway, center drive assembly, center drive platform, feedwell, center support shaft, sludge collection arms with rake blades and pickets, effluent weir plates, scum baffle, anchor bolts and assembly fasteners, and control panels.
- E. Except where specifically indicated otherwise, all plate, and structural members designated for submerged service shall have a minimum thickness of 1/4 inch. All structural steel will conform to ASTM A-36 requirements and steel plate will conform to ASTM A283C requirements. All anchor bolts and fasteners shall be type 316 stainless steel.

1.02 RELATED SECTIONS

- A. SECTION 01300 – SUBMITTALS
- B. SECTION 01665 – SERVICES OF MANUFACTURER’S REPRESENTATIVE
- C. SECTION 01680 – EQUIPMENT AND SYSTEM CHECKOUT, CERTIFICATION, AND TESTING
- D. SECTION 01730 – OPERATION AND MAINTENANCE MANUALS
- E. SECTION 05500 – METAL FABRICATIONS
- F. SECTION 09900 – PAINTING

G. SECTION 13321 – INSTRUMENTATION AND CONTROL SYSTEM

H. DIVISION 16 – ELECTRICAL

1.03 REFERENCES

- | | | |
|----|------------|---|
| A. | ASTM A-36 | American Society of Testing Materials
Structural Steel Specifications |
| B. | ASTM A-325 | American Society of Testing Materials
Fastener Specifications |
| C. | ASTM 304 | American Society of Testing Materials
Bolt Specifications |
| D. | ASTM A-48 | American Society of Testing Materials
Cast Iron Specifications |
| E. | ASTM A-536 | American Society of Testing Materials
Cast Iron Specifications |
| F. | AISI 4142 | American Iron and Steel Institute
Heat Treated Steel Specifications |
| G. | AGMA | American Gear Manufacturers' Association Gear Ratings |
| H. | AWS | American Welding Society - Current Standards |
| I. | AFBMA | Anti-friction Bearing Manufacturers' Association – Bearing
Life Specifications |
| J. | ASTM A283C | American Society of Testing Materials
Steel Plate Specifications |
| K. | NEMA | National Electrical Manufacturer's Association - Motor
Design Standards and Standards for Control Enclosures |

1.04 SUBMITTALS

- A. Shop Drawings in accordance with specification Section 01300.
- B. Two copies of all materials required to establish compliance with these specifications shall be submitted for review. Submittals shall include at least the following:
 - 1. Certified general arrangement drawings showing all important details and materials of construction, dimensions, loads on supporting structures, and anchor bolt locations.

2. Descriptive literature, bulletins, and/or catalogs of the equipment.
 3. Complete data on motors and speed reducers.
 4. Wiring diagrams and electrical schematics for all control equipment to be furnished.
 5. Calculations documenting the AGMA rating of the drive unit and life of the main bearing, prepared and signed by a registered professional engineer.
 6. Complete descriptive information and electrical schematic for the torque overload device.
- C. Operation and Maintenance Manual in accordance with specification Section 01730.
- D. American Iron and Steel Certificate of Compliance

1.05 MARKING, DELIVERY, STORAGE, AND HANDLING

- A. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations, properly match-marked for ease of field erection.
- B. All components shall be erected immediately upon receipt from the thickener manufacturer or stored in strict conformance with storage recommendations provided by the thickener manufacturer in the operations and maintenance manual.
- C. The mechanism shall be lubricated in strict accordance with the instructions of the thickener manufacturer's field service representative. The contractor shall provide the required lubricants.

1.06 QUALITY ASSURANCE.

- A. The thickener equipment manufacturer shall modify his standard equipment to meet the minimum values specified for dimensions, design, and the intent of this specification.
- B. Manufacturers regularly engaged in the manufacture of the thickener equipment as specified herein and who can demonstrate equipment of this specified design, in actual service for a period of not less than 10 years will be considered as acceptable manufacturers.
- C. Manufacturers shall show evidence of quality assurance in manufacturing and supplying equipment essential in details to the equipment herein specified. This assurance will be met by certification to the quality system requirement of ISO 9001 or equivalent standard as accepted by the engineer.

- D. The equipment specified herein shall be factory assembled as far as practical to verify that all mating parts can be field assembled. The manufacturer shall submit certification of shop trial assembly and photographs of assembly before shipment.
- E. Shop inspection shall be performed by a qualified inspector and certified by the manufacturer. The inspection shall be documented and all deficiencies noted, corrected, re-inspected and final completion formally authorized. Final shipment authorization shall be by the manufacturer to ensure completion of all fabrication, assembly, and inspection requirements. Inspection records and evidence of inspector qualification shall be submitted to the owner upon request.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. The equipment manufacturer shall furnish an electronic copy and printed copies of the operation and maintenance manual at least two weeks prior to shipment of all major equipment components, which will be retained at the installation site to assist plant operators.
- B. Each manual shall be a bound, indexed binder with drawings and parts lists prepared specifically for this project rather than general instructions that are not designed for this project.
- C. As a minimum, the manual shall contain:
 - 1. Certified as built drawings - General arrangement
 - 2. Certified as built drawings - General arrangement details
 - 3. Erection drawings.
 - 4. A complete bill of materials for the equipment including the weights of all structural steel components.
 - 5. Installation and maintenance instructions for the specific equipment including the erection sequence, maintenance and trouble-shooting check points, and complete lubrication procedures with recommended grades of lubricants.
 - 6. Cut sheets for all equipment items purchased from sub-vendors.
 - 7. A list of the thickener manufacturer's recommended spare parts specifically denoting wear items, long delivery items, and all items convenient for stocking as optional replacement items.

PART 2 PRODUCTS

2.01 MANUFACTURERS

SLUDGE THICKENER
EQUIPMENT

11326-4

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- A. WesTech Engineering Inc., Salt Lake City, UT
- B. Approved equal.

2.02 DESIGN

- A. The Gravity Thickener Mechanism shall be designed as follows:

Influent Flow Rate Per Clarifier (MGD)	
– Design:	
– Maximum:	
– Solids Loading Design:	
– Solids Loading Maximum:	
Tank Diameter (ft):	50
Side Water Depth (ft):	14
Freeboard (ft):	1.5 (min.)
Bottom Slope (in/ft):	1.75/1
Center Support Outside Diameter (in):	20
Feedwell	
– Diameter (ft):	10
– Depth (ft):	5
Collector Tip Speed (ft/min):	8
Motor HP:	1
Torque (ft-lbs)	
– Design Running:	26,500
– Momentary Peak:	53,000
Ball Race Diameter (in):	?

2.03 MATERIALS

- A. All structural steel shall conform to AISC – Steel Construction Manual latest edition. All steel plates shall conform to ASTM A36. All structural steel shape series of M, MT, S, ST, C, MC, L shall conform to ASTM A36. Structural steel shapes W, WT, HP shall conform to ASTM A992/A572. All pipe shall be ASTM A53, Grade B. All square and rectangular tubing shall be ASTM A500, Grade B, unless otherwise noted. Steel members in contact with liquids, either continuously or intermittently, shall have a minimum thickness of 1/4 inch unless otherwise noted. All aluminum shall be type 5052, 6061, 6063, or 2014 alloy unless noted. All stainless steel shall be type 304/304L unless noted.

2.04 CENTER DRIVE ASSEMBLY

A. Design Parameters

1. The drive unit shall be designed and manufactured by the equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values previously listed. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L-10 life of 50 years or 438,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.
 - a. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the strength and durability values determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.
 - b. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.
 - c. Any and all welding on the drive unit shall be done using E70XX weld rod.

B. Physical Characteristics

1. The drive unit shall consist of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the center column and support the entire rotating load of the mechanism. The main internal gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. All speed reducers shall be fully enclosed and running in grease. Support base for the drive shall be of welded steel to assure rigidity. Lubricant and dust shields shall be provided. The drive bearing shall include a forged steel precision gear/bearing set, with fully contoured raceways hardened to a minimum 58-60 Rc and protected by a neoprene seal. Strip liners designed for periodic maintenance and replacement shall not be acceptable. The drive shall be designed so that the balls and nylon spacers can be replaced without removing the access walkway. The main gear to pinion gear mesh shall be oil lubricated. An oil sight glass, fill pipe, and drain shall be provided for the reservoir. Lubrication fittings shall be readily accessible.

- C. An overload device shall be provided in a stainless steel, weatherproof enclosure. The device shall be actuated by torque generated from the main drive, which shall

operate two independently adjustable switches (the alarm switch at 100 percent of design running torque and the motor cutout switch at 120 percent of design running torque). Devices that require the worm to float and measure the thrust of the worm gear shall not be acceptable. These two switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. It shall be calibrated from 0 to 160 percent of design running torque.

- D. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29×10^6 psi. The center cage shall be fastened to and supported from the gear casing. Ball bearings shall be of high carbon chrome alloy 52100 steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and protected by elastomer seals. Felt seals that allow the entrance of moisture from outside the drive (i.e. rainwater, condensate, etc.) will not be allowed.
- E. The speed reducing unit shall consist of cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v-belts, and shall be keyed to the pinion.
 - 1. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.
 - 2. Speed reducer helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage. The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.
 - 3. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and be grease lubricated. As a safety feature, the speed reducer shall be back driveable to release any stored energy as the result of an over torque condition.
- F. The motor shall be a Class 1 Div 1, heavy duty unit of ample power for starting and operating the mechanism without overload, with a minimum service factor of 1.15.
 - 1. Power supply to the equipment shall be 240/480 volt, 60 hertz, 3 phase.

2.05 WALKWAY & PLATFORM

- A. One (1) 36 inch wide walkway and platform with handrails shall be supported by the drive unit and influent column at the center and the tank wall at its outer end, and shall be designed to safely withstand a live load of 50 pounds per square foot. Deflection shall not exceed $L/360$ when both the dead load and live loads are applied. It shall consist of two trusses or beams with 1-1/4 inch aluminum I-bar grating between the trusses or beams. The walkway shall be diagonally braced against lateral movement, and provided with handrails 42 inches high, of double-row 1-1/2 inch diameter horizontal aluminum pipe, and 4 inch high kickplates on both sides. Walkway trusses may serve as the handrail if the top chord is 3 feet-6 inches above the walking surface.
 - 1. Stainless steel bearing plates, UHMW-PE slide plates, and anchor bolts for the wall support shall be provided by the equipment supplier and installed by the contractor. Bearing plate dimensions and anchor bolt diameter, length, quantity, and arrangement shall be per the equipment supplier. The contractor shall block out or otherwise modify the tank or support structure to accommodate walkway and supports, if required.
- B. A center drive platform shall be provided which allows 24 inches clearance outside the center drive components. It shall consist of 1/4 inch aluminum checkered plate with necessary stiffeners and supports, resting on the drive unit and center column, and provided with connections to the walkway. The entire platform shall be surrounded by handrails 42 inches high of double-row 1-1/2 inch diameter horizontal aluminum pipe with 4 inch high kickplates.

2.06 INFLUENT & SLUDGE REMOVAL

- A. A stationary cylindrical steel influent column of 1/4 inch minimum wall thickness shall be provided. One end shall have a support flange for bolting to the tank floor over the influent line, with a similar flange at the top for supporting the drive unit and walkway. The structure and anchor bolts shall provide adequate support for the entire mechanism dead load plus live loads and torque with an adequate factor of safety to eliminate excessive deflection or vibration. Suitable openings shall be provided in the upper portion of the column to allow unrestricted passage of the flow into the feedwell.
 - 1. Prior to the center column being grouted in place, the drive unit shall be installed, positioned, and leveled.
- B. A feedwell shall be supported outside of the center cage to diffuse the liquid into the tank without disturbance or formation of density currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.
 - 1. The feedwell shall be made of not less than 3/16 inch thick steel plate with necessary stiffening angles.

- C. The center cage shall be of steel box truss construction. It shall be provided with connections for the two sludge rake arms and feedwell supports if required. The cage top shall be bolted to the main gear which shall rotate the cage with the attached arms and feedwell. The cage and each arm shall be designed to withstand 150 percent of the design running torque of the drive without over stressing the members. Loading to develop the torque shall be considered as uniform loads applied to each arm individually.
- D. The mechanism shall include two sludge rake arms of steel truss construction with steel scraper blades with adjustable stainless steel squeegees and pickets. Squeegees shall be fastened to the rake blades with stainless steel fasteners. The blades shall be properly sized to ensure complete raking of the bottom twice per revolution. The blades shall rake the heavy sludge to a center sludge hopper. The arms shall be adjustable at the cage to assure an even grout thickness over the tank bottom.

2.07 EFFLUENT REMOVAL

- A. A rectangular effluent launder shall be provided around the perimeter of the tank. The launder shall be formed as part of the concrete wall. A drop-out box shall be provided in the bottom of the launder at one point for collection and discharge of the clarified effluent.
- B. An adjustable weir shall be provided around the periphery of the tank at the water surface for removal of clarified effluent.
 - 1. The weir shall consist of 1/4 inch thick x 9 inches deep fiberglass sections with 2-1/2 inch deep 90 degree v-notches at 6 inch intervals. The weir sections shall be curved and fastened to the launder wall with special large washers, anchor bolts, and hex nuts to allow vertical adjustment.

2.08 ANCHORAGE & FASTENERS

- A. All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.
- B. All structural fasteners shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

2.09 ACCESSORIES

- A. Pressure gauges, tank hatches, specialty valves, level sensors

2.10 CONTROLS

A. Control panels to be supplied with equipment? Communication with SCADA (4-20mA output)

2.11 PAINTING/FINISHING

A. Provide in accordance with Specification Section 09900 - Painting.

B. Sharp projections of cut or sheared edges of ferrous metals shall be ground to a radius by multiple passes of a power grinder as required to ensure satisfactory coating adhesion.

C. All iron and steel surfaces, except the drive unit, shall be field cleaned and painted by the contractor to ensure paint compatibility and assign unit responsibility for the coating system. The drive unit shall be coated with the manufacturer's standard enamel paint system.

D. Prior to assembly of the drive unit, the castings shall be sandblasted and thoroughly cleaned to remove any foreign particles in the drive base. After assembly, the drive mechanism shall be solvent cleaned and power wire brushed as needed prior to shop application of manufacturer's standard primer.

E. Gear motors shall be furnished with manufacturer's standard enamel.

PART 3 EXECUTION

3.01 INSTALLATION

A. The equipment shall be installed in strict accordance with the manufacturer's written instructions. The equipment shall be installed properly to provide a complete working system.

B. Special installation instructions (sequencing, relation to other equipment, etc.)

3.03 SERVICE

A. Provide the services of a manufacturer's representative in accordance with Section 01735. The representative shall inspect and approve the installation, certify that the torque settings of the drive overload protection device are correct, perform the torque test and instruct the owner's personnel on maintenance and operation. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

3.02 TESTING

A. Torque Tests:

1. The entire sludge collector mechanism shall be statically load tested by loading the rake arm with 150 percent of the specified design running torque. The test shall verify the torque overload control device settings for alarm and motor cutout. One truss arm shall be anchored and the load measured to demonstrate the rake arms', cage's, and drive unit's ability to withstand the specified torque. Sketches and calculations shall be submitted illustrating how the torque will be applied prior to the test taking place.

B. Operation Tests:

1. The contractor shall operate the mechanism in a dry tank for a minimum of 4 continuous hours before flow is allowed to enter the system. There shall be no binding, jerky, or unusual motion exhibited during this run in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same 4 hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be repaired or replaced and the test re-run.

3.03 STARTUP

- A. Provide startup services in accordance with Specification Section 01665
- B. The equipment supplier shall provide the service of a qualified representative for one trip and one day per mechanism to inspect the mechanism installation and assist in startup.

C. Additional startup checkout procedures, operator training...

3.04 SPARE PARTS

- A. The intent of this specification is to provide uninterrupted operation for a minimum period of two (2) years. To meet this objective the thickener manufacturer shall supply any spare parts, excluding lubricants that are required to meet this time frame.

As a minimum provide the following spare parts:

- List here...

END OF SECTION

SECTION 11350

SLUDGE DEWATERING CENTRIFUGES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification covers requirements for furnishing and installing two (2) sludge dewatering centrifuges.

1.02 RELATED SECTIONS

- A. SECTION 01300 – SUBMITTALS
- B. SECTION 01665 – SERVICES OF MANUFACTURER’S REPRESENTATIVE
- C. SECTION 01680 – EQUIPMENT AND SYSTEM CHECKOUT, CERTIFICATION, AND TESTING
- D. SECTION 01730 – OPERATION AND MAINTENANCE MANUALS
- E. SECTION 11305 – THICKENED SLUDGE HOSE PUMPS
- F. SECTION 11961 – INTERIOR AND EXTERIOR PROCESS PIPE
- G. SECTION 13321 – INSTRUMENTATION AND CONTROL SYSTEM

1.03 SUBMITTALS

- A. Shop Drawings in accordance with specification Section 01300.
- B. American Iron and Steel compliance certifications, as applicable
- C. List of centrifuge installations of comparable size in the U.S. from wastewater treatment plants.
- D. Operation and Maintenance Manual in accordance with specification Section 01730.

1.04 MARKING, DELIVERY, STORAGE, AND HANDLING

- A. The equipment will be shipped in a minimum number of components; and they will typically be comprised of the centrifuge assembly with drive and back drive, control panel, and other parts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Alfa Laval, Inc., Richmond, VA
- B. Andritz, Springfield, MA
- C. Approved equal.

2.02 DESIGN

A. Design Parameters:

Maximum number of centrifuges:	2
Sludge feed hydraulic flow rate (GPM):	200
Sludge feed solids concentration (%):	4.0%
Cake solids concentration (%):	25 – 30%
Capture efficiency (%):	95%
Polymer dosage (Lbs Active/DT):	15 – 25 lbs active / DT
Nominal inside bowl diameter, (in):	26
Minimum bowl length, (in):	100.9
Operating centrifugal force (at inside bowl wall diameter):	3,490 G

The water supply available at each unit shall be as follows:

Bowl Flushing:	150 gpm up to the feed rate @ 45 psi
CIP Flushing	75 gpm @ 45 psi
Temperature:	Ambient (40 - 90° F)

- B. Each centrifuge shall be a complete unit. The centrifuge shall be a solid bowl, horizontal, scroll type unit and shall be specifically designed to handle primary and secondary sludge. The centrifuge shall be capable of continuous operation with minimum of maintenance and operation supervision.
- C. The centrifuge bowl shall be supported by bearings mounted in pillow blocks and fitted for convenient lubrication. Main bearings shall have a calculated life of at least 100,000 hours at standard operating speeds in accordance with DIN ISO 281 requirements or SKF New Life bearing calculations.
- D. The centrifuge shall include a 316 stainless steel hub for the horizontal conical-cylindrical scroll conveyor. The conveyor shall be equipped with helical flights independently mounted concentrically within the bowl. The scroll shall utilize a differential speed to convey solids from the cylindrical section to the conical section and out of the bowl with a minimum disturbance to the pool, and to the maximum advantage of the variable speed back drive described in this section. The scroll conveyor shall be supported on grease lubricated anti-friction ball or roller bearings sealed from process contamination. The scroll assembly shall be independently balanced.
- E. The centrifuge shall be equipped with a multistage planetary gearbox to provide control of the differential speed between the centrifuge bowl and conveyor. The gearbox shall be independently balanced from the centrifuge, and interchangeable. Each gear unit should be protected from damage due to high torque overload. A thermal overload protection device shall not be considered as providing for sufficient protection for the gear unit.
- F. The rotating assembly and bearings of the centrifuge will rest on a steel frame. The frame and casing shall be supplied on a modular frame and shall be fabricated from structural tubular steel. The modular frame shall support both the drive motor and

back drive motor and shall provide a minimum clearance of 29 inches from floor to the casing solids and liquid discharge openings. The bottom of the casing shall be fitted with a flexible splashguard for cake discharge. The liquid discharge shall be fitted with a flexible connection fitted with an 8-inch Ø hose or 150 lb. flange connection for the centrate. The lower casing shall be fabricated from carbon steel with stainless steel cladding on the wetted parts. The casing assembly will be provided with a stainless steel upper casing, specifically designed for rigidity and noise reduction. The case shall be designed to act as a protective guard and to provide a complete enclosure for odor containment. The casing top shall be gasketed. Cover switch shall be provided so that the centrifuge cannot be started when the cover is open. Vibration isolators for the drive motor and back drive shall be supplied as required. Junction boxes for all centrifuge mounted switches, except those specifically related to the main drive motor, shall be mounted on the base.

- G. Sludge shall be fed to the centrifuge by means of a pump, supplied by others, suitable to minimize turbulence and pulsation. The minimum inlet pressure to the centrifuge shall be 5 psig at 100 gpm (when used on water with viscosity of 1 Centipoise). The feed connection to the centrifuge shall be a 3-inch 150 lb. flange connection. The feed tube shall also include a three-quarter inch (3/4") NPT connection for polymer. The feed flow to the centrifuge shall be monitored by a magnetic flow meter provided by others.
- H. The bowl drive system shall consist of an electric motor and a belt drive system. The belt drive system shall consist of multiple belts as required to provide full capacity and to withstand the full starting torque of the system. The drive system shall use one motor for the bowl drive and a separate back drive motor for differential adjustment.
- I. The centrifuge shall be furnished with a complete direct drive back drive system to control differential speed between the conveyor and the bowl. The back drive shall provide an adjustable differential speed variation over its range of operation. Each back-drive system shall be furnished with all the required instrumentation and electrical controls to meet the operating requirements of this specification.
- J. In order to minimize wear due to abrasive materials in the feed, replaceable hard surfacing shall be provided at all points where the abrasive action of the sludge will cause wear on the metal parts of the centrifuge. The following shall be considered a minimum degree of hard surfacing required.
- K. All equipment shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings and specifications, engineering data, instructions and recommendations of the equipment manufacturer. The centrifuge units shall be the product of suppliers regularly engaged in the design and manufacture of centrifuges and shall be specifically designed for the intended conditions of service. Appurtenant equipment shall be new and shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges. Components of the centrifuge shall be designed for the stresses that may occur during fabrication, shipping, erection, operation, or maintenance. Materials shall be suitable for service conditions and as described herein.

- L. The centrifuge manufacturer will be responsible for providing a complete centrifuge system, as described herein, and for delivering the equipment to the job site.
- M. The equipment shall be installed by an installing contractor, who will be responsible for off-loading the equipment, providing any temporary storage in accordance with the manufacturer's recommendation for storage and installing the equipment in place. Installation will include mounting the unit, piping the unit, and providing power to the panels and all interconnected wiring and piping required between various components.
- N. The centrifuges specified herein are of the counter-current design, horizontal, solid bowl type. The bowl of the centrifuge must be removed vertically from the frame and casing.
- O. Each centrifuge shall be continuously fed sludge conditioned with polymer by feed pumps. The sludge shall be fed into the center of the equipment. An internal screw conveyor shall continuously move the solids deposited against the bowl wall to one end of the machine where they are plowed up and discharged out a solids discharge chute. The cake shall discharge freely onto cake conveying equipment. The clarified liquid shall continuously flow over adjustable weirs at the other end of the machine where it discharges into a centrate chute. The centrifuges shall be provided with back drives to infinitely vary the speed of the conveyor to optimize sludge processing.

2.03 MATERIALS

- A. The bowl shall be manufactured from centrifugal castings of duplex stainless steel.
- B. All wetted parts of the centrifuge rotating assembly shall be 316, 317 or duplex stainless steel, except for the O-rings, seals, and abrasion-resistant material. O-rings shall be Nitrile rubber (NBR); lip-type seals shall be Nitrile rubber (NBR).
- C. The feed tube shall be constructed of AISI 316 stainless steel.
- D. The frame shall be fabricated from box beam profile in mild steel and shall contain no weighted aggregate.
- E. The upper casing shall be AISI 304, AISI 316 or duplex stainless steel with 316 stainless protecting the wetted parts of the lower casing.

2.04 ACCESSORIES

- A. Pressure gauges, tank hatches, specialty valves, level sensors

2.05 CONTROLS

- A. Local control panel shall be supplied with equipment. Control panel shall be capable of communication with SCADA (4-20mA output).

2.06 PAINTING/FINISHING

- A. Special protective coatings or painting

PART 3 EXECUTION

3.01 INSTALLATION (BY OTHERS)

- A. Install in accordance with the drawings and the manufacturer's instructions.
- B. Special installation instructions (sequencing, relation to other equipment, etc.)

3.02 TESTING

- A. Shop Testing
- B. Field acceptance testing.

3.03 STARTUP

- A. Provide startup services in accordance with Specification Section 01665
- B. Startup checkout procedures, operator training

3.04 WARRANTY

- A. Each unit shall be warranted to be free from defects in materials and workmanship for a period of twelve months after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed eighteen months from shipment, whichever occurs first. The warranty shall cover all repairs for all systems furnished by the manufacturer. Manufacturer shall repair or replace, at its option, any such equipment found to be defective, provided written notice of the alleged defect is received within twelve months after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed eighteen months from shipment.

3.05 SPARE PARTS

- A. Belts, lubricants, wear items

END OF SECTION

SECTION 11373

ODOR CONTROL FANS

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Work Included: Furnish and install THREE (3) factory assembled blower systems in the configuration denoted on the drawings and as described herein. The blower systems shall be complete, including motor, V-belt drive assembly with OSHA guard, spare parts, and other appurtenances as specified herein.

1.02 RELATED SECTIONS

- 1. Section 02620 – HIGH DENSITY POLYETHYLENE PIPE
- 2. Section 02660 – BIOFILTER

1.03 SUBMITTALS

- A. Shop Drawings in accordance with Section 01300.
- B. Submit Operation and Maintenance Manuals in accordance with Section 01730.
- C. Submit general arrangement and assembly drawings indicating:
 - 1. All piping requirements,
 - 2. Structural and foundation requirements which include curb dimension, curb location and anchor bolt requirements,
 - 3. Operating weight distribution,
 - 4. Installation requirements requiring coordination with the General Contractor.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers:
 - 1. Perry Fiberglass Products Incorporated, Westlake, Ohio
 - 2. Hartzell Fan Inc, Piqua, Ohio
 - 3. New York Blower Company, Willowbrook, Illinois
 - 4. Approved equal.

2.02 DESIGN

- A. Design Criteria:
 - 1. Blowers shall be sized as follows:
 - a. Headworks/Grit Chamber: 4,000 SCFM at 16 inches of static pressure
 - b. Sludge Thickeners: 7,000 SCFM at 16 inches of static pressure

- c. Solids Handling Building: 4,000 SCFM at 10 inches of static pressure
2. Blowers shall be fiberglass radial blowers, with a housing constructed of corrosive resistant polyester resin and fan wheel constructed of special corrosion resistant vinylester resin. No metal parts shall be exposed to the airstream and all internal hardware is 300 series stainless steel encapsulated.
 3. The blowers shall be supplied such that the design point is within the published design curve. Furthermore, the blower shall be capable of meeting the maximum specified design condition without exceeding 80% of the published maximum design capacity.
 4. The blower system must be suitable for year-round outdoor service.
 5. All valves, gaskets, rubber expansion joints, components and accessories shall be suitable for temperatures up to 250°F.
- A. Blowers:
1. Fiberglass centrifugal blower.
 2. Blower housing: Special corrosive resistant polyester resin having a Class I flame spread rate of 25 or less.
 - a. Blower Wheel: Multi piece radial design constructed of solid fiberglass molded with vinylester resin.
 - b. Shaft: Turned, ground and polished fiberglass
 - c. Shaft Seal: Fiberglass and neoprene shaft seal is placed where the shaft leaves the housing along with a neoprene shaft slinger between the seal and wheel.
 - d. Motor: Motor shall be mounted on common base with blower.
 - e. Drive Assembly: Belts shall be oil, heat and static resistant type and oversized for continuous duty.
 - f. Bearings: Bearings are heavy duty, self-aligning, pillow block type.
 - g. Bases shall be heavy gauge hot rolled steel and epoxy coated.
- B. Spare Parts:
1. One spare air filter.
 2. One spare set of V-belts.
 3. Complete set of bearings and seals.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install in strict accordance with manufacturer's written recommendations and as shown on the Drawings.

3.02 STARTUP, TESTING AND TRAINING

- A. In accordance with the requirements of Section 01800.

END OF SECTION

SECTION 11500

DOME ALUMINUM COVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification covers the supply and installation of two (2) aluminum sludge thickener dome covers.

1.02 RELATED SECTIONS

- A. SECTION 01300 – SUBMITTALS
- B. SECTION 03000 – REINFORCED CONCRETE
- C. SECTION 05500 – METAL FABRICATIONS
- D. SECTION 11326 – SLUDGE THICKENER EQUIPMENT
- E. SECTION 11961 – INTERIOR AND EXTERIOR PROCESS PIPING

1.03 REFERENCES

- A. ASTM C509 - Standard specifications for elastomeric cellular preformed gasket and sealing material
- B. ASTM C1115-00 - Standard specification for dense elastomeric silicone rubber gaskets
- C. ASTM C920 - Standard specification for elastomeric joint sealants
- D. Aluminum Association specifications for aluminum structures
- E. Aluminum Association Aluminum Design Manual 2010; Specifications and guidelines for aluminum structures
- F. ASCE 8-02 - Specification for the design of cold-formed stainless steel structural members
- G. ASTM F593 - Standard specification for stainless steel bolts, hex cap screws, and studs
- H. Federal Specification TT-S-00230C
- I. Federal Specification A-A-59588

1.04 SUBMITTALS

- A. Shop Drawings in accordance with specification Section 01300 showing dimensions, sizes, thickness, gauges, materials, finishes, joint attachment, and erection procedure.
- B. A complete set of design calculations for the dome(s) shall also be submitted. These calculations shall be signed by a registered professional engineer. All work shall be fabricated and erected in accordance with the approved drawings.

- C. Certification that the specified material alloys, sizes and quantities have been furnished shall be submitted upon completion of the project.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. CST Covers, Conroe, TX
- B. Approved equal.

2.02 DESCRIPTION

- A. The dome roof shall be clear-span and self-supporting from the peripheral structure with primary horizontal forces contained by an integral aluminum tension ring (unless otherwise specified). The frame shall consist of aluminum structural members with the joints arrayed on the surface of a sphere. The arrangement of members shall result in a pattern of triangular spaces. These spaces shall be closed with light gauge aluminum panels. The members shall be joined by means of bolting their flanges to aluminum gusset plates.
- B. All metal components of the aluminum dome structure shall be aluminum or 300 series stainless steel. No galvanized, aluminized, painted, or plated steel shall be used anywhere in the dome above the mounting bracket base plates. Dissimilar materials in the supporting structure shall be isolated from the aluminum dome by means of a compatible elastomeric gasket.
- C. The entire structure shall be designed as a watertight system under all design load and temperature conditions. The design shall include all sealant joints to be tooled slightly concave after sealant is applied to the gusset covers' outside connection. Care shall be taken to keep sealant confined to the joint area, and any outside of the joint shall be removed so that the panels will be free from misplaced sealant. All sealants shall be placed only in a manner as recommended by the sealant manufacturer.
- D. The aluminum closure panels shall be attached continuously along their edges to the structural members by means of batten bars, which engage the panels in an interlocking joint. These batten bars shall also secure an elastomeric weatherseal gasket that shall form a continuous watertight seal along the panel edges. The top surface of the batten bars must be completely flush with the panel surfaces and shall in no way allow water to pond at the cover joints. Designs that incorporate raised battens, overlapping panels and/or designs that incorporate fasteners which penetrate panels and attach to structural members are expressly prohibited.
- E. Roof panels shall be fabricated from continuous 3003-H16 aluminum sheeting.
- F. Connection forces shall be transferred through gusset plates connected to the top and bottom flanges of the beam struts. The connections shall be designed as moment connections; a minimum of four bolts shall be used to connect the gusset plate to each strut flange.
- G. The structural analysis shall be performed using non-linear, second order, stiffness analysis models. The structural computer models shall include the effect of geometry irregularities such as dormer openings and perimeter support members. Full provisions shall be made to allow for thermal expansion.

- H. Fasteners shall be designed with a factor of safety of 2.34 on ultimate strength and 1.65 on yield strength.

2.03 MATERIALS

- A. Bolts and Fasteners: Threaded fasteners shall be 300 series stainless steel per ASTM F593, Alloy Group 1. Lockbolts shall be 7075-T73 aluminum, 304 or 305 stainless steel. Screws shall be aluminum or 300 series stainless steel.
- B. Plates and Sheets: Plate and sheet material shall be aluminum alloy 3003-H16, 3105-H154, 6061-T6, 5052-H32 or 5052-H36; mill finish AA - M10 as fabricated. Minimum thickness for gussets shall be 5/16". Sheet materials shall be 0.05" minimum thickness.
- C. Structural Shapes: Aluminum structural shapes shall be alloy 6061-T6, 6005A-T61. The aluminum structural members shall be a minimum of 6 inches deep. To improve torsional stability, the dome's structural members must incorporate a double web. The use of I-beams with only a single web is expressly prohibited.
- D. Tension Ring: Tension ring structural shapes shall be 6061-T6 aluminum. Design of the tension ring shall be based on the net cross section of the members and shall not include top flange protrusions used for panel attachment, bolt holes, or outstanding legs that are not connected through the joints.
- E. Miscellaneous Shapes: Miscellaneous aluminum shapes shall be alloy 6061-T6 or 6063-T5.
- F. Gaskets: All gaskets shall be ozone resistant Silicone or Neoprene only. If Neoprene gaskets are utilized they must be shielded from exposure to ultraviolet light. The gaskets must have a 1/8" minimum thickness.
- G. Sealant: All sealants shall be silicone and resistant to ozone and ultraviolet light and conform to Federal Specification TT-S-00230C.
- H. Miscellaneous Penetration Seals: All other penetration seals shall be weatherproof rubber seals.
- I. Support Bearings: Acceptable bearing surfaces for sliding bearing are Teflon to stainless steel only. In order to avoid damage to the Teflon and to reduce the coefficient of bearing friction, Teflon shall not bear on aluminum surfaces. Dome supports shall utilize only bolted connections. The use of aluminum structural welding at the dome supports is expressly prohibited.

2.04 DESIGN LOADS

- A. The entire dome structure shall be designed to sustain the loads specified herein, with the stress limitations of the Aluminum Association SPECIFICATIONS FOR ALUMINUM STRUCTURES. For members subjected to axial forces and bending moments due to load eccentricity or lateral loads, the combined member stresses shall be determined by adding the stress component due to axial load to the stress components due to bending in both the major and minor axis. In no case shall the dome be designed for any loads less than those specified by the local building code and/or local amendments.

- B. The load cases to be considered shall be those described below unless more severe loads are specified by the purchaser.
1. Dead Load: The dead load shall be defined as the weight of the structure and all permanently attached to and supported by the structure.
 2. Live Load: As required per ASCE 7-10 Section 4.8.2.
 3. Snow Load: As required per ASCE 7-10 Chapter 7 but not less than required by local building codes and/or local amendments.
 - a. Importance Factor (I_s) = 1.1 or greater per ASCE 7-10 Table 1.5-2 for Risk Category III.
 - b. Exposure Factor (C_e) = 1.0 or greater per ASCE 7-10 Table 7-2.
 - c. Thermal Factor (C_t) = 1.2 or greater per ASCE 7-10 Table 7-3.
 - d. Slope factor (C_s) = ASCE 7-10 Figure 7-2 or greater.
 4. Unbalanced Snow Load: As required per ASCE 7-05 Section 7.6.4 and Figure 7-3 but not less than required by local building codes and/or amendments.
 - a. Importance Factor (I_s) = 1.1 or greater per ASCE 7-10 Table 1.5-2 for Risk Category III.
 - b. Exposure Factor (C_e) = 1.0 or greater per ASCE 7-10 Table 7-2.
 - c. Thermal Factor (C_t) = 1.2 or greater per ASCE 7-10 Table 7-3.
 - d. Slope factor (C_s) = ASCE 7-10 Figure 7-2 or greater.
 5. Wind Load: As required per ASCE 7-10 Chapter 26 but not less than required by local building codes and/or amendments.
 - a. Importance Factor (I_w) = 1.0 or greater per ASCE 7-10 Table 1.5-2.
 - b. Basic Wind Speeds for Occupancy Category III and IV per ASCE 7-10 Figure 26.5-1B. Or greater wind speed if specified or as required for local conditions.
 - c. Exposure Factor = C minimum or D where required.
 - d. Internal wind pressure coefficient per ASCE 7-10 Table 26.11-1.
 6. Load Combinations: As required per ASCE 7-10 Section 2.4.1 for allowable stress design and Section 2.3.2 factored loads strength design.
 7. Temperature: The load combinations listed above shall be considered for a temperature change of 100 degrees F below the installation temperature and 100 degrees F above the installation temperature and for a material temperature range of 40 degrees F below 0 to 160 degrees F above zero.
 8. Panel Design Load: In addition to the above mentioned loads and load combinations, the aluminum panels shall be designed for a 250 pound load distributed over one square foot at any location and a plus or minus 60 psf load distributed over the entire area of any given panel. These loads are to be taken as acting separately from one another and not simultaneously with other design loads.

2.05 DESIGN

- A. Analysis of the cover shall be performed in accordance with ADM 2010 Chapter C. Stability shall be provided for the structure as a whole and for each of its components. The available strengths of members and connections determined in accordance with

Section C.3 shall equal or exceed the required strengths determined in accordance with Section C.2

The required strengths of members and connections of the structure shall be determined from an elastic analysis that considers the effects of each of the following:

1. Non-linear second order analysis. Structural members shall be sub-divided a minimum four times to account for the second order effects;
2. Flexural, shear, and axial deformations, including all member and connection deformations that contribute to displacements of the structure;
3. Second-order effects including P- Δ effects (the effect of loads acting on the displaced location of joints or nodes in a structure) and P- δ effects (the effect of loads acting on the deflected shape of a member between joints or nodes);
4. Geometric imperfections. The effect of geometric imperfections on the stability of the structure shall be accounted for by analyzing the structure with the members' points of intersection displaced from their nominal locations by the tolerances specified in the contract documents. The displacements shall be placed to cause the greatest destabilizing effect.
5. Member stiffness reduction due to inelasticity. The effect of member stiffness reduction due to inelasticity on the stability of the structure shall be accounted for by using a reduced stiffness as follows:

A factor τ_b shall be applied to the flexural stiffnesses of all members whose flexural stiffnesses contribute to the stability of the structure, where

$$\tau_b = 1.0 \text{ for } \epsilon^*P_r/P_y \leq 0.5$$

$$\tau_b = 4(P_r/P_y) (1 - \epsilon^*P_r/P_y) \text{ for a } \epsilon^*P_r/P_y > 0.5 P$$

6. Uncertainty in stiffness and strength shall be addressed by applying a factor of 0.8 to all axial, shear and flexural stiffnesses in the structure.
7. The effective length factor k of all members shall be taken as 1.

The analysis shall include all gravity loads and a separate analysis shall be performed for each load case or load combination.

- B. Snap-Through Buckling (General Shell Buckling) shall be determined in accordance with the following formula:

$$w = \frac{2258 \times 10^6 \sqrt{I_x A}}{(SF)R^2 L}$$

Where:

w = Allowable load [pressure psf].

I_x = Moment of inertia of strut about the strong axis [in⁴].

A = Cross sectional area of strut [in²].

R = Spherical radius of dome [in].

L = Average member length [in].

SF = Safety factor (1.65).

The allowable buckling pressure shall be compared to the maximum intensities of symmetrical and nonsymmetrical load conditions.

In lieu of the above formula, non-linear analysis modeling may also be performed to verify that the stiffness is adequate to prevent snap-through buckling for all load cases include live, snow and wind loads. To account for modeling variations and/or user assumptions in the analysis, a minimum safety factor of 1.95 shall be used.

- C. Cross sectional area of structural members shall be reduced as required by ADM 2010 Section D.3.2 to account for effective net area due to the connection of the structural member. In lieu of this requirement, testing can be performed in accordance with ADM 2010 to justify a greater effective net area.
- D. Torsional and Flexural-Torsional Buckling of Compression Members: Structural members with an axial compression load must be designed to meet Section E.3.2 of ADM 2010, in addition to Section E.3.1 of ADM 2010, unless by finite element analysis it can be proven that flexural buckling is the controlling buckling mode for an individual member. It is prohibited to assume that the panels will brace the structural members so that major axis flexural buckling is the controlling failure mode. Lateral buckling of the member bottom flange shall be investigated even if the top flange is braced. Pinned end connections, in both the major and minor axis, must be used in the finite element analysis model. In lieu of this requirement, designing axial compression members for only flexural buckling is allowed if k is no less than 1.0 and the smallest radius of gyration of the structural section is used to determine the controlling slenderness ratio.
- E. Lateral-Torsional Buckling: Design of members for flexure must meeting Chapter F of ADM 2010.
- F. Connections shall be designed as required by ADM 2010 Chapter J. Block shear strength of the connection must meet the requirements of Section J.6.3.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the drawings and the manufacturer's instructions.
- B. Field re-fabrication of structural components or panels will not be accepted. Forcing of the structure to achieve fit-up during construction is expressly forbidden and not acceptable.
- C. All gasket materials shall be continuous; splices will not be allowed. All sealants shall be placed only in a manner as recommended by the sealant manufacturer.

3.02 WARRENTY

- A. The dome manufacturer shall warrant that the work described herein shall be free from defects, workmanship and material. The dome manufacturer shall replace or repair only faulty workmanship or defective material furnished by it that is reported to it within one (1) year from the date of completion of this scope of work.

END OF SECTION

SECTION 11555

SHAFTLESS SCREW CONVEYORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification covers furnishing, installing, and testing shaftless type screw conveyors for the conveyance of dewatered wastewater sludge as indicated and specified.
 - 1. Conveyors furnished in this specification shall be fabricated and assembled in full conformity with this specification and as shown in the contract drawings. Each conveyor shall be furnished complete with all supports; all mechanical equipment required for proper operation, including complete drive units; all steel, iron, and other metal construction specified herein; and all additional materials or fabrication as required by the supplier's design.

1.02 RELATED SECTIONS

- A. SECTION 01300 – SUBMITTALS
- B. SECTION 01665 – SERVICES OF MANUFACTURER’S REPRESENTATIVE
- C. SECTION 01680 – EQUIPMENT AND SYSTEM CHECKOUT, CERTIFICATION, AND TESTING
- D. SECTION 01730 – OPERATION AND MAINTENANCE MANUALS

1.03 REFERENCES

- A. ASTM A167 – Standard specification for stainless and heat-resisting chromium-nickel steel plate, sheet, and strip

1.04 SUBMITTALS

- A. Shop Drawings in accordance with specification Section 01300.
- B. Certification that all iron or steel brackets, hardware, fittings or other components are produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014**
- C. Operation and Maintenance Manual in accordance with specification Section 01730.

1.05 QUALITY ASSURANCE

- A. Provide in accordance with Section 01400 and as specified.
- B. Welding shall be in accordance with latest applicable American Welding Society Code.

- C. Services of Manufacturer's Representative as stated in Section 01665 and as specified herein.

1.06 MARKING, DELIVERY, STORAGE, AND HANDLING

- A. Provide in accordance with Section 01600 and as specified.
- B. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
- C. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
- D. Deliver spare parts at same time as pertaining equipment. Deliver to Owner after completion of work.
- E. Inspect and inventory items upon delivery to site.
- F. Store and safeguard equipment, material, and spare parts in accordance with manufacturer's recommendations. Store materials to permit easy access for inspection and identification. Keep all items off ground, using pallets, platforms or other supports. Do not store items in a manner that might cause distortion or damage to that item.
- G. Assume responsibility for equipment, material and spare parts just before unloading from carrier at site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. JDV Equipment, Dover, NJ
- B. KWS Manufacturing Company, Ltd., Burleson, TX
- C. Approved equal.

2.02 QUALIFICATIONS

- A. Conveyor to be the product of one manufacturer. The Contractor shall provide the Engineer with a written statement indicating that the conveyor manufacturer has at least 5 years experience in the construction and manufacture of shaftless conveyor systems incorporating the design features as herein specified.
- B. The Supplier shall acknowledge that he is familiar with all the requirement of the contract documents relevant to the equipment supplied herein and agrees to perform and observe all obligations under the contract documents which relates to the portion of the work covered by this section and related sections.
- C. The Supplier of the equipment included in this section undertakes and agrees to defend, at Supplier's own expense, all suits, action or proceeding brought against the municipality or it's Contractor(s) for actual or alleged infringement on any United States patent or foreign letters patent because or on account of the employment of sales of such material or products, and further agrees to pay and discharge any and

all judgments or decrees which may be rendered in any such suit, action or proceeding against the defendants herein.

2.03 DESIGN

A. Design Parameters:

Number of conveyors:	2
Cubic ft per hour:	200
Material:	Sludge
Material Density:	65
Length:	See drawings
Angle:	(1) Horizontal & (1) Inclined 5°
Max. Screw Speed:	20 RPM
Max. Trough Fill:	50%
Min. Flight OD:	11.2"
Min. Spiral Weight per ft:	27"
Min. Trough Width:	12.5"
Min. Motor HP:	3
Drive Location:	Inlet
Motor Type:	TEFC
Reversing Screw:	None

B. Spiral Flighting:

1. Spiral flighting for the shaftless screw conveyors shall be designed to convey material without a center shaft. The minimum overall spiral weight and surface pressure shall be as specified herein. The conveyor will include an inner flight to increase axial strength and capacity of the conveyor. The minimum spiral weight shall be specified herein.
2. Spiral flights shall be cold-formed high strength micro alloy steel with a minimum hardness of 220 Brinell. The spiral flights shall be designed with the stability to prevent distortion and jumping in the trough. The torsional rating of the auger flighting shall be reached at 30% of the Fy value in the extreme fiber of the flight material. Supplier shall demonstrate that, at 250% of the motor nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting, and that the "spring effect" of the spiral shall not exceed + 0.8 mm per meter of length at maximum load conditions.
3. Spiral flight material, fabrication technique, strength, hardness, and overall quality are critical to the proper operation of the conveying system as herein designed. Spiral flights that do not meet the characteristics or herein specified are specifically not acceptable. Supplier shall provide certified written documentation that the spiral flights conform to the following:

Material:	Micro Alloy Steel
Hardness:	220 Brinell Minimum
Concentricity:	2.0 mm +/-

4. Supplier shall maintain a certified factory quality control program which shall include certification of spiral flighting as described herein
5. The spiral flighting shall be formed in sections from one continuous flat bar and shall be concentric to within 2mm +/- . Sectional flighting formed from plate shall not be permitted.
6. Spiral flighting shall have full penetration welds at all splice connections. The flights shall be aligned to assure true alignment when assembled in the field and shall be made in accordance with the supplier's requirements. The spiral flights shall be coupled to the end shaft by a flanged, bolted connection.
7. The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate.

D. Horizontal and Inclined Troughs:

1. Troughs shall be similar to the dimensional standards of CEMA 300 and enclosure classification IIE. Each conveyor trough shall be U-shaped, fabricated from a minimum 1/8 inch stainless steel plate.
2. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape and act as a face seal for the covers; apply a continuous gasket, one half inch width, to the entire top face of the trough top flange and stiffeners.
3. Each trough shall be equipped with filling and/or discharge openings as required by the contract drawings. If required, each filling and discharge opening shall be flanged suitable for interconnection to other devices. Any interconnecting devices such as chutes and hoppers shall be fabricated from the same material as the troughs.
4. A flanged covered drain outlet shall be provided with each conveyor to facilitate cleaning.
5. The portion of each trough that is not covered by the filling chute shall be covered by a bolted cover of a material identical to the trough. The covers shall be manufactured in maximum four foot length section to allow for access to the conveyors. To prevent unsafe access to the conveyors, quick opening covers will not be allowed.

E. Wear Liner:

1. The wear liner for each conveyor shall be fabricated of ultra high molecular weight polyethylene sintered with an anti-wear filler to reduce wear and synthetic lubricant to reduce friction. The liner shall be provided with a visual (two different color) indicator of excessive wear. The wear liner shall be furnished in maximum four foot sections, 3/8" minimum thickness, to provide ease of replacement. The liner shall be held in place with clips; no fasteners will be allowed.

F. Inlet and Discharge Chutes:

1. Inlet and discharge chutes shall be provided by the conveyor supplier as shown on the drawings. All chutes shall be fabricated from the same material as the conveyor trough.

G. Conveyor Supports:

1. Each conveyor shall be furnished complete with supports suitable for mounting as shown on the contract drawings and as required by the supplier's design. The supports shall be shop fabricated from structural steel shapes and plates, and shall be assembled and fitted to the conveyor prior to its delivery to the jobsite. Supports and conveyor segments shall be match marked and shipped to the jobsite for assembly by the contractor. At a minimum, each conveyor shall be provided with supports at the inlet and discharge end, with intermediate supports as required. Supports shall be fabricated of AISI 304 stainless steel or equal.
2. All shop welding shall conform to the latest standards of the American Welding Society (AWS). The supports shall be designed to avoid interference with other equipment or equipment supports.

H. Structural Design:

1. All structural supporting members shall be designed such that the ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for any compression member and shall not exceed 240 for any tension member (of angles about Z-Z axis). In addition, all structural members and connections shall be designed so that the unit stresses will not exceed the American Institute of Steel Construction allowable stresses by more than 1/3 when subject to loading of twice the maximum design operating torque of the spiral conveyor drive motors.

I. Drive Units:

1. Each spiral conveyor shall be driven by a constant-speed integral gear reducer/motor drive unit mounted to an adapter flange mounted to the end plate of the conveyor. The adapter flange shall allow the leakage of any material from the conveyor trough to atmosphere rather than into the gear reducer/ motor drive unit. Direct coupling of the gear reducer/motor drive unit to the end flange of the conveyor will not be acceptable.
2. The drive unit shall be rigidly supported so there is no visible "wobble" movement under any operating condition. In the event of a prolonged power failure or emergency system shutdown the drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled throughout its entire cross sectional area and length with partially dried and hardened dewatered material.
3. Each motor shall be 460 volt, 60 Hz, 3 phase conforming to the General Equipment specifications, except as modified herein. Each motor shall be high efficiency, 40C ambient rated, 1.15 service factor and shall have Class F insulation. Motor shall have a TEFC enclosure with Design B speed/torque characteristics.

J. Gear Reducers:

1. All gears shall be AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. Bearings shall be designed for the thrust loads from the fully loaded startup condition and shall have a AFBMA B10 life of 30,000 hours. The reducer will be the standard air cooled unit with no auxiliary cooling. The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.

K. An adjustable greased gland packing ring consisting of two Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate.

L. Motion Failure Alarm Unit:

1. Each conveyor drive unit shall be equipped with a motion failure alarm unit. The location and mounting details shall be as recommended by the conveyor manufacturer. Motion sensors shall be the non-contacting type using a probe with a pre-amplifier and main electronic assembly. The main electronic unit shall operate on 120 volts, single phase, 60 Hz power supply, and shall be housed in a NEMA 4X enclosure. A 0 to 60 second time delay shall be provided for startup of the conveyor.

M. Emergency Shutdown:

1. Each conveyor shall be furnished with an emergency trip cord and safety switch. The cord shall run the full length of each conveyor. The trip switch shall immediately stop all conveyors when the switch is actuated.

2.04 MATERIALS

A. Unless otherwise specified or permitted, the materials used in fabrication of the equipment under this section shall conform to the following:

Chutes:	AISI 304, ASTM A167, 18-8
Troughs, End Plates, Covers:	AISI 304, ASTM A167, 18-8
Supports:	AISI 304, ASTM A167, 18-8
Hoppers:	AISI 304, ASTM A167, 18-8
Spiral Flighting:	Cold formed, high strength micro alloy carbon steel with a minimum Brinell Hardness of 220
Wear Liner:	Ultrahigh molecular polyethylene (4.02.04A)
Bolts, Nuts, & Washers for Supports:	AISI 316, ASTM A167, 18-8
Conveyor Trough Lids, & Drive:	AISI 304, ASTM A167, 18-8

2.05 PAINTING/FINISHING

A. After surface preparation, metal surfaces except for the spiral flighting shall receive a minimum of one coat of primer or equal for the spiral, and for other surfaces one primer and one coat epoxy paint prior to shipment to jobsite. The spiral shall receive one coat of primer. Stainless steel components shall be furnished unpainted.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the drawings and the manufacturer's drawings, installation manual and recommendations. Care shall be taken to avoid warping the chute and to maintain tolerances between the screw and the wear surfaces. The equipment plumbed, shimmed, bolted and aligned accurately. Conveyor equipment shall be installed in strict accordance with manufacturer's published instructions.
- B. Store equipment and appurtenances in accordance with manufacturer's written recommendations.
- C. Clean debris and dirt from mounting surfaces before placing the conveyor.
- D. Erect and support conveyor in position free from distortion and strain on appurtenances during handling and installation.
- E. Inspect material for defects in workmanship and material.
- F. Clean out debris and foreign material from chute, test operating mechanisms to check proper functioning, and check nuts and bolts for tightness. Repair equipment that does not operate easily or are otherwise defective.

3.02 TESTING

- A. The shaftless screw conveyor shall be factory assembled and factory run tested.
- B. The screw conveyor shall also be field tested after erection in the presence of the Owner and Engineer to confirm and verify the structural and mechanical compliance to the specification. The field acceptance test shall include demonstrating that the screw conveyor operates without vibration, jamming or overheating and perform its specified function satisfactorily.

3.03 STARTUP

- A. Provide startup services in accordance with Specification Section 01665.

3.04 SPARE PARTS

- A. Provide one (1) year's worth of wear items, including belts & lubricants.

END OF SECTION

SECTION 11601

FIBERGLASS REINFORCED PLASTIC WEIRS AND SCUM BAFFLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification covers fiberglass reinforced plastic (FRP) weirs and scum baffles to be installed in grit chambers, primary clarifiers, and final clarifiers.

1.02 RELATED SECTIONS

- A. SECTION 01300 – SUBMITTALS

1.03 REFERENCES

- A. ASTM D638 – Standard Test Method for Tensile Properties of Plastics
- B. ASTM D790 – Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- C. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics
- D. ASTM D756 – Practice for Determination of Weight and Shape Changes of Plastics under Accelerated Service Conditions

1.04 SUBMITTALS

- A. Shop Drawings in accordance with specification Section 01300.
 - 1. Include manufacturer's catalog information, descriptive literature, specifications and identification of materials of construction, including resins and glass fiber content and layout for FRP constructions
 - 2. Detailed drawings showing method of attachment including number, locations and size of fasteners, wall anchorage, supports, and weights of fabrications
- B. Certification that all iron or steel brackets, hardware, fittings or other components are produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014**

1.05 MARKING, DELIVERY, STORAGE, AND HANDLING

- A. Ship and store FRP products to protect them from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. NEFCO, Palm Beach Gardens, FL
- B. Enduro Composites, Houston, TX
- C. Fiberglass Fabricators, Inc., Smithfield, RI
- D. Approved Equal

2.02 DESIGN

- A. The Contractor shall furnish and install fiberglass weirs and scum baffles complete as shown on the Contract Drawings and described in the Specifications. All Fiberglass Reinforced Plastic (FRP) utilized on the project shall be a commercial grade

2.03 MATERIALS

- A. Except for bolts and hardware specified herein, the weirs, scum baffles and supports shall be polyester plastic resin, reinforced with glass fiber. All weir plates, weir washers, weir splice plates, scum baffle panels, scum baffle splice plates and baffle support brackets shall be fiberglass reinforced plastic molded to produce uniform smooth surfaces. The surface shall be resin rich, free of voids and porosity, without dry spots, crazes or unreinforced areas and shall provide for increased corrosion resistance and UV protection.
- B. The weir plates, splice plates and weir washers shall be 1/4" thick plastic laminate. Oversized mounting holes in the weir plates shall be provided for vertical and horizontal alignment of at least 2" with 5" diameter FRP weir washers to cover the holes. The weirs shall be mounted with 1/2" x 4-1/4" stainless steel expansion anchors 2' on center. Cut ends of non-standard lengths shall be sealed with resin.
- C. Scum baffle panels and splice plates shall be 1/4" thick plastic laminate. The scum baffle panels shall be 12" high and shall not exceed 12' in length unless otherwise noted. Splice plates shall be 6" x 12". The scum baffle brackets shall be 6" x 6" x 3/8" Angle with slotted holes to provide horizontal, vertical and radial adjustment of the baffle. The brackets shall be installed on 4' centers. Fastening holes in the scum baffle panel shall be countersunk to accommodate flat head fasteners. Cut ends of non-standard lengths shall be sealed with resin.
- D. Expansion anchors, nuts, bolts, washers and other hardware shall be Type 304 stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with the drawings and the manufacturer's instructions.
- B. Contractor shall field verify existing dimensions. Field cutting and drilling shall be permitted, provided the contractor seal all cuts and penetrations per the manufacturer's instructions.
- C. Weirs and baffles shall be aligned and leveled to the elevations shown on the Contract Drawings. No variation in elevation greater than 1/8" per 10' of any weir shall be permitted.

END OF SECTION

SECTION 11961

INTERIOR AND EXTERIOR PROCESS PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. The work covered under this Section of the Specifications includes the furnishing of all labor, equipment, and materials, and in performing all operations in connection with the furnishing, installation and testing of interior and exterior process piping systems, including piping, pipe fittings and specials, wall fittings, valves, jointing materials, and accessories, of the various materials, sizes, classes, joints and types, and appurtenant work, at the locations and to the general arrangements and details as indicated and/or as directed, complete in place, in accordance with the Drawings and Specifications.
- B. Multiple types of pipe and fittings specified in this section shall be produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014. These items include (but are not limited to) the following:**
 - 1. Ductile Iron Pipe and Fittings**
 - 2. Stainless Steel Pipe and Fittings**
 - 3. Carbon Steel Pipe and Fittings**
 - 4. Iron and Steel Valves**

1.02 RELATED SECTIONS

- A. Section 02618 – Ductile Iron Pipe for Buried Service
- B. Section 02620 – HDPE Pipe for Buried Service
- C. Section 02622 – PVC Pipe for Buried Service
- D. Section 09900 – Painting

1.03 REFERENCES

- A. ASTM A716 – Standard Specification for Ductile Iron Culvert Pipe
- B. ASTM A746 – Standard Specification for Ductile Iron Gravity Sewer Pipe
- C. ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipe

1.04 SUBMITTALS

- A. Submit the following in accordance with Division 1 Specification Sections.
- B. Shop Drawings: Include materials lists, catalog cuts, and complete specifications for all piping materials including gaskets and connections. Shop drawings for all pumps, valves, valve operators, strainers, hangers and supports, wall pipes, wall sleeves, flexible connections, hydrants, nozzles, cleanouts, and other like manufactured items. Detailed piping layout drawings of all interior and exterior piping. Drawings of exterior piping shall also show the relationship between the work included in this section and that included in others where in close proximity.
- C. Operation and Maintenance Manuals: Submit materials for inclusion in Operation and Maintenance Manuals specified in Division 1.

1.05 MARKING, DELIVERY, STORAGE AND HANDLING

- A. All pipe shall be properly marked by the manufacturer in accordance with ASTM D2241. Markings shall be spaced at intervals of not more than five feet and shall include the following:
 - Nominal pipe size
 - Type of material with designation code
 - Pipe diameter to wall thickness ratio or class, as applicable
 - ASTM designation with which pipe complies
 - Manufacturer's name or trademark and code

PART 2 - PRODUCTS

2.01 PIPE SCHEDULE

- A. Pipes, fittings and specials, appurtenances and jointing shall be in accordance with the following schedule. This schedule is set forth as a guide as to types of materials and jointing required. The lack of mention of any specific pipe shall not relieve the Contractor from the responsibility of furnishing and installing all piping as required or directed for a complete job. The schedule indicates the types of pipe required for the principal piping systems included under this Section of the Specifications and is presented herein for convenience of references for the Contractor.

2.02 MATERIALS

- A. Ductile Iron Pipe and Fittings
 1. **Ductile Iron pipe and fittings shall be produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014**
 2. Ductile Iron Pipe and Fittings shall be manufactured by:
 - a. U.S. Pipe, Birmingham, AL

- b. American Ductile Iron Pipe, Birmingham, AL
 - c. McWane Ductile, Phillipsburg, NJ
 - d. Approved equal
3. All ductile iron pipe shall be minimum of special thickness Class 52 unless otherwise noted. All ductile iron fittings shall be minimum of Pressure Class 250 unless otherwise noted. Ductile iron pipe and ductile iron pipe fittings and specials shall have cast upon them the class, thickness designation and initials of the manufacturer.
 4. Ductile iron pipe with screwed-on flanges shall be centrifugally cast pipe conforming to ANSI Specification A-21.51 of latest editions. Flanges for flanged pipe shall conform to ANSI Specifications B16.1, latest edition, for American 125 Standard and shall have long hubs. After flanges have been screwed onto the pipe the face of the flange and end of the pipe shall be refaced together in the shop and the flange shall be sealed with epoxy compound to prevent corrosion of threads from the outside. Flanges shall be faced and drilled to American 125 Standard and to match the facing and drilling of the equipment, valves and to such other items to which they are attached. Ends of pipe connecting to flexible mechanical couplings shall be suitable for and properly prepared for making the joint with the flexible mechanical coupling. Pipe shall be lined as specified herein.
 5. Ductile iron pipe with mechanical grooved couplings shall be centrifugally cast pipe conforming to ANSI Specification A-21.51 of latest revision. The pipe shall be radius grooved conforming to Victaulic Company of American's specifications for rigid joints. Flexible joints may be used to design considerations, as shown on drawings or detailed elsewhere in these specifications. Installation shall be in accordance with Victaulic Company of American's recommendations. Grooving dimensions are the same for any one pipe OD regardless of pipe class and pressure. The outside surface of pipe between the groove and pipe end must be smooth and free from deep pits or swells to provide a leaktight seat for the Victaulic gasket. All rust, loose scale, oil, grease and dirt shall be removed. Penned surfaces may require corrective action in order to provide a leaktight gasket seal.
 6. Ductile iron flanged joint fittings shall be of the types indicated or as required and approved, and shall conform to the requirements of ANSI Specifications A21.10, latest edition, Pressure Class 250. Flanges shall be cast integral with the pipe fittings and specials and shall be faced and drilled in accordance with ANSI Specification B 16.1, latest edition, for American 125 Standard, and facing and drilling of all flanges shall match that of the equipment, valves, and such other items to which they are attached. Blank flanges shall be provided as required. Flanged fittings not available under ANSI Specification 21.10 shall be provided as required and shall conform to the application ANSI Specifications B 16.1 or B 16.2. Pipe fittings and specials shall be lined as specified herein. Pipe fittings, specials and adapters shall be of the sizes, dimensions and types as indicated, as specified, as required for the proper fitting of the completed work, and as approved by the Owner.
 7. Fittings for mechanical joint pipe shall conform to requirements of ANSI specification A-21.10 with the exception of the end preparation. The end preparation shall be radius grooved conforming to Victaulic Company of America's

recommendations for rigid joints. Coupling housings shall be malleable iron conforming to the requirements of ASTM specification A-47 or of ductile iron conforming to the requirements of ASTM Specification A-536. Sizes 3-inches through 12-inches shall be of two segments; sizes 14-inches and larger shall be four or more segments. Couplings shall be Style 31 as manufactured by Victaulic or approved equal. Lightly coat pipe ends and all gasket surfaces with Victaulic lubricant or other non-petroleum base lubricant. Bolts and nuts shall be carbon steel heat-treated and plated, conforming to ASTM Specification A-183, minimum tensile 110,000 psi. Bolts shall be of oval neck, track head design. Gaskets shall be of the mechanical grooved coupling design with short center leg to bridge pipe ends, and shall have properties as designated by ASTM Specification D-2000. Such gaskets shall be suitable for the required service. Victaulic-Style 341/342 transition flanges shall be used for direct connection of 125 pounds cast iron flanged valves, pumps or other equipment, directly to grooved pipe or fittings. Victaulic Style 341/342 transition flanges shall be malleable iron conform to the requirements of ASTM Specification A-47 or ductile iron conforming to the requirements of ASTM Specification A-536. Gaskets shall have properties as designated by ASTM Specification D-2000 and shall be suitable for the required service.

8. All fittings associated with exterior ductile iron pipe shall be ductile iron with restrained joints conforming with ANSI A-21.10. Push on joints for such fittings shall be in accordance with ANSI A-21.11. All fittings shall be coated and lined as specified for its associated pipe and use. Restrained joint ductile iron pipe fittings shall be TR Flex® by US Pipe or equal.
9. Cement-mortar linings: Ductile iron pipe and ductile iron pipe fittings and specials, where indicated, shall be cement-mortar-lined in accordance with ANSI A-21.4. Thickness of the mortar lining shall be 1/8-inch for pipe 12-inches and smaller and 3/16-inch for pipe 14-inches and larger.
10. Glass lining: Glass lining where indicated shall be a specially formulated internal coating on ductile iron pipe or ductile iron pipe fittings and specials. All metal preparation, application and processing will follow the manufacturer's recommended procedures.
 - a. The coating shall consist of special glasses and inorganic materials applied in a minimum of two (2) coats, separately fired, to internal surfaces prepared by blasting. Following application of the ground (base) coat, the items shall be exposed to an appropriate maturing temperature (above 1400°F) to fuse the glass to the base metal forming an integral molecular bond with the metal. The resulting bond shall be sufficient to withstand a metal yield point of 0.001-inch/inch without damage to the glass.
 - b. Subsequent coatings (finish coats) shall be processed in a similar manner, forming an integral molecular bond with the base coat.
 - c. The entire coating shall be from .008-inch to .012-inch thick. It shall have a hardness of from 5 to 6 on the Mohs Scale, and a density of from 2.5 to 3.0 grams

per cubic centimeter. The green glass lining shall be capable of withstanding a thermal shock of 350°F to corrosion by solutions between pH-3 and pH-10 at 125°F. There shall be no visible loss of surface glass on the glass lining after immersion of a normal production run sample in an 8 percent sulfuric acid solution at 148 degrees F for a period of ten (10) minutes. In addition, when tested according to ASTM Designation C283-54, it shall show a weight loss of not more than 3 milligrams per square inch.

- d. The glass lining shall be in accordance with the manufacturer's standard tolerances for coverage, continuity and gloss. Pin holes, crazing or fishscales, which substantially expose the metal substrate, shall be cause for rejection of the pieces.
 - e. Sizes, details, handling, stacking, etc. shall be in accordance with the manufacturer's recommendations.
 - f. No cutting or tapping of glass-lined pipe in the field shall be permitted.
11. Asphaltic exterior coating: All ductile iron pipe and fittings for buried service shall be given an asphaltic exterior coating. Coating shall be in accordance with ANSI A-21.51 for pipe and ANSI A-21.10/A-21.53 for fittings.
 12. Painting: Pipe exterior preparation and coating for interior and above grade pipe shall be in accordance with Specification Section 09900 – Painting.
 13. Pipe fittings with integrally cast bases shall be provided where indicated and as directed.
 14. All flanged joints for ductile iron pipe shall be made with bolts or bolt studs with a nut on each end and 1/8-inch thick neoprene gaskets extending at least to the inside of the bolts. Bolts and nuts shall be heavy unfinished hexagon head bolts and nuts of Grade B low-carbon steel. Bolt studs and nuts shall be of the same quality as machine bolts. Gaskets shall be Flange-Tyte® by US Pipe or equal.

B. Polyvinylchloride (PVC) Pipe and Fittings

1. PVC Pipe shall be manufactured by:
 - a. J.M. Eagle, Los Angeles California
 - b. United States Plastic Corp., Lima, OH
 - c. Charlotte Pipe and Foundry, Charlotte, NC
 - d. Approved equal
2. Three types of PVC pipe are specified on this project – Schedule 80 pipe for pressure service, SDR 21 pipe for pressure service, and SDR 35 pipe for gravity service.
3. Schedule 80 Pressure Pipe: Unplasticized polyvinylchloride pipe and fittings shall be Type 1, high chemical resistance, normal impact, Schedule 80 pipe made of virgin polyvinylchloride and conforming to ASTM D 1785. Pipe fittings shall be of the same material and shall be of the proper classification and wall thickness for use with Schedule 80 pipe. Joints in piping shall be solvent weld connections. A sufficient number of unions shall be provided to allow for convenient removal of piping. Connections to pipe of other materials, connections to equipment, and connections at such other locations, as indicated or directed, shall be made with flanges. All flanges

shall be 150-pound PVC pipe flanges and flanged connections shall be made using 1/16-inch thick neoprene rubber gaskets and type 316 stainless steel bolts and nuts. Flanges shall be faced and drilled to American 125 Standard and as required to match the facing and drilling of the flanges to which they are to be connected.

4. SDR 21 Pressure Pipe: Pipe shall conform to the requirements of ASTM D2241 for Class 200, SDR 21 pipe. Pipe shall be manufactured from clean, virgin, approved Class 12454-B compounds, conforming to ASTM D1784, with an established hydrostatic design minimum of 2,000 psi for water at 73 degrees. F. Pipe shall be furnished in maximum 20-foot laying lengths with integral bell joints formed so as to contain a rubber sealing gasket. Joints shall be Push-on bell and spigot conforming to the requirement of ASTM D3139. Fittings shall be push on joint, conforming to ASTM D3139. Fittings shall be of a pressure classification at least equal to that of the piping with which they are to be used.
 - a. SDR 21 PVC Pressure pipe shall conform to Specification Section 02627.
5. SDR 35 Gravity Pipe: PVC pipe, couplings and fittings for gravity and sleeve service shall conform to ASTM D-3034 Type PSM with a SDR of 35.
 - a. SDR 35 PVC pipe shall conform to Specification Section 02622.
 - b. 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.
 - c. Y-branches or tees utilized shall be of the same class and type as the pipe in which they are connected to.
- C. Copper Piping: Piping shall be of the thickness specified herein or as shown on the drawings, and shall be of the longest lengths commercially available.
 1. Copper Pipe shall be manufactured by:
 - a. Mueller Streamline Co., Collierville, TN
 - b. Cambridge-Lee Industries, LLC, Reading PA
 - c. Approved Equal
 2. Copper tubing for city water and plant water shall be ASTM B-88, Type K.
 3. Copper pipe shall conform to ASTM B-42.
 4. Fittings shall be cast bronze for copper pipe and cast bronze or copper stream-lined fittings for copper tubing conforming to ASTM B-30 UNS Alloy No. C83800.
 5. Unions shall be bronze with ground joints and shall be semi-finished.
 6. Joints for copper fittings shall be made with solder composed of 95 percent tin and five percent antimony.
 7. For copper tubing, Type K shall be used for underground services; Type L shall be used for above ground interior services.

D. Fiberglass Reinforced Plastic (FRP)

1. FRP Pipe shall be manufactured by:
 - a. Perry Fiberglass Products, Elyria, OH
 - b. Fibrex, Victoria, TX
 - c. Approved equal
2. Pipe shall conform to ASTM D2996 and ASTM D4024. Pipe shall be suitable for industrial air service.
3. The pipe shall be manufactured by the filament winding process using an amine cured epoxy thermosetting resin to impregnate strands of continuous glass filaments, which are wound around a mandrel at a 35.25° helix (54.75° winding) angle under controlled tension. Pipe shall be heat cured and the cure shall be confirmed using a Differential Scanning Calorimeter. Pipe shall have a resin-rich corrosion barrier reinforced with surfacing veil. The corrosion barrier shall have minimum resin content of 80%. The minimum acceptable cured thickness of the corrosion barrier shall be as follows:

1" to 1-1/2" pipe	15 mil nominal
2" to 4" pipe	30 mil nominal
6" to 16" pipe	35 mil nominal

4. Pipe shall be supplied with a matching tapered coupling and a matching tapered spigot. Pipe shall have a minimum continuous cyclic pressure rating of 150 psig at 225 degrees F in accordance with ASTM D2992 Procedure A.
5. All fittings shall be manufactured using the same type materials as the pipe. Fittings may be manufactured either by compression molding or spray-up/contact molding methods. Fittings shall be adhesive bonded matched tapered bell and spigot, or flanged. Flanges shall have ANSI B16.5 Class 150 bolt hole patterns. Bonding adhesive shall be manufacturer's standard for the pipe specified.
6. Gaskets shall be 1/8" thick, 60-70 durometer full-face type suitable for the service specified as recommended in the manufacturer's standard installation procedures. Bolts, nuts and washers shall be type 316 stainless steel.
7. Pipe shall be Green Thread, by Smith Fiberglass Company, or equal.

E. High Density Polyethylene (HDPE)

1. HDPE Pipe shall be manufactured by:
 - a. Chevron Phillips Chemical Co., The Woodlands, TX;
 - b. ISCO Industries, Louisville, KY, or
 - c. Approved equal.
2. HDPE pipe for biofilter air service shall be SDR 17, and for liquid service (lime slurry, etc.) shall be SDR 17, unless otherwise noted or approved.
3. Pipes shall conform to Specification Section 02620 – HDPE pipe for buried service.

F. Stainless Steel Pipe

1. **Stainless Steel pipe and fittings shall be produced in the United States in accordance with the American Iron and Steel requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014**

2. Stainless Steel Pipe Shall be manufactured by:
 - a. Felker Brothers Corp, Marshfield, WI
 - b. Douglas Brothers, Portland, ME
 - c. Approved equal
3. Stainless Steel pipe shall be Schedule 10S unless otherwise noted.
4. Material: Stainless steel pipe shall be Type 304L sheet and plate per ASTM 240. Maximum carbon content of 304L material limited to 0.03 percent.
5. Fabrication: Fabricate in accordance with ASTM A778 in NPS sizes shown with dimensional tolerances per ASTM A530. Perform welding by qualified welders conforming to standard procedures. Weld piping with wall thickness up to 11 gauge (0.125-in.) 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. 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.
6. Concavity, undercut, cracks or crevices are not acceptable.
7. Butt Welds: Full penetration to the interior surface, with inert gas shielding provided to the interior and exterior of the joint.
8. Remove excessive weld deposits, slag, spatter, and projections by grinding.
9. Continuously weld angle face rings on both sides to the pipe or fitting.
10. Grind all welds on gasket surfaces smooth.
11. 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.
12. Wire-brush outside weld area with brushes of stainless steel that are specifically designed for use only on stainless steel.
13. 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 neutralizing operation by a clean water spray wash.
14. After fabrication, scrub welds with stainless steel wire brushes to remove weld discoloration and then wash clean.
15. Welding done in shop. Field welding not permitted.
16. Fittings: Butt weld type manufactured in accordance with ASTM-A-774 of the same raw material and in the same thicknesses as the pipe.
 - a. Elbows: Provide smooth flow, die formed, long radius; with centerline to end of elbow equal to 1.5 times the nominal pipe size.
 - b. Tees and Wyes: Fabricate tees and wyes true and square with wall thickness same as pipe.
 - c. Reducers evenly tapered with tangent ends for butt weld connection. Reducers may be straight tapered cone construction.
17. Secure flanges to pipe ends and openings plugged before shipment.

18. Joints: Field joints for plain end pipe sections shall be made by sleeve type couplings. Sleeve type couplings shall be shouldered-type or 'Fixed x Expansion' (FxE) couplings (Depend-O-Lok by Victaulic or equal). Split couplings requiring cut or roll grooving of the pipe will not be allowed unless specifically called for. Connections at valves shall be flanged joints of the Van Stone back-up flange type using 150 lb. ANSI B16.1 forged steel, carbon steel or ductile iron back-up flanges with hot-dipped galvanized finish. Fabricate flanged joint face rings fabricated of rolled stainless steel angles. 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.
 19. Shouldered Couplings: Couplings for joining pipe in a piping system where positive longitudinal locking action is required. Couplings shall consist of four basic components: a one-piece housing, gasket assembly, bolts and nuts, and end rings for pipe restraint.
 20. Bellows Type Expansion Joints: Expansion joints for joining stainless steel pipe in a piping system where axial movement due to thermal expansion and contraction, angular deflection and lateral offset is required. Expansion joints shall consist of expansion bellows designed for the specified expansion/contraction and lateral offset; bellows end preparation; and end connection of the expansion joint to the stainless steel pipe.
 3. Bellows type expansion joints shall be OmniFlex Expansion Joints shall be as manufactured by Brico Industries, Inc., Atlanta, Georgia to meet the system design requirements as shown on the drawings.
 4. OmniFlex expansion joints shall be furnished for installation at the locations shown on the drawings. All OmniFlex expansion joints shall be selected and installed in accordance with manufacturers' recommendations.
- B. Expansion Bellows
1. The expansion bellows shall be produced from fully annealed stainless steel sheet stock, rolled into a tube, seam welded and formed into corrugations.
- C. Bellows End Preparation
1. The expansion bellows shall have ends prepared for the end conditions called for on the drawings.
- D. End Condition
1. Ends of expansion bellows shall be prepared for AirMaster Shouldered Couplings or flanges as required.
- E. Anchors
1. Anchors or tie rods, where called for, are used to protect the expansion joint against excessive expansion and contraction forces, and shall be installed in accordance with the manufacturers' recommendation.

- F. Materials
 - 1. Bellows shall be manufactured from stainless steel meeting ASTM A240 type 321.
 - 2. Bellows end preparation shall be stainless steel pipe ends conforming to ASTM A240 type 304 and shall be welded to the integral end of the bellows. Ends to be prepared for the specified end condition.
 - 3. AirMaster end rings shall meet the requirements of ASTM A276 type 316L stainless steel.

2.5 PIPE SUPPORTS

- A. General:
 - 1. Provide a complete system of pipe supports, guides and anchors complete with necessary inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel and other accessories.
 - 2. Pipe supports shall support stainless steel pipe in a piping system where axial movement due to thermal expansion and contraction is required.
 - 3. Fixed supports shall be utilized where necessary to resist pipe movement and sliding supports shall be installed where necessary to allow for pipeline movement.
 - 4. Supports, guides and anchors located as required by MSS-SP69.
 - 5. Fabricate supports, guides and anchors in accordance with MSS-SP58.
- B. Anchors
 - 1. Pipe supports shall be bolted to structures in accordance with the pipe support engineer's design. There shall be no field welding of stainless steel pipe joints or of the stainless steel supports to the stainless steel pipe.
- C. Materials
 - 1. Supports shall be manufactured from stainless steel meeting the requirements of ASTM A240 type 304.
 - 2. Anchor bolts shall be type 316 stainless steel epoxy doweled type by Hilti or equal.

2.6 SHOP PAINTING

- A. Carbon steel, forged steel or ductile iron flanges and pipe support components shall be shop and finish coated.

2.02 WALL SLEEVES

- A. Wall sleeves shall be provided for all pipes passing through reinforced concrete structures, floors, walls, and brick or concrete masonry unit walls, except manholes. Wall sleeves shall be cast iron or HDPE. The Contractor shall be responsible for having wall sleeves readily available and tightly secured in the formwork at time of concrete placement.
- B. Cast iron wall sleeves shall be standard type, Class 250 with integrally cast wall flange. The wall sleeves shall be of the dimensions required and as directed with ends flush with both faces of the wall and for proper fitting of the carrying pipe through wall sleeve with suitable annular space. Cast iron wall sleeves shall be of approved type, dimension and wall thicknesses.
- C. HDPE wall sleeves shall have integral water stop collars and end caps that hold the sleeve's circular configuration during concrete pours. Sleeves shall be molded with textured exteriors for concrete bonding. HDPE wall sleeves shall be Century-Line® Engineered Sleeves by Thunderline and shall be engineered to mate with Link-Seal® modular mechanical seals.
- D. The annular space created by the wall sleeve and the pipe shall be positively sealed with Link-Seal manufactured by Thunderline Corporation or an approved equal. Seals shall be the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assemblies positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these two members. All wall sleeves of which any portion is 25 feet or more below finished grade or where the wall sleeve penetrates a wall between a tank and an interior room shall have link seals on both the interior and exterior faces of the wall. All wall sleeves above this elevation shall have link seals on the interior wall only.
- E. The Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing the seals. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and Link-Seal to assure a watertight joint.
- F. The Contractor shall familiarize himself with the installation of the seals through the manufacturers instruction bulletin that illustrates the proper procedure for installing and tightening the seal to provide a watertight pipe penetration.
- G. Wall and/or floor sleeves with closure for which the above sleeves are not suited as described shall be made by means of a sleeve capable of being bolted directly to

the formwork to prevent misalignment. Seal of the annular space between the carrier pipe and the sleeve shall be by means of a confined rubber gasket and capable of withstanding 350 psi. Sleeve shall be manufactured from Ductile Iron with an integrally cast water-stop of 1/2" minimum thickness and 2-1/2" minimum height. Mechanical joint gaskets shall be EPDM. Wall sleeves shall be Omni Sleeve, Malden, MA or approved equal.

2.03 FLEXIBLE MECHANICAL PIPE COUPLINGS

- A. Flexible mechanical cast iron pipe couplings for joining of plain ends of ductile iron pipe shall be suitable for a 200 psi water working pressure and shall be of the proper size and suitable for use on the piping on which it is installed. Couplings shall be of cast iron construction and shall be provided with middle ring not less than 5-inches in length, galvanized bolts and nuts with rolled threads, "Grade 42" molded rubber gaskets, follower rings and accessories as required for the complete installation. Where indicated, the coupling shall be provided with not less than four tie rods extended from flange connections on each side of the couplings. Thickness of middle rings shall be as approved. Follower rings shall be amply proportioned to take, without deformation, the strains imposed on the coupling by the installation. The ends of the pipes shall be prepared and the couplings installed in accordance with the printed recommendations of the manufacturer of the couplings, and the Contractor shall be responsible for verifying dimensions of piping materials necessary to insure the proper fabrication, installation and fitting of the contract work.
- B. Flexible non-metallic couplings for joining flanged ductile iron pipe at equipment shall be suitable for a 200 psi water working pressure and shall be of the proper size and suitable for use on the piping on which it is installed. Couplings shall be of EPDM construction and shall be provided with type 316 stainless steel retaining rings. Where indicated, the coupling shall be provided with not less than four tie rods extended from flange connections on each side of the couplings. Couplings shall be Redflex Type J-1W, Wide Arch Expansion Joints or equal.

2.04 FILLER RINGS

- A. Filler rings of the same materials, facing and drilling as the flanges they are used with shall be provided in flanged piping where necessary and approved for the proper fitting and layout of the piping.

2.05 TAPPED CONNECTIONS

- A. Tapped connections in pipe and fittings shall be made in such manner as to provide a watertight joint and adequate strength against pullout. The maximum size of taps in pipe or fittings without bosses shall not exceed that listed in the appropriate table of the Appendix to the ANSI A 21.51 based on three full threads for ductile iron.
- B. Where the size of the connection exceeds that given above for the pipe in question, a

boss shall be provided on the pipe barrel, the tap shall be made in the flat part of the intersection of the run and branch of tee or cross, or the connection shall be made by means of a tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, all as indicated or approved.

- C. All drilling and tapping of ductile iron pipe shall be done normal to the longitudinal axis of the pipe; fittings shall be drilled and tapped similarly, as appropriate. Drilling and tapping shall be done only by skilled mechanics. Tools shall be adapted to the work and in good condition so as to produce good, clean cut threads of the correct size, pitch, and taper.
- D. Tapping is not allowed for glass-lined pipe. All taps for glass-lined pipe shall be done at a tapped flange, filler flange or unlined spool piece that can be readily removed for maintenance.

2.06 VALVES. Valves fitted with extension stems or valve boxes shall be NRS type. All other valves shall be O.S.& Y type except where space limitations require a NRS type valve. NRS valves shall be used as directed by the Engineer where limited space is a controlling criteria. All valves shall open when turned left unless specified otherwise.

A. Gate Valves (Process Lines)

- 1. Valve Construction. Gate valves shall be made in accordance with AWWA Specification C-500. Gate valves shall be iron body, bronze trim, solid wedge with tapered seat or double revolving disc, parallel seat construction. If of the parallel seat type, the discs and wedges shall be free of pockets and rib. Gate valves shall be iron body, bronze trim, solid wedge with tapered seat or double revolving disc, parallel seat construction. If of the parallel seat type, the discs and wedges shall be free of pockets and ribs. The valves shall be designed for 125 psi working pressure. Interior gate valves shall be O.S. & Y. except where N.R.S. is called for, and have a packing seal. Interior valves shall be flanged unless otherwise shown on the drawings. Flanges shall be drilled to the ANSI 125/150 pound standard. Exterior gate valves shall have O-ring seals and mechanical joints.
- 2. Manual Actuators. Interior gate valves shall be hand-wheel operated with extension stems or chain operators as required. Exterior gate valves shall be operated by a two-inch operating nut set 18-inches below finished grade when buried. Valve boxes and extension stems shall be as specified hereinafter. Means of actuation shall be by lever, gear actuator, tee wrench, extension stem, motorized actuator, and the like, as specified or as shown on the drawings.
- 3. All valves larger than twelve inches shall be equipped with gear actuators. The actuator gear box shall be of totally enclosed oil or grease bath lubricated type, suitable for operation at any angle and provided with the appropriate

filling and drain plugs. All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Actuator shall clearly indicate valve position and an adjustable stop shall be provided. Construction of actuator housing shall be semi-steel. All exposed nuts, bolts, and washers shall be zinc plated. All valve actuators shall be as recommended by the valve manufacturer. Chain operators shall be used on all valves located six feet or more above the finished floor. Chain wheels and chains shall be provided by the valve manufacturer to operate the particular valve. All exterior valves shall be equipped with the specified actuator and shall be suitable for buried service.

B. Gate Valves (Potable Water Lines)

1. Gate valves shall be manufactured in full compliance with the content and intent of the specification. Gate valves shall be cast iron body, bronze mounted, double disc, parallel seat, O-ring type stuffing box with double Buna O-rings and non-rising stem. Valves shall have a two-inch operating nut or hand-wheel as required for the particular application and as shown on the drawings. Gate valves shall conform in every respect to AWWA.
2. All exterior and interior gate valves shall be designed for a minimum of 150 psi working pressure. Exterior valves shall have mechanical joints and shall be bituminous coated. Exterior gate valves shall be operated by a two inch operating nut set 18 inches below finished grade when buried and have an extension stem or chain operator as required when in structures. Chain operators shall be as specified. Valve boxes and extension stems shall be as specified hereinafter.

C. Gate Valves (2" and smaller)

1. Gate valves shall be 125 pound bronze with solid wedge, screwed-in bonnet, inside screw, non-rising stem, and screwed ends.

D. Check Valves

1. Check valves larger than two inches shall be of swing design and with iron bodies. Valves shall have bronze faced cast iron disc plate suspended at the top from a stainless steel shaft. Valve shaft shall be supported by bronze bushings and bearings and shall be packed through externally accessible stuffing box. Disc shall seat against resilient seat installed in the valve body. Valve closure shall be assured by means of outside lever and weight.
2. The valves shall be compatible with 125 pound ANSI drilled flange. Valves shall be cleaned and shop primed on the outside with a rust inhibitive priming system. All check valves shall be horizontally mounted.
3. Check Valves. (Two inches and smaller). Check valves shall be 300 pounds bronze curving design with screwed-in bonnet, regrinding bronze disc, and screwed ends. Disc shall be suspended at the top with a stainless steel shaft.

All check valves shall be horizontally mounted.

E. Elastomeric “Duckbill” Check Valves

1. Valve body shall be a two-piece split configuration, of cast iron. The two halves shall be sealed by rubber sheet gaskets that are cut to match the profile of the body halves. The flanges shall be drilled to mate with ANSI B16.1, Class 125/ ANSI B16.5 Class 150 flanges, and port areas shall be 100% of the mating pipe port area. Valve body shall be drilled and tapped for a supplied clean out plug on the top of the body and flushing connections on the bottom of the body supplied with plugs.
2. The check sleeve is to be of the fabricated elastomer “duckbill” type. The sleeve shall be one-piece rubber construction with fabric reinforcement. The inlet port shall have an integral flange, drilled to be retained by the flange bolts and acting as the gasket between pipe and valve. The flange will be drilled to ANSI B16.1, Class 125/ ANSI B16.5 Class 150 standards, and the inlet port area shall be 100% of the mating pipe port area. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow.
3. Manufacturer must have available flow test data from an accredited hydraulics laboratory to confirm pressure drop data. Company name and location shall be cast onto the valve body. Valves are to be manufactured in the USA.
4. When line pressure inside the valve exceeds the backpressure outside the valve by a certain amount, the line pressure forces the bills of the valve open, allowing flow to pass. When back pressure exceeds the line pressure by at the same amount, the bills of the valve are forced closed.
5. All elastomeric “duckbill” check valves shall be Series 39 as manufactured by the Red Valve Co., Inc. of Carnegie, PA, or approved equal.

F. Plug Valves

1. Valves shall be of the non-lubricated, resilient seated, quarter-turn type furnished with flanged or mechanical joint end connections as required. Flanged valves shall have flanges in full compliance to ANSI B 16.1 Class 125 Standards, including facing, drilling and thickness. Face to face dimensions of flanged valves through 12" size shall be that of standard gate valves. Mechanical joint ends shall be in full conformance to ANSI Standard A21.11.
2. Port areas for all valves shall be at least 80% of full pipe area.
3. Valve bodies shall be of ASTM A-126 Class B, cast iron. Plugs shall be ductile iron (ASTM A-536, Grade 65-45-12) with upper and lower shafts internal. The valves must provide bidirectional sealing at 175 psi differential in sizes to 12" and 150 psi differential for sizes 14" and larger. Proof of design and cycle life testing shall be in full conformance to AWWA Standard C504-80. Valve seating shall provide a consistent opening/closing torque

that is not dependent on adjustment of stop. Resilient seating shall be field replaceable on the existing plug.

4. All surfaces are to be protected, both internally and externally, with a factory coated heat fused thermoset epoxy or thermoplastic nylon complying fully with AWWA Standard C-550-81. These fusion-bonded coatings shall provide protection from corrosion in the shaft areas. Bearing areas to be isolated from solid particulates. All valves shall be of the bolted bonnet, top entry design, capable of repacking without removing the bonnet or valve from the pipe line.
5. Valves larger than eight inches and valves located seven feet or more above the finished floor shall be provided with manual gear operators having a maximum rim pull of 80 pounds as per AWWA C-504. Gear operators shall be enclosed and provided with seals on all shafts to prevent entry of water, allow submerging of the operator and suitable for running the gears in oil. All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Adjustable stops shall be provided.
6. Actuators for gear operated valves shall be by handwheel if within six feet of the finished floor, and in accessible areas valves above six feet from the finish floor shall be operated by a chain operator and chain wheel provided by the valve manufacturer to operate that particular valve.
7. Actuators for valves eight inches and smaller located within six feet of the finished floor in accessible locations shall be by a portable lever. One portable level shall be provided for 50 percent of the valves or 15 portable levers whichever is less.
8. Actuators for valves in inaccessible locations shall be by extension stem, stem guides, 2-inch operating nut with mounting bracket or floorbox, or floor stand, and lever or handwheel as appropriate. The plug valve manufacturer shall provide all operator accessories as required to make each operator system completely operational. Design criteria for extension stems and stem guides shall be as specified under the section title -Miscellaneous Metal Work.
- . Valve actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washers used in buried service shall be stainless steel.
10. Three-way plug valves shall be tapered design with resilient (EPT) coated plug, cast in semi-steel. Port opening shall be a minimum of 95 percent of pipe area. Shut off shall be dead-tight. Interior of valve body shall have a minimum 0.005-inch epoxy coating. Flanges shall conform to ANSI 125 pound standard. Valves shall have upper and lower stainless steel bushings and an adjustable gland to control turning torque. Other features as specified herein for plug valves shall apply except that three-way valves six inches and larger shall be provided with gear operators. Unless otherwise shown on the drawings, three way plug valves shall be three port, three position, 180-degree turn design. Valves shall be as manufactured by Drum Owen Valve

Company (Homestead), Bethlehem, PA, Style H, DeZurik, or equal.

G. Motor Operators

1. Motor operators shall be provided for plug valves as shown on the drawings. Operators shall be as manufactured by Limitorque Corporation, Jamesbury Corporation, Rotork, Inc., or equal. It shall be the motor operator manufacturer's responsibility to mount and test the valve and actuator assembly to insure proper operation.
2. Motor operators shall be provided with a hand wheel for manual override and shall be provided with automatic electrical disengagement of the motor and automatic brake release when in the manual mode. Handwheel shall not turn when under electric operation and shall be of sufficient size as to require no greater than a 60-pound total rim effort. Handwheel shall be provided with an integral cutoff switch during manual operation.
3. Motor operator shall be designed to be removable from the valve without dismantling the valve and shall be provided with the following features:
 - a. Motor brake.
 - b. Heater with thermostat.
 - c. Limit switches. One switch shall be open and the second switch closed when the valve is fully open. When used with three-way valves, switches shall be used to indicate which outlet is open and which is closed.
 - d. NEMA 4X enclosure.
 - e. Operators shall operate on a 120 volt, single phase, 60 Hz, power supply up to 1/3 HP, and 480 volt, three phase, 60 Hz on greater than 1/3 HP.
 - f. Motor operator shall be capable of holding any valve position.
 - g. Motor operator controller shall be furnished with reversing motor starter, control power transformer, manual/automatic and open/stop/close manual controls, open and close indicator lights and torque switches.
 - h. Valve controllers shall be suitable for remote control and status via the facility I&C system.
4. Motor operator shall be provided with shaft seals and shall be totally enclosed and require no additional lubrication. Bearings shall be ball or roller type suitable for all loads encountered in the service conditions. Motor operator shall incorporate machine cut and hardened gears and shall have a bolting pattern to allow parallel or perpendicular mounting.
5. Motor operator shall produce the torques and speeds as listed below:

Size (Inches)	Minimum Torque (Inch-Pounds)	Fastest Operating Speeds (Seconds)
3	3,200	10

4	3,200	10
6	10,000	26
8	10,000	26
10	21,000	55
12	21,000	55
14	48,000	125
16	48,000	125

NOTE: It is the responsibility of the equipment supplier to verify minimum torques and fastest operating speeds for the motor operators supplied.

H. Knife Valves

1. Valves shall be of the bonnetless knife type with wafer face-to-face flanged connections. Flanges shall be drilled to the ANSI 125/150 pound standard. WOG valve rating shall be 150 psi in sizes two inches through 24 inches and 125 psi in sizes 30 inches and 36 inches.
2. Valves shall be metal seated and lapped. Metal seated valves shall have a round port. Valves bodies shall have wetted parts of Type 304 stainless steel.
3. Valve packing shall be multiple layers of square, braided flax and shall be impregnated with marine or petroleum base lubricants. The packing gland shall be plastic coated. The gate shall have a knife edge. Both sides of the gate shall be finish ground. The stem shall be stainless steel. Valve superstructure shall be fabricated or hot rolled angular steel.
4. Valves two inches through 24 inches shall have a raised face seat with relieved area around the seat to prevent jamming.
5. Unless otherwise shown or specified, stem shall have double pitch threads and be equipped with two to one ratio gear operators with handwheels, which shall provide adequate clearance. Valves shall be by DeZurik or equal.

I. Butterfly Valves

1. Butterfly valves shall have semi-steel bodies as specified under ASTM A-126, Class B, close nickel alloy iron with solid one-piece stainless steel shaft and constant contact with the disc to provide strength and rigidity. Shaft shall be ground and polished to minimize bearing and seal wear. Packing shall be multiple ring type packing. Valves shall have reinforced Teflon corrosion resistant bearings with phenolic back to assure smooth valve operation. Valve shall be of the lug body type for use between 125/150 ANSI flanges.
2. Butterfly valves shall have universal actuator mounting for field interchangeability. Valve disc shall be secured to shaft by means of wedge shaped 304 stainless steel tangible pins driven flat against the valve shaft and held in place by threaded pipe plugs. Disc material shall be semi-steel with welded nickel edge to provide corrosion resistance and to minimize undue seat wear. The resilient seat shall be bonded to a bronze retention ring and shall be held in place by stainless steel retaining screws. Retaining screws

shall allow seat adjustment. A thrust bearing shall be provided at the bottom of the shaft to assure proper disc to seat alignment and absorb shaft thrust.

3. Valves shall be operated by a means of an enclosed handwheel. All actuator gearings shall be enclosed suitable for running in oil with seals provided on all shafts to prevent entry of dirt and water into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze bearings and bushings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to closing torque. A maximum of 18 turns shall actuate the valve from fully closed to fully open. Valves shall be by DeZurik, Keystone or equal.

J. Solenoid Valves

1. Valves shall be direct acting packless two-way solenoid valves for water service. Valves shall be normally closed, unless otherwise shown suitable for operation with 120 volt, 60 Hertz power and have continuous duty Class A insulation and general purpose enclosure. Valve body shall be forged brass with safe body working pressure of at least 250 psi, NPT connections, with Buna-N seat, wetted parts shall be of stainless steel. Valves shall operate satisfactorily when mounted in any position. Valves shall be by ASCO or equal.

K. Globe Valves

1. Valves shall have bronze body and fittings and shall be hand-wheel operated. Discs shall be bronze and renewable type. Valves shall be designed for 150 psi working pressure and shall have threaded connections unless otherwise specified. Valves shall be by Powell, Stockham or equal.

L. Ball Valves

1. Ball Valves shall be of Type 316 stainless steel construction, except for those valves specified PVC construction or installed in PVC piping. Body shall be of rigid construction and symmetrically cast. The shaft and ball shall be integrally cast.
2. Seats and seals shall be Teflon and shall be recessed in a machined groove. Shaft packing shall be a braided band. Packing shall be tightened by means of a gland bearing strip. Replacement of the packing shall be accomplished without removing the actuator.
3. Ball shall have a straight-through passageway, and shall be of the full-port design. Valves shall be rated for 150-psi service. Valves shall be by Apollo or equal.

M. PVC Valves

1. Polyvinylchloride (PVC) valves shall be manufactured of the same PVC

Type 1 Grade 1 molding compound used for the fittings to assure proper compatibility of system components.

2. Ball valves and ball check valves for PVC pipelines shall be true union PVC valves. Valve design shall allow for entire valve body removal by turning back the union nut at both ends of the valve. Valves shall have Teflon seats and packing. Valves shall carry a pressure rating of 150 psi at 75 degrees F water.
3. Diaphragm Valves. Valves shall be constructed of PVC, except diaphragm, including bonnet and handwheel. Diaphragm shall be replaceable and fully supported in any position. Valve shall have a non-rising stem with a diaphragm position indicator. Diaphragm shall be constructed of Teflon and shall be replaceable without removing valve from the line. Valve shall be socket ends. Valves shall be by Nibco or equal.

N. V-Port Ball Valves

1. Valves shall have a stainless steel, segmented, v-port ball with hard chrome facing. The body shall be cast carbon steel, ASTM A216, Grade WCB. Valves shall have integrally cast flanges for ANSI class 150 service. Shafts shall be type 316 stainless steel with splined ball-to-shaft connections and positive blow-out protection. Bearings shall be reinforced PTFE. Seats shall be reinforced PTFE meeting ANSI leakage classification VI. Adjustable packing shall be PTFE Chevron. Operation shall be manual by handwheel or chainwheel operators. Valves shall be DeZurik Type VPB or equal.

O. Pressure Reducing Valves. (Larger than two inch)

1. Valves shall be flanged globe body, bronze mounted, external pilot operated with a free floating piston and shall operate without springs, diaphragms or levers. The valve shall have a single seat with the seat bore equal to the size of the valve. Piston travel shall be a minimum of 25 percent of the seat diameter. The piston shall be guided above and below the seat no less than a length equal to 75 percent of the seat diameter. The piston shall be cushioned and designed to insure positive closure.
2. The valve shall be packed with leather and shall be furnished with an indicator rod to show the piston position. Gauge petcocks shall be furnished on the valve body. The pilot valve shall be easily accessible and shall be removable from the main valve under pressure. The pilot valve shall be adjustable without special tools or the removal of springs or weights. The main valve shall be designed to facilitate repairs internally without removing the valve from the line.
3. The valve shall be designed to maintain a preadjusted downstream pressure for varying rates of flow by piston positioning without water hammer.
4. The valve shall be suitable for 150 pound flanged service and shall conform to AWWA standards for flange thickness, drilling and the wall thickness of the body and caps. The valve body shall be constructed of grey iron, free

from cold shuts and defects and having a minimum tensile strength of 35,000 psi.

5. The valve shall be hydrostatically tested at a minimum of two times the rated service pressure. All iron castings shall be coated on all surfaces with two coats of asphaltic base metal paint.

P. Pressure Reducing Valves (two inches and smaller)

1. Pressure reducing valves two inches and smaller shall be of the single seated balanced design type globe body with threaded inlet and outlet ports. Valves shall be diaphragm operated, spring loaded, permitting convenient adjustment. The body shall be of bronze construction with stainless steel stem and furnished with a replaceable rubber seat. Valves shall be G-A Industries Figure 43-D, Watts No. 223, or equal.

Q. Pressure Relief Valve

1. Pressure relief valve shall be cast iron frame and cover with a bronze body ring and rubber flap ring. Hinge pin shall be bronze and secured with cotter pins. Valve shall have two pivot points and shall have a flanged end. No leakage shall occur on a valve with at least 18 inches of water cover above the installed valve.

R. Air Release Valves

1. Air release valves shall allow for the admission or release of large quantities of air during the fillup or drainage of pipelines and shall be specially designed for use with raw sewage. The valve shall open when the operating pressure falls below atmospheric pressure, and shall close and remain closed when the operating pressure is above atmospheric pressure.
2. Valves shall consist of a compact tubular all stainless steel fabricated body, HDPE hollow direct acting float, HDPE solid large orifice float, stainless steel nozzle and woven dirt inhibitor screen, nitrile rubber seals and natural rubber seat.
3. The valve shall have an integral anti-surge orifice mechanism which shall operate automatically to limit surge pressures rise or shock induced by closure to less than 2 times the valve rated working pressure. The intake orifice area shall be equal to the nominal size of the valve i.e., a 6" valve shall have a 6" intake orifice.
4. Large orifice sealing shall be by the flat face of the control float seating against a nitrile rubber O-ring housed in a dovetail groove circumferentially surrounding the orifice. The seating & unseating of a small orifice nozzle on a natural rubber seal affixed into the control float shall control discharge of pressurized air. The nozzle shall have a flat seating land surrounding the orifice so that damage to the rubber seal is prevented.

5. The valve construction shall be proportioned with regard to material strength characteristics, so that deformation, leaking or damage of any kind does not occur by submission to twice the designed working pressure.
6. Connection to the valve inlet shall be by flanged ends conforming ANSI B16.1 Class 125. Flanged ends shall be supplied with type 316 stainless steel screwed studs inserted for alignment to the specified standard. Provide type 316 stainless steel nuts and washers.
7. Air and vacuum valves shall be Series RGX by Vent-O-Mat©. Valves shall be sized as indicated on the Drawings.

S. Pinch Valves

1. Pinch valves shall be of the open body, full port design and shall be for service up to 75 psig. The valves shall be designed for a minimum of 50,000 cycles of operation. Valves shall incorporate a positive opening device to prevent collapsing under vacuum service. The manufacturer shall furnish certified test data of a bubble tight leakage test performance on each valve supplied.
2. Valves are to be of the full cast metal body, mechanical pinch type with flange joint ends on both the body and the sleeve trim. The valve shall have face-to-face dimensions of standard gate valves, in accordance with ANSI B16.10 up to 12" size. Sizes 14" and larger shall have a face to face dimension no longer than twice the nominal valve port diameter. The flanges shall be drilled to mate with ANSI B16.1, Class 125/ANSI B16.5, Class 150 flanges. The valve body halves are to be sealed with an elastomer sheet gasket cut to fit the contour of the valve body. Body shall be epoxy coated for additional corrosion protection.
3. The sleeve trim shall be one piece construction with integral flanges drilled to be retained by the flange bolts. The sleeve trim shall be reinforced with calendared nylon or calendared polyester fabric to match service conditions. The sleeve trim shall be connected to the pinch bar by tabs imbedded in the sleeve trim reinforcing ply. All internal valve metal parts are to be completely isolated from the process fluid by the sleeve trim.
4. For full port and reduced port sleeves, the port areas shall be 100% of the full pipe area at the valve ends. For cone and variable orifice sleeves the inlet port area shall be 100% of the full pipe area, reducing to a smaller port at the outlet.
5. The steel mechanism shall be double acting with pinching of the sleeve trim occurring equally from two sides. ACME threads shall be used on all valve mechanisms. There shall be no cast parts in the operating mechanism.
6. For buried valve service, a torque tube shall be fitted to the body of the valve via a mounting plate. The tube shall extend from the valve to above grade level, providing protection for the operating stem and sealing the opening in the top body half. Valve shall be operated by turning a non-rising stem, contained within the torque tube, and connected to the pinch mechanism. Bevel gear operators shall be provided on all valves over 8" size, and on

smaller sizes as specified on the purchase order. Torque tube shall be epoxy coated for additional corrosion protection. Valves shall be manufactured in the USA.

7. Rotating the handle clockwise, simultaneously lowers a pinch bar above the sleeve and raises a pinch bar below the sleeve, pinching the sleeve closed at the center of the valve. Turning the handle counter-clockwise separates the two pinch bars to open the valve.
8. Pinch valves shall be Series 75-B as manufactured by the Red Valve Co., Inc. of Carnegie, PA, or approved equal.

S. Vacuum Breakers

1. Vacuum breakers shall be provided as shown on the drawings. Breakers shall be series "VB" as manufactured by Past-o-matic Valves, Inc., Totowa, NJ, or equal. Breakers shall be of Type 1, Grade 1 construction with stainless steel fasteners and shall have a one inch NPT connection.

T. Sampling Valves

1. Sampling valves and fittings shall be provided on the discharge lines of pumps as shown on the Drawings. Valves shall be one inch stainless steel ball valves by Apollo or equal. The discharge side of each valve shall be provided with a 90 degree stainless steel elbow facing downward.

U. Floor Stands for Valves

1. Floor stands for valves shall be provided where shown on the drawings, and shall be the straight type design. The floor stands shall have a 15-inch long hand crank operator, and an operating reduction ratio of two to one. The floor stands shall be the rising stem type. The floor stands shall have a life nut, with Acme type threads, which shall engage an Acme threaded valve extension stem to raise or lower the valve. The threads and diameter of the lift nut shall be compatible with threads and diameter of the associated valve extension stem. The two to one reduction shall be accomplished with steel or cast iron gears which shall be designed for smooth operation and shall be able to support the operating loads without undue stress. The lift nut shall be of bronze and shall be mounted with roller bearings, which shall properly support the upward and downward thrusts encountered when operating the valves. The pinion shaft shall be mounted with roller and/or needle bearings. Lubrication fittings shall be provided for all bearings. All gearing, bearings, shafts, and the lift nut shall be housed in a weatherproof cast iron housing. Nuts and bolts shall be rustproofed steel. Seals shall be provided on all shafts and on the lift nut, where required, to exclude dirt and moisture, and to prevent leakage of lubricant. Floor stands shall be provided with stainless anchor bolts for installation.

2.07 TEMPORARY MANHOLES

- A. Temporary manholes shall provide convenient access to the temporary sewers and process lines during the construction of the proposed facility. The manholes shall be constructed of concrete block, brick, cast-in-place concrete, or precast concrete. Manholes shall be of the sizes and shapes required to provide convenient access and be of sufficient strength to withstand the traffic loads. Manholes shall have inverts and tables of concrete and/or brick. Manhole access shall be new or used reasonably watertight cast iron frame and cover with minimum 22 inch, and maximum 30 inch opening. Cover shall be maintained at temporary grade during construction.
- B. Following acceptance of the proposed facility and the abandonment of the temporary manholes, the temporary lines shall be plugged, the manholes demolished to at least two feet below proposed finish grade, and the manholes filled with clean backfill.

2.08 VALVE EXTENSION STEMS

- A. Valve extension stems shall be furnished as required and as shown on the drawings. Stems shall have a two-inch operating nut and a two-inch coupling for connection of the valves. Shaft lengths shall suit the particular installation. All exterior valves shall be provided with valve extension stems and valve boxes. All operating nuts shall be located 18 inches below finished grade.

2.09 VALVE BOXES

- A. Valve boxes shall be provided for buried valves. Valve boxes shall be cast iron, tar coated, sliding-type, adjustable together with a cast iron cover. For buried installations, bell end shall be sufficiently large to fit over the stuffing box of the gate valve.

2.10 VALVE TAGS

- A. NOT USED.

2.11 TAPPING SLEEVE AND VALVE

- A. Tapping sleeves and valves shall conform to the latest specifications adopted by the AWWA and be of the specific size to suit the existing conditions.
- B. The tapping sleeves shall be mechanical joint, two 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 lead gaskets. 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. This shall be properly spaced to insure uniform gasket pressure and compression.

- C. Sleeve outlets shall have counterbored flanges to insure proper centering of the tapping valve.
- D. All tapping valves shall be mechanical joint. Tapping valves shall conform to the specifications for gate valves (Municipal water lines).

2.12 DUPLEX STRAINERS

- A. Strainers shall be manual duplex units with cast iron bodies and 125 lb flanged connections. Sizes shall be as indicated on the Drawings.
- B. Strainers shall have quick-opening, yoke type with Buna-N gaskets and elastomers. Bodies shall have NPT plugged drains. Strainer baskets shall be type 316 stainless steel with 1/8-inch perforations and bow-type handles. Flow diverters shall be tapered bronze valve plugs.
- C. Flow capacities shall be as indicated on the Drawings. Operating pressure drop shall not exceed 0.5 psig when measured with clean baskets and water.
- D. Strainers shall be standard Model #50 Series Manual Duplex Strainers by Hayward.

2.13 PRESSURE SENSORS AND GAUGES

- A. See Specification Section 15060 – Gauges.

2.14 CLEANOUTS

- A. Cleanouts shall be installed in the exterior piping at all bends in all sludge and scum lines and in other lines where shown on the drawings so as to allow clearing of the pipe(s) by rodding in either direction. Some bends therefore require two cleanouts. The four-inch riser pipe shown on the cleanout detail on the drawings shall be equipped with a bronze four-inch diameter cap. The dust cap shall connect to the flange adapter coupling without the use of threads. Two female quick disconnect coupling hose adapters shall be supplied for connection to hose. The hose adapter shall be four inches.

2.15 RESTRAINTS

- A. All valves and fittings shall be restrained, so that all thrusts shall be supported independent of the piping system. All restraints shall conform to pipe manufacturer's recommendation.
- B. For interior piping, restraints shall be located as follows:
 - 1. Anchors shall be placed so all forces will be balanced.

2. Tiedowns shall be used to hold the pipe in position where velocity and surge forces will cause pipe movement. They shall control stress due to thermal expansion at wall pipes, sleeves and equipment.
 3. Guides shall be used to prevent transverse motion at flexible couplings used as expansion joints.
- C. Tie Rods: On piping, where flexible couplings are located near fittings or valves, stainless steel tie rods shall span the coupling from the two adjacent flanges. Such restraints can be deleted at the discretion of the Engineer, if both pipe ends are anchored in a concrete structure with no fitting or valve within the span. Where the Engineer intends to have flexible couplings used as expansion couplings, tie rods may be omitted. All tie rods shall be sized, spaced and installed according to the manufacturer's recommended procedure, or as directed by the Engineer.
- D. Thrust blocks shall be constructed at all exterior pipe fittings 22-1/2° and over, and valves, unless specifically ordered otherwise by the Engineer. The blocks shall be placed against undisturbed soil or against soil which has been compacted as specified in Division 2 for structures and pipes. Concrete used for thrust blocks shall be 3000 psi strength.

2.16 PIPE INSULATION

- A. The insulation for the pipe shall be a cellular glass type. It shall be a product which is made specifically for thermal insulation of underground piping and is compatible with the piping material.
1. Insulation shall be composed of all glass sealed cells having no binders or fillers. The completed product shall be rigid and impermeable. Its ultimate compressive strength shall be at least 100 psi. The thermal conductivity of the cellular glass shall be no higher than 0.40 BTU/sq ft/F°/in.
 2. The cellular glass thickness shall be 2-inches thick. It shall comply with all requirements of federal specification HH-1-551 and ASTM C552.
 3. Bands for securing the insulation to the pipe shall be 0.5 inches wide by 0.020 inches thick and shall be made of stainless steel.
 4. Jacketing for buried insulation shall be flexible laminate consisting of asphalt and glass fabric. The material shall be prefabricated so that it can be wrapped around the insulation and easily secured in place. This flexible insulation covering shall be flexible and tough enough to be wrapped tightly around the insulation and secured without tearing or cracking.
 5. Jacketing for above ground insulation shall be standard gauge aluminum jacketing with stainless steel bands.

2.17 CHEMICAL INJECTION ASSEMBLIES

- A. Provide chemical injection assemblies for points of chemical introduction into process pipelines as indicated on the Drawings. Assemblies shall be SAF-T-FLOW

chemical injection assemblies by Ryan Herco Products Corporation or equal.

- B. Assemblies shall consist of ¾-inch brass corporations with wetted parts of PVC, Hastelloy C and Viton, and suitable for the chemical service intended. Check valve balls and seats shall be Teflon. Connections to chemical feed tubing shall be ½-inch NPT.
- C. Assemblies shall have stainless steel safety chains to allow the closing of the corporation stop without withdrawing the solution tube beyond the corporation packing.
- D. Assemblies shall be rated for 240 gallons per hour of chemical feed flow at 150 psig working pressure.

2.18 FOAM SPRAY NOZZLES

- A. Nozzles shall be low pressure, standard spray, full-cone jet nozzles. Nozzles shall be high-grade, Type 316 stainless steel with removable caps and vanes. Nozzles shall have ½-inch NPT connections and 0.188-inch nominal orifice diameter and 0.125-inch maximum free passage diameter. Nozzle Capacity shall be 2.5 gpm per nozzle at 10 psi and 2.1 gpm at 7 psi. Horizontal spray distance at 10 psi shall be 12.5 feet, 14 feet and 15.5 feet at nozzle heights of 3 feet, 5 feet and 7 feet above the water surface elevation respectively. Spray cone width at the tank water surface shall be 10.5 feet minimum at 10 psi. Twenty (20) spare spray nozzles shall be provided. Nozzles shall be Model ½ GG-316SS FullJet by Spraying Systems Company.

2.19 IN-LINE STATIC MIXERS

- A. In-line static mixers shall be of a compact ring body design for mounting between two standard pipe flanges as sized on the Drawings. The ring body shall be a minimum thickness of 0.875 inches and shall be fabricated from Derakane FRP or Schedule 80 PVC.
- B. Ring-type neoprene gaskets shall be furnished and adhered to both sides of the mixer body. The mixer plate shall be designed to provide a geometric shape to create mixing vortices to effectively mix the injected chemicals with the process stream. The average variation in the process stream from the injection fluid shall be within 1 percent of the mean 10 pipe diameters downstream from the mixer.
- C. The mixing plate shall be no less than 0.125 inches thick and shall be Type 316 stainless steel. The mixer plate shall be mounted in a machined cavity on the upstream side of the ring body. The mixer body shall include two Type 316 stainless steel injection fittings as sized on the Drawings. Injection systems shall be designed for 100 psi working pressure. The in-line static mixers shall be Model 2800 by Westfall Manufacturing Company, Bristol, RI or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. **Handling of Pipe.** The loading, hauling, unloading and handling of pipes and appurtenances shall be accomplished without damage to same. Dropping of pipe and appurtenances directly to the ground or floor will not be permitted. Suitable buffers or runners shall be provided. The Contractor shall be liable for any damage to the pipe or appurtenances until they are accepted in the completed work. Each pipe section shall be handled into its final position only in such a manner and by such means as the Engineer approves as satisfactory, and these operations will be restricted to those considered safe for the workmen and such as to cause no injury to the pipe or to any property. As far as practicable, the Contractor shall be required to furnish slings, straps, and/or approved devices to permit satisfactory support of the pipe when it is handled. Transportation from delivery areas to the trench shall be restricted to certain operations which can cause no injury to the pipe units.
- B. **Tools for Pipe Installation.** The Contractor shall furnish all tools, torque wrenches, materials and labor necessary to make the joints in pipe in strict accordance with the manufacturer's specifications. Proper and suitable tools and appliances for the safe and convenient handling and installation of pipes shall be used. The Contractor shall exercise reasonable precaution during his operation in order to avoid damaging the material. All pipes, fittings or appurtenances which are so damaged shall be replaced by him at his sole expenses.
- C. **Installation.** All materials and equipment shall be installed in a neat workmanlike manner, and as recommended by the manufacturer. All piping shall be installed true to line and grade and rigidly supported. Pipe shall be installed with a constant slope and with a straight alignment between structures and fittings. When pipes are laid in a trench suitable coupling holes shall be dug to provide ample space for making joints and to allow the pipe to have bedding along its entire barrel length. Before setting wall sleeves and pipes to be cast-in-place, the Contractor shall check all plans and figures which may have a direct bearing on his pipe location and he shall be responsible for the proper location of his pipes during the construction of the buildings. A minimum of two, 1/4 lengths of pipe shall be used to connect to any manhole, pull box, foundation, building, structure and the like. All interior piping shall have sufficient number of unions or their equivalent to allow convenient disassembly and removal of piping. All valves and appurtenances shall be installed in accordance with manufacturer's directions at locations shown on the drawings. All in-line devices provided under instrumentation shall be installed as part of the work of this section.
- D. **Cleaning and Plugging Pipe.** The pipes and fittings shall be thoroughly cleaned before being laid and shall be kept clean until accepted in the finished work. The ends of all uncompleted lines shall be tightly closed with temporary plugs at all times when pipe laying is not in progress, and no trench water shall be permitted to enter

the pipe.

- E. Trenching and Backfill. Trenching and backfill shall conform to the applicable provisions of the Earthwork Section of these Specifications. All pipes shall have a bedding of 3/4-inch stone from the face of the structure for a distance of ten feet or to undisturbed material.
- F. Screwed Connections. All threads shall be clean, machine cut, and all pipe shall be reamed before erection. Screwed joints shall be made up with good quality thread compound applied to the male thread only. After having been set up, a joint must not be backed off unless the joint is completely broken, the threads cleaned and new compound applied. Teflon tape or Teflon compound may be used for steel, polyvinyl chloride, chlorinated polyvinyl chloride and copper threaded connections.
- G. Arrangements. Except as otherwise required, changes in direction shall be made using proper fittings, and unless shown otherwise piping shall run parallel and at right angles to walls and floors. Systems shall be arranged with low points and drains to permit complete drainage of the system. Control piping may be arranged with unions or union connections at low points to permit draining. Unions or flanges shall be provided close to main pieces of equipment and in branch lines to permit ready dismantling of piping without disturbing main pipe lines or adjacent branch lines.
- H. Penetrations. All penetrations in walls, floors and ceilings shall be sealed watertight to the satisfaction of the Engineer.

3.02 PLASTIC PIPING (PVC and CPVC). The installation of plastic pipe for pressure service shall be strictly in accordance with the manufacturer's technical data and printed instructions and as follows:

- A. General. The solvent welding procedure detailed herein applies to all Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) pressure piping systems including molded fittings and socket type pump and valve connections.
- B. Cement. Shall be a grade specifically recommended by the piping manufacturer for the size and schedule of pipe specified.
- C. Pipe Preparation.
 - 1. Cutting. Pipe shall be cut in accordance with the recommendations of the pipe manufacturer.
 - 2. Deburring and Beveling. All burrs, chips, filings, and the like shall be removed from both the pipe inside diameter and outside diameter before joining. All pipe ends shall be beveled approximately 1/16-inch to 3/32-inch back from the edge at an angle of 10 to 15 degrees.

- D. Fitting Preparation. Prior to solvent welding, all fittings and couplings shall be removed from their cartons and exposed for at least one hour to the same temperature conditions as the pipe in order to assure that they are thermally balanced before joining.
- E. Cleaning. Pipe and fittings shall be clean of all loose dirt and moisture from the inside diameter and outside diameter of the pipe end and the inside diameter of the fitting. DO NOT ATTEMPT TO SOLVENT WELD WET SURFACES.
- F. Priming. Apply primer to the pipe approximately 1/2 of the pipe diameter and in accordance with the manufactures recommendations. Apply primer freely in the socket keeping surface wet and applicator wet and in motion 5 to 15 seconds. Avoid puddling in socket. For checking penetration, you should be able to scratch or scrape a few thousandths of the primed surfaces away. Repeated applications to either or both surfaces may be necessary. Weather conditions do affect priming action. In cold weather more time is required for proper penetration.
- G. Solvent Cement Application. Solvent cement application shall be in accordance with the manufactures recommendation with a minimum of two coats. All excess cement shall be cleaned from the surfaces of the pipe and fittings.
- H. Joining. Joining of PVC pipe and fitting shall be in accordance with the manufacturers recommendations and only at the below solvent welding joining temperatures and joint drying times:
 - 1. THE ACTUAL JOINING SHOULD NOT BE DONE IN ATMOSPHERIC TEMPERATURES BELOW 40°F OR ABOVE 90°F, OR WHEN EXPOSED TO DIRECT SUNLIGHT.
 - 2. NOT LESS THAN 48 HOURS OF JOINT DRYING TIME SHALL ELAPSE FOR ALL SIZES OF PIPE AND DRYING TEMPERATURES BEFORE THE JOINT IS MOVED OR SUBJECTED TO ANY APPRECIABLE INTERNAL OR EXTERNAL PRESSURE.

NOTE: Joints for plastic pipe shall be solvent welded except flanged or screwed where required. For plastic to steel, cast iron pipe or ductile iron pipe connections, complete metal pipe assembly first. Use flanged connections and tighten bolts evenly to prevent warping of rigid plastic pipe. A torque wrench may be used for a tight seal on gasket. Joints shall conform to manufacturer's recommendations installation of valves and fittings shall be strictly in accordance with manufacturer's instructions. In making solvent weld connections, the solvent should not be spilled on valves or allowed to run from joints. All completed pipe lines shall remain undisturbed for 48 hours to develop complete strength at all joints.

3.04 PVC PIPING. The installation of PVC pipe for sewers and conduits shall be strict accordance with the manufacturer's technical data and printed instructions.

- A. General. The pipe shall be laid with extreme care as to grade and alignment. Each pipe shall be so laid as to form a close 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. Suitable coupling holes shall be dug 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 haunches of the pipe. No walking upon or working over the pipes 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 in tamping the earth and backfilling. All openings to the pipelines shall be satisfactorily protected to prevent the entrance of earth or water.
- B. Laying Pipe. Excavations shall be made to accommodate the bedding materials as previously specified. All excavations shall be kept dry while pipe is being laid and until each joint and pipe has been inspected 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.
1. The pipe is 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 atmosphere conditions in the pipe that could affect the acceptable standard of construction. The laser aligning method selected shall be shown to have worked satisfactorily on at least three contracts, and is operated by competent, trained personnel. The Contractor shall establish center line and offset stakes at each manhole, plus one intermediate center line and offset stakes as a check point between manholes.
- C. Allowable Pipe Deflection for PVC Pipe. Pipe installed under this specification shall have a maximum deflection of five 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. Upon completion of a pipe section, including the placement and compaction of backfill, and the cleaning of the pipe, the Contractor shall measure the amount of deflection in all of the lines. This testing shall be done by the use of deflectometer, calibrated television or photography, or a properly sized "go, no go" mandrel or sewer ball. All lines with a deflection angle of greater than five percent shall be repaired by a re-bedding or replacement of the pipe.

3.05 LINES AND SLEEVES.

- A. Lines, hoses, pipes, etc., installed in sleeves, including but not limited to chlorine solution, alum and lime discharges, shall have no joints, couplings, or fittings

installed or located within the sleeve. All joints, couplings, and fittings shall be installed outside, in buildings, in pull boxes, or in manholes. The annular spaces between lines and sleeves at all structures shall be sealed watertight to the satisfaction of the Engineer.

3.06 FIRE HYDRANTS.

- A. Fire hydrants and appurtenances shall be installed in accordance with the local municipal fire codes, and in accordance with specification Section 02641.

3.07 TESTING OF PROCESS PIPING

- A. General. All piping and piping systems shall be leak tested by the Contractor in the presence of the Engineer. The Contractor shall provide typed and witnessed test reports for all such tests. One of two types of tests is required depending upon the service of the pipe. Exfiltration/Infiltration tests shall be performed on all gravity sewers and on low pressure rated lines (five psi or less). Pressure tests shall be performed on all pressure lines including siphons and piping with pressure rated joints. All piping and piping systems not complying with the leak test shall be repaired or replaced by the Contractor to the satisfaction of the Engineer and be re-tested all at no additional cost to the Owner.

- B. Exfiltration/Infiltration Test

- 1. After the completed line including service connections, if any, has been installed, the trench has been compacted to specification requirements, and manhole or joints showing noticeable streams or jets have been repaired and/or replaced the Contractor shall perform all exfiltration/infiltration tests. The Contractor shall be responsible for furnishing all labor, materials and equipment so that such tests can be accomplished at the times and locations necessary. The rate of infiltration/exfiltration shall not exceed 200 gallons per inch of pipe diameter per mile of pipe per day.

THE ATTENTION OF THE CONTRACTOR IS DIRECTED TO THE STRICT REQUIREMENTS RELATIVE TO MAXIMUM RATES OF INFILTRATION/EXFILTRATION AND TO THE IMPORTANCE OF THESE SPECIFICATIONS RELATIVE TO TIGHT JOINTS REQUIRED. LINES NOT MEETING THE ABOVE REQUIREMENTS SHALL BE REPAIRED AS NECESSARY AT THE CONTRACTOR'S EXPENSE.

- 2. Test Procedure

- a. When infiltration is observed the Contractor shall conduct V-notch weir infiltration tests. If such tests shown that the infiltration rate exceeds the limits specified above he shall make all necessary repairs to reduce the

infiltration to the specified limit.

- b. When the V-notch weir tests as specified in Paragraph 1 above show that the rate is within the specified limits or when no infiltration has been observed an exfiltration test utilizing water or air shall be performed.

3. Exfiltration Tests

- a. Water tests shall be performed by filling the pipe with water to a point four feet above the top of the pipe at the upper end and measuring the water loss during a one hour period.
- b. For making low-pressure air tests, the Contractor shall use 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 of air safety valve so set that the internal air test using low-pressure air shall be made on each structure-to-structure section of pipeline. 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. All air used shall pass through a single control panel. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches four 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 eight psig. At least two 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:

<u>Pipe diameter in inches</u>	<u>Minutes</u>
6	4.0
8	5.0
10	6.5
12	7.5
14	9.0
15	9.5
18	11.5

- c. For larger diameter pipe: Minimum time = 7.7 X Dia. (ft). When the pipe 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.

C. Pressure Test

1. After the completed line including connections, if any, has been installed, the trench has been compacted to specification requirements and/or all supports and restraints have been installed, the Contractor shall perform all pressure tests. The Contractor shall be responsible for furnishing all labor, materials, and equipment so that such tests can be accomplished at the times and locations necessary.
2. All lines shall be pneumatically or hydrostatical tested for a period of two consecutive hours. The test pressure shall be that of the pipe design pressure or 1.5 times the apparent working pressure, whichever is the greater. The piping and piping system shall withstand the test pressure with a maximum loss of ten percent of the test pressure.

3.08 DISINFECTING AND FLUSHING

- A. The Contractor shall disinfect the lines carrying potable water.
- B. The Contractor shall furnish all equipment and materials necessary to do the work of disinfecting, and shall perform the work in accordance with the procedure outlined in the AWWA Standard for Disinfecting Water Mains, Designation C651-92, except as otherwise specified herein.
- C. The dosage shall be such as to produce not less than 10 parts per million after a contact period of not less than 24 hours.
- D. After treatment, the main shall be flushed with clean water until the residual chlorine content does not exceed 0.2 PPM.
- E. During the disinfection period, care shall be exercised to prevent contamination of water in existing mains.
- F. The Contractor shall dispose of the water used in disinfecting and flushing in an approved manner.
- G. If, in the opinion of the Engineer and/or owner, the above method of disinfection is deemed impractical; the lines carrying potable water shall be disinfected by the method outlined in AWWA Standard C651-92-Section 9.

3.09 PAINTING

- A. All piping shall be painted in accordance with specification Section 09900 – Painting.

3.10 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01700.

END OF SECTION

DIVISION 13

SECTION 13320

INSTRUMENTATION

1.00 PART 1 – GENERAL

1.01 DESCRIPTION:

- A. The Work of this Section shall include all labor, materials, and equipment required to provide instrumentation system as specified herein. A single Instrumentation System Supplier shall provide all labor, materials, equipment and services required to achieve this scope as specified herein and within the Contract Documents.
- B. The work shall include providing equipment and instrumentation for the Taunton Wastewater Treatment Facility Solids Handling Upgrade project in Taunton, MA.
- C. The work shall include an interface for equipment provided under other Sections of the Contract Documents. In order for the equipment furnished and installed within this Section to function as a complete system there shall be close coordination with other equipment furnished under other Sections of the Contract Documents.
- D. Provide and configure all new instrumentation and related equipment.

1.02 SUBMITTALS:

- A. Detailed submittal packages identifying the equipment to be supplied and its operation shall be furnished. The intent of the submittals is to ensure complete project scope coverage and does not relieve the Instrumentation System Supplier from fulfilling any specified requirements. The submittal shall consist of legible printed text and high quality prints bound in three-ring notebooks with index tabs that identify major sections of the document.
- B. Submittals shall include at least the following:
 - 1. Data sheets for each piece of equipment following ISA S20 format as applicable.
 - 2. Manufacturer's data, order sheet or equivalent for each individual instrument, control panel, or device being supplied. The information shall include but not be limited to model number, exact chart, scale or calibration range, type of enclosure and mounting, input/output and power data and the instrument tag number (or loop number for auxiliary equipment). Sales literature will not be accepted.
 - 3. The Instrumentation System Supplier shall clearly identify in the Project Plan any exception to the Contract Documents. Failure to do this will be grounds for rejection of the submittal.
- C. For approval before release for manufacturing

1. All equipment to be provided under this Section must be approved prior to any of this equipment being released for manufacturing unless otherwise noted by the Engineer.
- D. Shop drawings shall be submitted in accordance with Section 01300 and include the following special conditions:
1. All material submitted for review shall be contained in one submission. The material shall be furnished in bound volumes, not to exceed three inches thick, with cover sheet, description of project and table of contents as required for a complete submittal. Loose material submitted will not be reviewed. Partial submittals, unless agreed to by the Engineer, will not be reviewed. Sales bulletins or other general publications are not acceptable as submittals.
- E. Operation and Maintenance Manuals shall be submitted in accordance with the requirements of this Contract and include the following:
1. Index.
 2. Complete directions on equipment supplied, including: physical description, installation, adjustments, configuration as installed, operation, technical information and servicing including parts list with stock numbers.
 3. All material that is to be furnished as part of the Operation and Maintenance Manuals shall be submitted in bound volumes with hard cover binders. Each bound volume shall be no more than three inches thick. This material shall be furnished complete in one submittal for review and final acceptance.

1.03 DEFINITIONS

- A. 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 accessory and appurtenance.
 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 specified operation in the project.
 3. “Provide” shall mean furnish and install.
 4. “Coordinate” shall mean all Work provided under this Section of the Contract Documents shall be in compliance with the Work of other referenced Divisions and other referenced Sections of the Contract Documents.

1.04 DESIGN CRITERIA

- A. The Contractor shall provide a complete and operational instrumentation system. This equipment shall be provided as described in this Section. It shall be the Contractor's responsibility to coordinate the installation of this equipment with all other associated equipment and to provide for a complete and operational system.

- B. The Work of this Section shall require field equipment interconnections. This Section shall describe the field equipment for interconnections but does not detail each specific point-to-point connection. It shall be the Contractor's responsibility to verify and coordinate final connections to all equipment.
- C. The Work of this Section shall adhere to the requirements of the standards listed below as applicable. The latest edition in effect at the time of bid opening shall apply.
 - 1. American Petroleum Institute (API)
 - 2. The Instrumentation, Systems and Automation Society (ISA)
 - a. ISA S5.4, Instrument Loop Diagrams.
 - b. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - c. ISA RP60.3, Human Engineering for Control Centers
 - d. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers
 - 3. National Electrical Manufacturers Association (NEMA)
 - 4. National Fire Protection Agency (NFPA)
 - a. NFPA 70, National Electrical Code (NEC).
 - b. NFPA 79, Standard for Industrial Machinery.
 - 5. Underwriters Laboratories, Inc. (UL)
 - a. UL 508, Standard for Industrial Control Equipment.
 - b. UL 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.
 - 6. American Society for Testing and Materials (ASTM)
 - a. ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

1.05 RESPONSIBILITY FOR EQUIPMENT

- A. The General Contractor shall be responsible for providing and placing in satisfactory operation all instruments and equipment necessary for a complete system. This shall include all piping, electrical connections, and system engineering as provided by a qualified Instrumentation and Control System Supplier, and accessories required by the Work of this Section or other related Work included under other Sections in the Contract Documents.
- B. The supply of control panels, instrumentation shall be by a single Instrumentation and Control System Supplier. The supplier shall be responsible to the General Contractor for: (1) satisfactory detailed design of a complete and coordinated system (2), start-up and testing services, (3) training, and (4) services to assure satisfactory operation.

- C. The General Contractor shall not purchase separate equipment and attempt to assemble a system. This Work is to be performed by a qualified Instrumentation and Control System Supplier as approved by the Engineer.
- D. The Instrumentation System Supplier shall be required to furnish equipment that is installed under other Sections in the Contract Documents. The General Contractor shall be responsible for coordinating this Section with the necessary equipment in order to provide for a complete installation. It shall be coordinated such that there is proper installation of this equipment between suppliers in order to avoid delays in completion due to availability of this equipment. The Instrumentation and Control System Supplier shall provide a separate submittal on this specific equipment for early approval in order to avoid delays.

1.06 INSTRUMENTATION SYSTEM SUPPLIER

- A. The Instrumentation and Control System Supplier shall be the following with no substitutions allowed.
 - 1. The following are pre-qualified Instrumentation and Control Contractors.
 - a. R.E. Erickson Co., Inc.
Walpole, Massachusetts
508-668-9330
 - b. Electrical Installations, Inc.
Center Harbor, New Hampshire
603-253-4525
 - c. Harbor Controls
North Kingstown, RI
401-667-0930

2.00 PART 2 – PRODUCTS

2.01 GENERAL

- A. All equipment shall be of the latest proven design. First generation equipment with less than three years general use shall have documentation on construction operation, field test and user list.
- B. All equipment shall be suitable for operation in the environment of the Project.
- C. Transmission to and from analog devices shall be 4-20 mA DC.
- D. Electronic transmitting equipment shall provide loop power. A true two-wire transmitter may have its loop power supplied in the receiving instrument, if available.
- E. The Instrument List included in this Section indicate the intent of the process design and interconnection between instruments. Equipment specified herein does not purport to cover all equipment that may be required to complete the process design intent.

- E. All shielded cable shall be grounded at the control panel end only. Shields shall be carried through junction boxes with the least possible resistance and kept isolated from ground at these points. The field end of the shield shall be insulated to prevent grounding.
- F. All field electronics and outdoor control panel equipment shall be suitable for operation in ambient temperatures of -40 degrees Fahrenheit to 140 degrees Fahrenheit. All indoor control panel located electronics shall be suitable for operation in ambient temperatures of 40 degrees Fahrenheit to 120 degrees Fahrenheit.

2.02 MAGNETIC FLOW METER

- A. Flow Element (FE)
 - 1. Type:
 - a. 316 SS self-cleaning bullet nose electrodes
 - b. Steel with Polyurethane Liner
 - c. Connections - ANSI Class 150, RF carbon steel flange
 - 2. Operation:
 - a. Purpose - To produce a low-level voltage output signal proportional to flow rate.
 - b. Operating Principle - Induced voltage proportional to flow rate is produced by the measured fluid (conductor) moving through a magnetic field. Voltage sensed across a pair of diametrically opposed electrodes in a pipe section.
 - 3. Functional:
 - a. Power Requirement - supplied by magnetic flow converter.
 - b. Max Power Consumption - 1 Watt per 5 mm (diameter).
 - c. Electrical Class - NEMA 4X plus temporary submergence at 25-ft for 48 hours.
 - 4. Physical:
 - a. Electrodes - Type 316 SS, field replaceable, configuration for periodic electrode inspection or cleaning.
 - b. Body - Carbon Steel.
 - c. Liner - Polyurethane.
 - d. Coils - Completely potted with epoxy-based compound.
 - e. Ends - Carbon Steel flanges
 - f. Exterior Surface - Epoxy coated.
 - g. Grounding rings - Stainless steel grounding rings with grounding strap.
 - h. Approvals - FM.

5. Performance:
 - a. Accuracy - ± 0.5 percent of rate between 10 percent and 100 percent of flow (including transmitter).
 - b. Documentation Required - Certified hydraulic lab calibration data.

B. Flow Transmitter (FIT)

1. Type:
 - a. Liquid crystal display with rate and total.
 - b. 4-20 mA DC Output.
 - c. NEMA 4X Enclosure.
2. Operation:
 - a. Purpose - Provides coil drive current to the flow tube and convert the electrode signal from the flow tube into 4-20 mA signal linear with flow.
 - b. Circuitry - Microprocessor-based with data stored in nonvolatile EEPROM memory, performing continuous self-diagnostics. Solid-state integrated circuitry, feedback electronically controlled. External contacts shall initiate circuitry that clamps the output to 4 mA under no flow conditions.
3. Functional:
 - a. Input - Low level input from electromagnetic flow element.
 - b. Power Requirement - 120 VAC ± 10 percent, 60 Hz.
 - c. Output - 4-20 mA DC into 0 to 750 ohms.
 - d. Indicator - LCD.
4. Physical:
 - a. Case Material - Cast aluminum.
 - b. Case Type - NEMA 4X.
 - c. Mounting - Wall mounted.

C. Performance:

1. Systems Accuracy - ± 0.5 percent of rate between 10 percent and 100 percent of flow (including flow element).

D. Manufacturer: Endress & Hauser, Krohne, ABB, Foxboro or equal.

2.03 LEVEL SWITCHES – LIFTING

- A. Provide a level switches for the chemical containment areas.
- B. Type: Lifting foot type.

- C. Operation. To produce a contact output when lifted.
- D. Manufacturer: Rule-A-Matic 35A Float Switch by ITT, or approved equal

2.04 DOOR POSITION SWITCHES – MAGNETIC

- A. The switch mechanism shall have a minimum gap of 3/8-inch and a maximum gap of 1 ¼ inches without internal adjustment.
- B. Surface mount switch housing for the switch element shall have capabilities to receive threaded conduit.
- C. The housing cover for surface mounted switches shall be secured using tamper resistant stainless steel screws. The magnet housing cover shall not be readily removable.
- D. Conductors running from the door to alarm circuits shall be jumpered within a flexible armored cord constructed from corrosion-resistant metal.
- E. Each end of the armored cord shall terminate in a junction box or other enclosure. Armored cord ends shall be mechanically secured to junction boxes by clamps or bushings. Conductors within the armored cord shall be provided with lug terminals at each end. Jumpered conductors and the armored cord shall experience no mechanical strain as the door is removed from fully open to closed. The switch circuit shall initiate an alarm if a short circuit is applied to the door cord.

3.00 PART 3 – EXECUTION

3.01 INSTALLATION

- A. Instrumentation and accessory equipment shall be installed in accordance with the best field and shop practices.
- B. The workmanship shall be in accordance with the best field and shop practices for instrumentation and control systems.
- C. All workmen shall be skilled in the work to which they are assigned and all work shall be performed under the direct supervision of an experienced and competent Instrumentation and Control System Supplier foreman.
- D. All internal wiring of control panel(s) shall be done by the Instrumentation and Control System Supplier in accordance with the drawings and instrument manufacturer's instructions and UL requirements.
- E. The Contract Documents indicate the extent of the interconnections between and the type of individual instrument. The proposed equipment shall be supplied complete with all mounting hardware and accessories to satisfy the functional requirements.
- F. All work shall be executed in full accordance with UL requirements and codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Instrumentation and Control System Supplier and ultimately the Contractor shall bear full responsibility for such violations and assume all costs arising there from this situation.
- G. Interfacing devices shall be compatible with the equipment to which they are attached

and shall comply with the applicable specifications.

- H. Coordination with the process and equipment, in addition to standard quoted devices required to conform the instrumentation to the process, shall be the responsibility of the Contractor. The Instrumentation and Control System Supplier shall provide detailed information on the devices being supplied and the extent of the field installation required.
- I. Brackets and hangers required for mounting of equipment shall be provided as noted in the Contract Documents or as required. They shall be done in a workmanlike manner and not interfere with any other equipment. These devices shall be manufactured from non-corroding stainless steel, suitable to the installed environment.
- J. The Contractor shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the equipment manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.
- K. The shield on each process instrumentation cable shall be grounded as directed by the manufacturer of the instrumentation equipment or as noted in this Section, but in no case shall more than one ground be employed for each shield. Only one end of shielded cable shall be grounded.
- L. Maximum practical separation shall be maintained between signal (analog, alarm, and status) conduits and power feeders and AC systems.
- M. All field conductors shall terminate at the control panel terminal blocks. Millivolt signal wires (i.e., thermocouple) may be connected directly to the input terminals of the receiving instrument if so specified.
- N. All wire ends shall be identified at both ends with wire markers.
- O. Lifting rings from cabinets/assemblies shall be removed. Hole plugs shall be provided for the holes of the same color as the cabinet.

3.02 COMMISSIONING

- A. The instruments and equipment shall be tested for proper installation, interconnection, and function.
- B. Testing and calibration of equipment shall be performed as specified herein and per manufacture recommendation/requirements.
- C. Prior to electrical check out all breakers, switches and similar disconnect devices shall be placed in the off position.
- D. Control panel and other equipment grounding shall be verified. The systems shall be checked for improper or accidental grounding.
- E. Visual inspection and continuity testing shall be made to verify that no damaging wiring errors occur between power and signal wiring.

- F. The Contractor shall arrange for and obtain the services of a factory trained and qualified service engineer(s) from the Instrumentation and Control System Supplier and/or from the equipment manufacturer(s) to perform the calibration and commissioning of the instrumentation and equipment.
- G. Instrument calibration shall be the responsibility of the Instrumentation and Control System Supplier and the supplier of the equipment. Each applicable instrument shall be calibrated at 0 percent, 10 percent, 25 percent, 50 percent, 75 percent, 90 percent and 100 percent, ascending and descending, of the instrument's span using calibration equipment that is traceable to an instrument or group of instruments calibrated by the National Institute of Standards and Technology, as applicable. A certified calibration report and calibration curve for each applicable instrument shall be completed and submitted to the Engineer.

3.03 SUPPLIER'S SERVICES

- A. The supervisory service of a factory-trained service engineer specifically trained on the type of equipment specified herein shall be provided during construction to assist the Contractor in equipment installation, the location of sleeves, methods of installing conduit and special cable, mounting, piping and wiring of one of each type of device, and the methods of protecting all of the equipment prior to placing it into service.
- B. Upon completion of the installation, the service engineer's services shall be provided for calibration, testing and start-up of the equipment.

3.04 PRODUCT HANDLING

- A. Special instructions for proper field handling and installation required by the manufacturer for proper protection shall be securely attached to each piece of equipment prior to shipment.
- B. Each package shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.
- C. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number as given in the Instrument List and/or in the Contract Documents shall be provided on each piece of equipment supplied under this Section. The tag shall be attached by stainless steel screws or stainless steel chain/wire to a permanent part of the instrument. The tag number characters shall be a minimum 3/16-in high.
- D. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters and, including in-line equipment, shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired or the damaged equipment replaced by the Contractor at the Contractor's cost and expense. If any apparatus has been subject to possible damage by water, it shall be thoroughly dried out and put through such tests as directed by the Engineer at the Contractor's cost and expense, or the apparatus shall be replaced by the Contractor at the Contractor's cost and expense.

3.05 GUARANTEE:

- A. The instrumentation shall be warranted for one (1) year from date of substantial completion.

INSTRUMENTATION LIST								
TAG #	FACILITY	FUNCTION	INSTRUMENT	TYPE	LOCATION	RANGE	UNITS	REMARKS
FE-7203	Solids Handling Building	Thickened Sludge Pump #1 Flow	Flow Element	Magnetic Meter	Thickened Sludge Pump #1 Sludge Line	0-500	GPM	--
FIT-7203	Solids Handling Building	Thickened Sludge Pump #1 Flow	Flow Transmitter	Electronic	Thickened Sludge Pump #1 Sludge Line	0-500	GPM	--
FE-7204	Solids Handling Building	Thickened Sludge Pump #2 Flow	Flow Element	Magnetic Meter	Thickened Sludge Pump #2 Sludge Line	0-500	GPM	--
FIT-7204	Solids Handling Building	Thickened Sludge Pump #2 Flow	Flow Transmitter	Electronic	Thickened Sludge Pump #2 Sludge Line	0-500	GPM	--
LSH-7605	Solids Handling Building	Polymer Tank Leak	Level Switch	Lifting	Polymer Tank	--	--	--
ZSO-8110	Solids Handling Building	Solids Bay Door Open	Door Position Switch	Magnetic	Solids Bay Door	--	--	--
FE-9115	Solids Handling Building	Plant Water WAS Injection #1	Flow Element	Magnetic Meter	Plant Water WAS Injection #1 Line	0-200	GPM	--
FIT-9115	Solids Handling Building	Plant Water WAS Injection	Flow Transmitter	Electronic	Plant Water WAS Injection Line	0-200	GPM	--
LSH-9356	Solids Handling Building	Thickened Sludge Pump Station Flood	Level Switch	Lifting	Thickened Sludge Pump Station	--	--	--

END OF SECTION

DIVISION 15

SECTION 15400

PLUMBING

PART 1 GENERAL

1.01 SCOPE

- A. The Work of this section includes all labor, tools, material, fittings, accessories and equipment necessary to provide plumbing system(s), complete and operable.
- B. Attention is directed to DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this section of the Specifications.
- C. The Work includes, without limiting the generality thereof:
 - 1. Water supply system
 - 2. Domestic cold water distribution system.
 - 3. Domestic hot water distribution system and oil-fired water heater.
 - 4. Emergency Eyewash/Shower: A complete tempered water system connecting to all emergency showers and eyewashes. Included shall be a master blending valve.
 - 5. Plumbing Fixtures
 - 6. Floor drain repair and refurbishment.
 - 7. Storm water drain piping
 - 8. Roof drain replacement and new installation.
 - 9. Hose bibs and wall hydrants.
 - 10. Sump pumps
 - 11. Pitless Drainage pumps
 - 12. Plumbing Demolition.

1.02 SUBMITTALS

- A. Shop drawings, brochures and samples, as listed, shall be submitted for all items to be furnished in accordance with the provisions of DOCUMENT 01300, SUBMITTALS.
- B. Provide submittals for the following items consisting of manufacturer's published data. All submittals shall show compliance with the referenced specification.

1. Water and drain piping and fittings
2. Hangers and supports
3. Sleeves and escutcheons
4. Plumbing specialties
5. Valves
6. Oil Fired Domestic Water Heater
7. Emergency Eyewash/Shower
8. Floor drain replacement strainers and grates
9. Storm water piping and fittings
10. Roof drains
11. Mixing valve
12. Cleanouts
13. Piping insulation
14. Sump pumps with wall bracket mounted float switches and control panels.
15. Pitless drainage pumps with level switch.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. SECTION 02220, EARTHWORK - Excavation, filling, sheeting, shoring, pumping, dewatering.
- B. SECTION 03300, CAST-IN-PLACE CONCRETE - for trench drains.
- C. SECTION 07002, ROOF AND FLASHING - for roof penetrations.
- D. SECTION 07841, PENETRATION FIRE STOPPING - for sleeves in floors and walls.
- E. SECTION 07920, JOINT SEALANTS – caulking for sleeves in floors and walls.
- F. SECTION 15500, BREECHING AND STACK (PREFABRICATED) – for water heater flue pipe.
- G. SECTION 16120, WIRE AND CABLES - Power wiring.

1.04 ITEMS INSTALLED BUT NOT FURNISHED

- A. Install water meter as furnished by the Owner.

1.05 ITEM FURNISHED BUT NOT INSTALLED

- A. Furnish pipe sleeves for placement in concrete and masonry construction.

1.06 DESIGN CRITERIA

- A. The Work of this section shall comply with the requirements of the Massachusetts Uniform Plumbing Code (248 CMR) and of any other authorities having jurisdiction.
- B. The equipment covered by the Specifications is intended to be standard equipment of proven quality as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practice of the industry and shall operate satisfactorily when installed in accordance with the Contract Documents. The Specifications call attention to certain details, but do not purport to cover all details entering into the construction of the equipment.
- C. All material shall be new and shall bear the manufacturer's full identification.
- D. Requirements of the Regulatory Agencies
 - 1. The final, complete installation shall comply with all state and local statutory requirements having jurisdiction. Arrange for all necessary permits, pay all fees and arrange for all required inspections by local authorities. In general, all Work shall comply with the requirements of the rules, regulations, standards, codes, ordinances and laws of local, state and federal governments, and other authorities that have legal jurisdiction over the Project. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:
 - a. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
 - b. National Fire Protection Association (NFPA).
 - c. Occupational Safety and Health Act (OSHA).
 - d. Underwriter's Laboratories (UL).
 - e. Material and equipment shall be listed by Underwriter's Laboratories (UL) and approved by ASME and AGA for intended service.
 - 2. When requirements cited in the Specifications conflict with each other or with Contract Documents, most stringent shall govern Work.

3. Most recent editions of applicable specifications and publications of the following organizations form part of Contract Documents:
 - a. American National Standards Institute (ANSI).
 - b. American Society of Mechanical Engineers (ASME).
 - c. National Electric Manufacturers Association (NEMA).
 - d. American Society for Testing and Materials (ASTM).
 - e. American Water Works Association (AWWA).
 - f. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - g. American Society of Plumbing Engineers (ASPE).
 - h. Thermal Insulation Manufacturers Association (TIMA).
 - i. Institute of Electrical and Electronics Engineers (IEEE).
 - j. Insulated Cable Engineers Association (ICEA).
 - k. Cast Iron Soil Pipe Institute (CISPI).
 - l. Plumbing and Drainage Institute (PDI).
 - m. National Association of Plumbing-Heating Cooling Sub-Contractors (NAPHCC).

1.07 PRODUCT HANDLING

- A. All materials and equipment shall be shipped, stored, handled and installed in such manner as not to degrade quality, serviceability, or appearance.
- B. Store all materials and equipment on site in a location approved by the Engineer.
- C. Protect all Work, the Owner's property and the property of others from injury or loss caused by operations associated with the Work of this section. Make good any such injury or loss, at no cost to the party suffering the injury or loss.

1.08 PROCEDURE

- A. Secure all permits, inspection, and approvals and pay all costs and fees.
- B. Unless the Specifications state "No Substitutions", substitutions will be considered for any specified item.

- C. Coordinate safety program with that of the Contractor. Cooperate with other trades to establish lines, levels, openings, chases, clearances, and locations to avoid interference, and to protect the Work.
- D. Deliver all materials as needed to avoid delaying any other contractor.
- E. Store all materials and equipment on the Project Site in a location approved by the Engineer.

1.09 INTERPRETATION OF DRAWINGS

- A. Listing of Contract Drawings does not limit responsibility of determining full extent of Work required by Contract Documents. Refer to Architectural, Plumbing, Electrical, Structural and other Contract Drawings and other sections that indicate types of construction in which Work shall be installed and Work of other trades with which Work of this section must be coordinated.
- B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the Contract Drawings or Specifications or both, carries with it the instruction to provide the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- C. Item referred to in singular number in Contract Drawings shall be provided in quantities necessary to complete Work.
- D. Contract Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting and component. The purpose of the Contract Drawings is to indicate a systems concept, the main components of the system, and the approximate geometrical relationships, the Subcontractor shall provide all other components and materials necessary to make the systems fully complete and operational.
- E. Information and components shown on riser diagrams but not shown on the Contract Drawings and vice versa, shall be provided as if expressly required on both.
- F. Data that may be furnished electronically by the Engineer (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for Engineer's sealed or stamped construction documents.

1.10 DISCREPANCIES IN DOCUMENTS

- A. Where Contract Drawings or Specifications conflict or are unclear, advise the Engineer in writing before Award of Contract. Otherwise the Engineer interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or incongruities thus resolved.

- B. Where Contract Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert the Engineer in writing before installation. Otherwise, make changes in installed Work as the Engineer requires at no additional cost to the Owner.
- C. If the required material, installation or Work can be interpreted differently from drawing to drawing, or between Contract Drawings and Specifications, the Subcontractor shall provide that material, installation, or Work which is of the higher standard.
- D. Provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the Contract Documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the Subcontractor has failed to notify the Engineer of the situation in accordance with the Specifications, the Subcontractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.
- E. In cases covered by the Contract Documents, where the Subcontractor needs engineering guidance, submit a sketch identifying the proposed solution to the Engineer for approval.

1.11 MODIFICATIONS IN LAYOUT

- A. HVAC, Plumbing, and Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other Work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from the Engineer.
- C. Check Contract Drawings as well as Shop Drawings of all trades to verify and coordinate spaces in which Work of this section will be installed.
- D. Maintain maximum headroom at all locations. All piping and associated components to be as tight to underside of structure as possible.
- E. Make reasonable modifications in layout and components needed to prevent conflict with Work of other trades and to coordinate as specified herein. Systems shall be run in a rectilinear fashion.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to the Engineer for review and approval.

1.12 RECORD DRAWINGS

- A. Refer to SECTION 01700, CONTRACT CLOSEOUT for record drawing requirements.

- B. As Work progresses and for duration of Contract, maintain complete and separate set of prints of Contract Drawings at Project Site at all times. Record Work completed and all changes from original Contract Drawings clearly and accurately including Work installed as a modification or addition to the original design.
- C. At Completion of Work prepare a complete set of reproducible record drawings.
- D. The Engineer will not certify the accuracy of the record drawings; this is the sole responsibility of the Contractor.
- E. Submit the record set for approval by the building department in a form acceptable to the department, when required by jurisdiction.
- F. Record drawings shall show record condition of details and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

1.13 MATERIAL LIST

- A. Within 4 weeks of Award of Contract, the Subcontractor through the Contractor shall submit a "Plumbing Equipment and Material List".
- B. The list shall contain all categories of material required with names of intended manufacturers. The list does not replace submittals specified herein.

1.14 WARRANTIES

- A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this section. Such warranties shall be in addition to and not in lieu of all liabilities, which the manufacturer and the Subcontractor may have by law or by provisions of the Contract Documents.
- B. All materials, equipment and Work furnished under this section shall be guaranteed against all defects in materials and workmanship for a minimum period of one year commencing with the Date of Substantial Completion. Any failure due to defective material, equipment or workmanship which may develop shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.
- C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Contract Drawings.
- D. Upon receipt of notice from the Owner of the failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.15 SURVEY AND MEASUREMENTS

- A. Base all required measurements, horizontal and vertical, from referenced points established by the Contractor and be responsible for correctly laying out the Work required under this section of the Specifications.
- B. In the event of discrepancy between actual measurements and those indicated, notify the Contractor, in writing, and do not proceed with the related Work until instructions have been issued.

1.16 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600 MATERIALS AND EQUIPMENT.
- B. All manufactured materials shall be delivered to the Project Site in original packages or containers bearing the manufacturer's labels and product identification.
- C. Protect materials against dampness. Store off floors, under cover, and adequately protected from damage.
- D. Deliver products to the Project Site and store and protect same as recommended by the manufacturers'.
- E. Inspect all Plumbing equipment and materials, upon receipt at the Project Site, for damage and correctness.

1.17 PROTECTION OF WORK AND PROPERTY

- A. Care and protect all Work included under this section until it has been tested and accepted.
- B. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment.
- C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by Work or workmen under this section and make good damage thus caused.

1.18 SUPERVISION

- A. Supply the service of an experienced and competent supervisor who shall be in charge of the plumbing work at the Project Site.

1.19 SAFETY PRECAUTIONS

- A. Comply with all of the safety requirements of OSHA throughout the entire construction period of the Project.
- B. Provide and maintain proper guards for prevention of accidents and any other necessary construction required to secure safety of life and/or property.

1.20 SPARE PARTS

- A. Furnish spare parts data for each different item of equipment furnished. The data shall include a complete list of parts and supplies, with current unit prices and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified hereinafter to be furnished as part of the contract; and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 180 days at the particular installation. The foregoing shall not relieve the Subcontractor of any responsibilities under the guarantees specified herein.

1.21 HOISTING, SCAFFOLDING AND PLANKING

- A. The Work shall include the furnishing, set-up and maintenance of all derricks, hoisting machinery, scaffolds, staging, planking, ladders, etc. as required for the Work.

1.22 SLEEVES, INSERTS, ANCHOR BOLTS, AND PLATES

- A. Be responsible for the location of and the maintaining in proper position all sleeves, inserts and anchor bolts supplied and/or set in place. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Subcontractor's expense without any additional cost to the Owner.

1.23 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

- A. Provide all supplementary steel, channels and supports required for the proper installation, mounting and support of all plumbing equipment, piping, etc., required by the Specifications.
- B. Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Engineer.
- C. The type and size of the supporting channels and supplementary steel shall be determined by the Sub-contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

1.24 CERTIFICATES OF INSPECTION/APPROVAL

- A. Furnish upon completion of all Work, certificates of inspections from the manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be in satisfactory operating conditions.

1.25 ACCESSIBILITY

- A. All Work shall be installed so that parts requiring inspection, operation, maintenance and repair are readily accessible. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Engineer.

1.26 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 accessory and support.
 2. "Install" shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting, proper location 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, drains, hangers and other accessories relative to such piping.
 6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, embedded in construction or in crawl space.
 7. "Exposed" shall mean not installed underground or concealed as defined above.
 8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the general 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 of the specification shall be in compliance with work of other trades.

PART 2 MATERIALS

2.01 DOMESTIC WATER SUPPLY PIPE AND FITTINGS

- A. Above floor piping shall be Type L copper tubing, ASTM B88, hard tempered, with wrought copper fittings and unions; joints shall be made up with 95/5 tin antimony solder and non-corrosive flux.
- B. Under ground and under slab piping (as applicable) shall be Type K copper tubing, soft annealed copper tubing with ANSI B16.18 or ASME B16.22 solder joint fittings. Provide minimum number of joints in buried copper tubing. Joints shall be brazed. Brazing filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints. Braze joint fittings shall be specifically designed for brazing.

2.02 DRAIN WASTE AND PUMPED DISCHARGE PIPE AND FITTINGS

- A. Below grade (as applicable) shall be service weight cast iron soil pipe and fittings, ASTM A74, coated with tar or asphaltum, resilient gasket joints.

- B. Above grade shall be service weight cast-iron with no hub joints, except piping two inch or smaller may be schedule 40 galvanized steel with 150 lb. galvanized malleable iron drainage fittings, or type DWV copper with wrought copper drainage fittings.
- C. Pumped discharge piping shall be schedule 40 galvanized steel with Class 125 galvanized cast iron fittings. Piping and fittings shall be joined by threaded connections.
- D. Cleanouts
 - 1. ANSI A112.36.2M; provide threaded bronze cleanout plugs.
 - 2. Floor Cleanouts
 - a. Provide cast-iron or ductile-iron floor cleanout with anchor flange, adjustable height polished bronze, nickel bronze, stainless steel, or chromium-plated copper alloy rim and scoriated floor plate with "CO" cast in the plate, and countersunk screws for installing floor plate flush with finished floor.

2.03 STORM DRAINAGE PIPING ABOVE FLOOR (AS APPLICABLE)

- A. Piping shall be no-hub service weight cast iron soil pipe except at cleanouts and joints just prior to exiting the building which shall be service weight hub and spigot with lead and oakum joints.
- B. Couplings for joining no-hub cast iron soil pipe: Couplings shall have a shield constructed of corrugated 304 stainless steel and provide a shield thickness of 0.16 inches or greater. Shield shall be a minimum width of 3 inches for pipe sizes 1-1/2 inch through 4 inch, and a minimum width of 4 inches for pipe sizes 5 inch through 10 inches. Couplings with at least four (4) sealing bands shall require 80 inch pounds of torque per band. Tightening screws shall be 3/8 inch hexagon head. Couplings with only two (2) sealing bands on sizes 1-1/2 inch through 4 inches shall require 125 inch pound of torque per band. Gaskets shall be neoprene rubber conforming to ASTM C-564.

2.04 STORM DRAINAGE PIPING BELOW FLOOR (AS APPLICABLE)

- A. Piping below floor shall be service weight cast iron hub and spigot.
- B. Joints in cast iron soil piping below ground shall be code approved compression type, made with rubber gaskets conforming to ASTM Specification C564. Joints in cast iron soil pipe and fittings using a double seal, compression type molded neoprene gasket shall be provided with a modified hub as required to provide a positive seal. No-hub pipe will not be allowed below ground.

2.05 ACID WASTE AND VENT PIPING (AS APPLICABLE)

- A. Pipe and fittings shall be one of the following:

1. Flame Retardant Polypropylene meeting ASTM F1412. Connections shall be electro fusion except mechanical joint shall be allowed under laboratory benches. Pipe and fittings shall be manufactured by Georg Fisher Sloan, Enfield, Orion or approved equal
 2. CPVC meeting ASTM F2618. Connections shall be made using a specially formulated solvent cement meeting ASTM F493 except mechanical joint shall be allowed under laboratory benches. Pipe and fittings shall be ChemDrain® manufactured by Charlotte Pipe and Foundry Co. or approved equal.
- B. In plenum areas, one of the following shall be used:
1. PVDF meeting ASTM F1673. . Connections shall be electro fusion except mechanical joint shall be allowed under laboratory benches. Pipe and fittings shall be manufactured by Georg Fisher Sloan, Enfield, Orion or approved equal.
 2. If allowed by the local AHJ CPVC may be installed using an approved plenum wrap insulation. Insulation shall be 3M™ Fire Barrier Plenum Wrap 5A+ or approved equal.
 3. Chemical or acid waste systems shall be listed by NSF International and bear the mark: “NSF-cw”.

2.06 HANGERS AND SUPPORTS

- A. Pipe hangers shall conform to MSS SP 58 and SP 69. Pipe hangers for piping 4 inch and larger shall have rolls either of the Harvard type or 2 rod type. Pipe hangers for 3 inch pipe and under shall be clevis type. Pipe hangers for pipe less than 2 inch may be 1A band type in lieu of clevis type. Hangers in contact with copper tubing shall be copper plated.
- B. All hangers on insulated piping shall be sized to fit the outside of the covering. Provide spacer blocks and 16 gauge galvanized protection shields (12 inches long) at hangers, when pipe is installed.
- C. All hanger rods shall be hung from wood frame ceiling structure using wood screws designed for use with threaded rod adapters or through-bolted with double nuts and flat washers.
- D. Where support points are required to avoid other Work, provide a system of channels and angles between support points as required. Provide all necessary supports and cross framing. No part of piping, ductwork, equipment, and the building shall be stressed beyond its normal allowable working strength.

2.07 SLEEVES

- A. Sleeves shall be sized to allow 1/2 inch of annular space between the covering (or bare pipe) and the inside of the sleeve.

- B. Pipe penetrations through floors and exterior walls shall be sleeved and sealed using Thunderline Link-Seal wall sleeves and seals or approved equal.
- C. In other areas, pack the annular space with non-combustible (as defined by ASTM E136) fire stopping material, and seal with non-combustible caulking flush with finish surface.
- D. Sleeves in concrete construction shall be galvanized steel pipe, except where passing through exterior walls they shall be ductile iron. Sleeves passing through floors shall project 1 inch above the finish floor. Sleeves in frame and dry wall construction shall be 18 gauge galvanized steel sheet metal.
- E. Provide escutcheons at all exposed pipe penetrations in finished areas. Escutcheons shall be chrome plated, sized to cover the sleeve, with set screw.

2.08 PLUMBING SPECIALTIES

- A. Pressure reducing valves shall be Watts, U5BLP (or 223 SB) with integral removable stainless steel strainer, nickel alloy seat, and bronze body. Provide a 0-100 psi pressure gauge immediately downstream of the valve.
- B. Relief valves (for hot water heater) shall be combination pressure/temperature relief valves, ASME labeled.
- D. Reduced pressure backflow preventers shall be Watts Series 909, Hersey Beeco, ITT Lawlor, or approved equal bronze body reduced pressure zone back flow type, 175 psi maximum working pressure, complete with replaceable seats, strainer, test cocks, shut off valves, union ends, and air gap fitting. Backflow preventers shall be ASSE, AWWA, and FCCCHR or USC approved.
- E. Vacuum breakers: Shall be provided in all domestic water heater cold water inlets, in hose bibb and wall hydrant outlets, and in all other locations specified and as directed by the authority having jurisdiction.
- F. Water hammer arrestors shall be certified per PDI Standard WH-201 and have stainless steel shell and bellows, 250 psi rated as manufactured by Josam, Zurn, J.R. Smith, or approved equal.
- G. Provide dielectric couplings at all ferrous to non-ferrous joints.
- H. Pressure gauges shall be ASME B 40.1, liquid filled type, 1% accuracy or better, minimum 2 1/2 inch diameter casing, 0 to 100 psig range, with ball valve shutoff and snubber.

2.09 VALVES

- A. Butterfly Valves, 2-1/2 Inch and Larger: MSS SP-67; rated at 200 psi; cast iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, nickel-plated ductile iron disc (except aluminum bronze disc for valves installed in condenser water piping), stainless steel stem, and EPDM O ring stem seals. Provide lever operators with locks for sizes 2 through 6 inches and gear operators with position indicator

for sizes 8 through 24 inches. Provide lug or wafer type as indicated. Drill and tap valves on dead end service or requiring additional body strength.

- B. Gate Valves 2-1/2 inch and larger: Class 175 iron body bronze mounted OS&Y with non-rising stem, bronze disk and flanged ends as manufactured by Jenkins, Crane, Stockham or approved equal.
- C. Gate Valves 2 inch and Smaller: MSS SP-80, Class 125, with bronze body and integral bronze seat, rising stem, screwed bonnet, solid wedge disk, and threaded ends as manufactured by Jenkins, Crane, Stockham, or approved equal.
- C. Ball Valves 2 inch and Smaller: MSS SP-110, 150 psi WSP, with 2 piece bronze body, PTFE seats and seals, full port, blowout proof pressure retaining stem, threaded ends, and vinyl covered carbon steel quarter-turn lever handle. Provide stainless steel ball and stem, with stem extension to accommodate thickness of pipe insulation.
- D. Check Valves 2 inch and Smaller: MSS SP-80, Class 150, with bronze body, swing check, thread-in cap, and threaded ends, designed for horizontal or vertical mounting.

2.10 MIXING VALVE

- A. Mixing valves shall be of lead free brass body constructions with thermal actuator, adjustable temperature selection with lock down, union connections, integral checks and screens. Provide Powers model LFLM490 or approved equal by Symmons or Lawler.

2.11 PLUMBING FIXTURES

- A. Emergency Shower and Eyewash Station (combination), EWU-1
 - a. Fixture: Guardian model G1996, stainless steel corrosion resistant drench shower with eye/face wash.
 - b. Mixing Valve: Lawler 911, emergency thermostatic blending valve, 30 gpm flow rate and 21 gpm by-pass flow rate at 30 psi.
 - c. Combination strobe light and alarm with flow switch, Guardian model AP275-705C1D2 for Class 1, Division 2 environment.

2.12 FLOOR DRAINS AND ELECTRONIC TRAP PRIMERS (As applicable)

- A. General: Floor drains shall be Froet, Jay R. Smith, Josam, Zurn, or approved equal. Manufacturer's catalog numbers specified herein for drains are intended only as a guide for the type and quality to be furnished under this Section of the Specifications.
 - 1. Floor Drain "A" (FD "A" Finished Areas) shall be equal to Jay R. Smith Figure #2005Y-A-B-P050 with sediment bucket and trap primer connection.
 - 2. Floor Drain "B" (FD "B" Mechanical Rooms) shall be equal to Jay R. Smith Figure #2130-B-U-PB-P with sediment bucket, trap primer connection and ductile iron grate.

- D. Where noted on plans, remove and discard strainers and/or grates from existing floor drains. Furnish and install new strainers and grates of type compatible with the existing floor drain and suitable for the floor type (Finish or Rough, as applicable.)
- C. General: Electronic trap primers shall be PPP Inc, Zurn, Sioux Chief, or approved equal. Manufacturer's catalog numbers specified herein for trap primers are intended only as a guide for the type and quality to be furnished under this Section of the Specifications.
 - 1. Electronic Trap Primer (ETP) shall be equal to PPP Inc MPB-500-115V mini-prime electronic trap priming manifold with box, 120V, single phase, integral stainless steel screen, solenoid valve, 1 inch air gap, and ½ inch inlet and outlet. Install per manufacturer's requirements and recommendations.

2.13 ROOF DRAINS AND ACCESSORIES

- A. General: Roof drains shall be Froet, Jay R. Smith, Josam, Zurn, or approved equal. Manufacturer's catalog numbers specified herein for drains are intended only as a guide for the type and quality to be furnished under this Section of the Specifications.
 - 1. Roof drain shall be equal to Jay R. Smith figure #1010 ERCY with secured cast iron dome extension, sump receiver, underdeck clamp, and no-hub adapter.

2.14 PIPING INSULATION

- A. General
 - 1. The pipe covering specified herein for piping system shall be provided to strict accordance with the manufacturer's printed instructions, the best practice of the trade and to the full intent of this Specification.
 - 2. Flame/Smoke Ratings: Provide complete fibrous glass pipe insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
 - 3. Manufacturer: Subject to compliance with requirements, provide products of Armstrong World Industries, Inc., Knauf Fiber-Glass, Owens Corning or approved equal.
 - 4. Apply insulation after systems have been tested, proved tight and approved by Architect. Remove dirt, scale, oil, rust and foreign matter prior to installation of insulation.
 - 5. No leaks in vapor barrier or voids in insulation will be accepted.
 - 6. Insulation and vapor barrier on piping which passes through walls or partitions shall pass continuously through sleeve, except that piping between floors and through fire walls or smoke partitions shall have space allowed for application of

approved packing between sleeves and piping, to provide firestop as required by NFPA. Seal ends to provide continuous vapor barrier where insulation is interrupted.

B. Interior Cold, Hot Water, and Non-Potable Water Systems:

1. 1 inch thickness fiberglass piping insulation (Note: hot water pipe size up to 1½ inch)
2. 1½ inch thickness fiberglass piping insulation (Note: hot water pipe size 2 inch and above)
 - a. ASTM E-547, Class I
3. Fire retardant foil face jackets for piping insulation: ASTM C-921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at installation option.
4. Encase piping fittings insulation with one piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.
5. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

2.15 OIL FIRED WATER HEATER

- A. Oil fired water heater shall be as manufactured by A.O. Smith, RHEEM, State, Bradford-White, or approved equals.
- B. 7DWH-1: Water heater shall be model COF-199, manufactured by A.O. Smith, having an oil firing rate of 1.42 GPH of No. 2 fuel oil and a recovery rate of 191 GPH at a 100°F temperature rise. Water heater shall have a storage capacity of 86 gallons. Water heater shall have the UL seal of certification. Tank interior shall be lined with alkaline borosilicate fused to a steel shell. Water heater shall meet or exceed the energy factor requirement of ASHRAE. Tank shall have working pressure rating of 160 psi, and shall be completely assembled. Tank shall be insulated with 2" fiberglass insulation.
- C. Water heater oil burner shall be UL listed and shall have flame retention, interrupted ignition and be equipped with primary controls which will provide for 15 second safety shutdown in the event of flame failure.
- D. The heater(s) shall be factory equipped with temperature limiting device, drain valve, flame observation port and 180°F adjustable thermostat having upper and lower sensing bulbs which average the water temperatures at the top and bottom of the tank for maximum water temperature control. A CSA Certified and ASME Rated T&P Relief Valve shall be furnished and installed by the factory. Heater tank shall have a 3 year limited warranty against corrosion and tank failure due to sediment buildup as outlined in the warranty.
- E. Furnish, install and pipe a thermal expansion tank off the hot water line. Expansion tank shall be an ELBI DTS-30, 8 gallon thermal expansion tank or approved equal.

2.16 WATER HEATER FLUE PIPE

- A. Water heater flue pipe shall be furnished and installed under the section BREECHING AND STACK (PREFABRICATED) in specification 15500.2.09.

2.17 SUMP PUMPS IN PITS

- A. This Plumbing Contractor shall furnish and install two 2 inch submersible sump pumps assemblies as shown on the drawings. The sump pumps shall have a capacity of 20 GPM against a TDH of 40 feet. The sump pump assembly shall be based around WEIL model 2443 or approved equal by Liberty or Zoeller.
 - 1. Motors shall be not less than 2 HP, 480 volts, 3 phase, 1350 RPM.
 - 2. Pumps shall have a 20 foot cord.
 - 3. Motor(s) shall be housed in watertight cast iron shell. Oil filled motors will not be considered equal. Motor(s) shall have Class 'F' insulation and permanently lubricated double seal ball bearings. Motor(s) using sleeve type bearing will not be considered equal. Mating surfaces between the motor and bell, motor shell and seal housing shall be sealed by means of 'O' rings. The motor shaft shall be Series 300 stainless steel with keyway for positive positioning of the impeller. Carbon steel and 400 series stainless steel shafts are not considered equal.
 - 4. Impeller shall be multi-vane, semi-open type and accurately machined to the proper diameter. The impeller is to be trimmed to suit job conditions and then dynamically balanced.
 - 5. Controls to include:
 - a. 3-Float switches suspended from wall bracket
 - b. 1-8111 NEMA 4X Simplex control panel to include:
 - 1) Comb. Manual disconnect switches & motor circuit protectors
 - 2) Magnetic starters
 - 3) H/O/A Selector switches
 - 4) On/Off Pilot lights
 - 5) Control circuit transformer
 - 6) Alarm bell with silencer
 - 7) Numbered & wired terminal strip
 - 8) Set of isolated dry contacts for remote alarm.
 - 9) Through door main disconnect switch.
 - 6. Pit by others

2.18 PITLESS DRAINAGE PUMPS

- A. This Plumbing Contractor shall furnish and install a 2 inch drain pump assembly as shown on the drawings. The pump shall be capable of operating on a flat floor without the need for a sump or pit. The sump pump shall have a capacity of 20 GPM against a TDH of 31 feet. The sump pump assembly shall be based around TSURUMI model LSR2.4S or approved equal.
1. Motors shall be not less than 2/3 HP. Voltage shall be compatible with the level switch in the controls section.
 7. Pumps shall have a 32 foot cord.
 8. Motor(s) shall be housed in watertight ethylene propylene rubber casing. Motor(s) shall have Class 'E' insulation and permanently lubricated double seal ball bearings. Mating surfaces shall be sealed by means of mechanical seals with silicon carbide faces. The motor shaft shall be Series 403 stainless steel.
 9. Impeller shall be semi-vortex urethane. Pump shall be top discharge flow-thru design.
 10. Pump control shall be via a Level Switch equal to TSURUMI SLS-LSC. Control shall consist of a switch assembly, attached cord and plug/receptacle. Plug shall be plugged into a wall receptacle and pump power plug shall be plugged into the Level Switch receptacle end.

PART 3 EXECUTION

3.01 OPENINGS

- A. The responsibility for determining the exact size and location of openings is part of the Work of this section. If this responsibility is not met, cutting and patching to achieve the correct size and location of openings and chases is part of the Work of this section.

3.02 CUTTING AND PATCHING

- A. Do all cutting and patching required for the Work of the section, except cutting and patching of finish (visible) materials. Cutting and patching of masonry walls, partitions, ceilings and floors is included. Concrete cutting shall be done with abrasive wheels or saws, and coring with a diamond core bit. The use of jackhammers is prohibited.

3.03 INSTALLATION OF EQUIPMENT

- A. Equipment shall be installed in strict accordance with manufacturer's instructions, unless otherwise specified herein, or on the Contract Drawings. In case of discrepancies, contact the Engineer for instructions.

- B. 1. Install roof drains at low points of roof areas, in accordance with the roof membrane manufacturers installation instructions.
- 2. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
- 3. Position roof drains so that they are accessible and easy to maintain.

3.04 INSTALLATION OF PIPING

- A. Provide a shutoff valve on each pressure piping connection at each item of equipment, except vent and overflow connections.
- B. Do not install valves with the stem below horizontal.
- C. Provide a union or flange at each connection at each item of equipment.
- D. Install piping parallel to or perpendicular to the lines of the building.
- E. Pitch all pressurized water piping up 1 inch in 80 feet, or run dead level and provide an air vent every 40 feet.

3.05 CLEANING

- A. Clean all debris resulting from the work of the section, and remove it from the Project Site, daily.
- B. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all Work, thoroughly clean all fixtures, exposed materials and equipment.

3.06 TESTS

- A. Test water piping at 100 psi hydrostatic pressure before any covering is installed. Blank off or remove items which may be damaged by the test pressure. Correct all defects and retest as many times as is necessary to verify that all defects have been remedied. Neither peening nor the use of leak seals is permitted.
- B. Test drain-waste piping by tightly plugging all openings except for the highest opening in the system. Fill all systems to overflowing. Systems shall be tight throughout with no drop in water level for a minimum period of 2 hours.

3.07 DISINFECTION OF WATER SUPPLY SYSTEM

- A. Fill all systems with a water and chlorine solution which contains 50 parts per million of available chlorine and allow it to stand 6 hours before flushing. Fill each system with a solution which contains 100 parts per million of available chlorine; allow it to stand 2 hours and flush it.

3.08 PAINTING

- A. Clean all surfaces free of dirt, oil, grease, etc. Surfaces shall be clean and dry before any paint is applied.
- B. Restore to original condition and appearance any equipment which has sustained damage to the manufacturer's prime and/or finish coat.

3.09 OPERATING AND MAINTENANCE MANUALS

- A. Furnish to the Owner operations and maintenance instructions of all mechanical, electrical and manually operated equipment furnished and/or installed under the Contract, as specified. See SECTION 01730, OPERATION AND MAINTENANCE MANUALS.

END OF SECTION

3.02 CUTTING AND PATCHING

- A. Do all cutting and patching required for the Work of the section, except cutting and patching of finish (visible) materials. Cutting and patching of masonry walls, partitions, ceilings and floors is included. Concrete cutting shall be done with abrasive wheels or saws, and coring with a diamond core bit. The use of jackhammers is prohibited.

3.03 INSTALLATION OF EQUIPMENT

- A. Equipment shall be installed in strict accordance with manufacturer's instructions, unless otherwise specified herein, or on the Contract Drawings. In case of discrepancies, contact the Engineer for instructions.
- B.
 - 1. Install roof drains at low points of roof areas, in accordance with the roof membrane manufacturers installation instructions.
 - 2. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
 - 3. Position roof drains so that they are accessible and easy to maintain.

3.04 INSTALLATION OF PIPING

- A. Provide a shutoff valve on each pressure piping connection at each item of equipment, except vent and overflow connections.
- B. Do not install valves with the stem below horizontal.
- C. Provide a union or flange at each connection at each item of equipment.
- D. Install piping parallel to or perpendicular to the lines of the building.
- E. Pitch all pressurized water piping up 1 inch in 80 feet, or run dead level and provide an air vent every 40 feet.

3.05 CLEANING

- A. Clean all debris resulting from the work of the section, and remove it from the Project Site, daily.
- B. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all Work, thoroughly clean all fixtures, exposed materials and equipment.

3.06 TESTS

- A. Test water piping at 100 psi hydrostatic pressure before any covering is installed. Blank off or remove items which may be damaged by the test pressure. Correct all defects and retest as many times as is necessary to verify that all defects have been remedied. Neither peening nor the use of leak seals is permitted.
- B. Test drain-waste piping by tightly plugging all openings except for the highest opening in the system. Fill all systems to overflowing. Systems shall be tight throughout with no drop in water level for a minimum period of 2 hours.

3.07 DISINFECTION OF WATER SUPPLY SYSTEM

- A. Fill all systems with a water and chlorine solution which contains 50 parts per million of available chlorine and allow it to stand 6 hours before flushing. Fill each system with a solution which contains 100 parts per million of available chlorine; allow it to stand 2 hours and flush it.

3.08 PAINTING

- A. Clean all surfaces free of dirt, oil, grease, etc. Surfaces shall be clean and dry before any paint is applied.
- B. Restore to original condition and appearance any equipment which has sustained damage to the manufacturer's prime and/or finish coat.

3.09 OPERATING AND MAINTENANCE MANUALS

- A. Furnish to the Owner operations and maintenance instructions of all mechanical, electrical and manually operated equipment furnished and/or installed under the Contract, as specified. See SECTION 01730, OPERATION AND MAINTENANCE MANUALS.

END OF SECTION

SECTION 15500

HEATING, VENTILATION AND AIR CONDITIONING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Work of this section includes all labor, tools, material, fittings, accessories and equipment necessary to provide the heating, ventilating and air conditioning systems, complete and operable.
- B. The Work includes, without limiting the generality thereof:
 - 1. Oil Fired Boiler/Burner Unit
 - 2. Boiler Flue Pipe
 - 3. Water Heater Flue Pipe (for Oil Fired Water Heater in Specification 15400)
 - 4. Circulating Pumps
 - 5. Piping
 - 6. Energy recovery ventilation systems
 - 7. Makeup Air Unit
 - 8. Odor Control Fan by Others.
 - 9. Wall Mounted electric heaters (As applicable)
 - 10. Hot Water unit heaters
 - 11. Ductless Split System Heat Pump (Comfort Cooling)
 - 12. Ductless Split System Heat Pump (Process Cooling for VFDs and Servers)
 - 13. Supply and exhaust ventilation ductwork.
 - 14. FRP ductwork.
 - 15. Control wiring and conduit
 - 16. Testing, adjusting and balancing.
 - 17. HVAC Demolition.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Oil Fired Boiler/Burner
 - 2. Energy recovery units
 - 3. Makeup Air Unit
 - 4. Wall Mounted electric heaters
 - 5. Hot Water unit heaters
 - 6. Ductless Split System Heat Pump
 - 7. Ductwork
 - 8. Ductwork accessories
 - 9. FRP ductwork
 - 10. FRP ductwork accessories
 - 11. Piping, Fittings Valves and Strainers
 - 12. Piping accessories
 - 13. Insulation

14. Testing Adjusting and Balancing Report.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300, Cast-In-Place Concrete, including equipment support pads.
- B. Section 05500, Metal Fabrications
- C. Section 09900, Painting
- D. Section 16085, Miscellaneous Equipment
- E. Section 16120, Wire and Cables

1.04 ITEMS INSTALLED BUT NOT FURNISHED

- A. Duct Smoke Detectors – DIVISION 16 – ELECTRICAL.

1.05 ITEMS FURNISHED BUT NOT INSTALLED

- A. Thermostats for unit heaters – SECTION 16 – ELECTRICAL.

1.06 DESIGN CRITERIA

- A. The Work of this section shall comply with the requirements of the Massachusetts State Building Code and of all other authorities having jurisdiction.
- B. The equipment covered by the Specifications is intended to be standard equipment of proven quality as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practice of the industry and shall operate satisfactorily when installed in accordance with the Contract Documents. The Specifications call attention to certain details, but do not purport to cover all details entering into the construction of the equipment.
- C. All material shall be new and shall bear the manufacturer's full identification.
- D. Requirements of Regulatory Agencies
 - 1. The final, complete installation shall comply with all state and local statutory requirements having jurisdiction. Arrange for all necessary permits, pay all fees and arrange for all required inspections by state and local authorities.
 - 2. In general, all Work shall comply with the requirements of rules, regulations, standards, codes, ordinances, and laws of local, state, and federal governments, and other authorities that have legal jurisdiction over the Project Site. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:
 - a. Local and state building, HVAC, plumbing, mechanical, energy conservation, electrical, fire and health department codes.
 - b. National Fire Protection Association (NFPA).
 - c. Occupational Safety and Health Act (OSHA).

- d. Underwriters' Laboratories (UL).
 - e. Material and equipment shall be listed by Underwriters' Laboratories (UL), and approved by ASME for intended service.
3. When requirements cited in the Specifications conflict with each other or with Contract Documents, most stringent shall govern Work.
4. Most recent editions of applicable specifications and publications of the following organizations form part of Contract Documents:
- a. American National Standards Institute (ANSI).
 - b. American Society of Mechanical Engineers (ASME).
 - c. National Electric Manufacturers Association (NEMA).
 - d. American Society for Testing and Materials (ASTM).
 - e. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - f. Air Moving and Conditioning Association (AMCA).
 - g. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 - h. Thermal Insulation Manufacturers Association (TIMA).
 - i. Institute of Electrical and Electronics Engineers (IEEE).
 - j. Insulated Cable Engineers Association (ICEA).

E. Tests, Adjusting and Balancing

- 1. Test all systems furnished under this section and repair or replace all defective Work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of all systems.
- 2. Defined to include, but not necessarily limited to, air distribution systems, and associated equipment and apparatus of mechanical Work. Work consists of setting speed and volume (flow) adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to Work as required by the Contract Documents.
- 3. Startup the following pieces of equipment in strict accordance with manufacturer instructions and with the manufacturer's representative.
 - a. Energy Recovery Unit(s)

- b. Makeup Air Unit(s)
 - c. Boiler/Burner
4. Submit certified test reports signed by test and balance supervisor performing TAB Work.
 5. Include identification and types of instruments used and most recent calibration date with submission of final test report.
 6. Shop Drawings
 - a. Submit sample test data forms complete with certifying agency logo, identifying required test data, date, page number, system designation, system location, Project name, and balancer's name.
 7. Tester's Qualifications: Firm with at least 3 years successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for the Project, not installer of system to be tested, and otherwise independent of the Project.
 8. NEBB or AABC Compliance: Comply with either National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, as applicable to mechanical air distribution systems and associated equipment and apparatus.
 9. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing except as otherwise indicated.
 10. Do not proceed with testing, adjusting, and balancing Work until each system is complete and operable. Ensure no later residual Work still to be completed.
 11. Do not proceed until Work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt, and discarded building materials.
 12. The Engineer shall be immediately notified of any unfavorable test results or indication of faulty equipment. No piece of equipment shall be energized until the test data is evaluated and the equipment is proven acceptable.
 13. Upon completion of the work herein described, the Testing Firm shall submit Test and Inspection Reports to the Engineer.
 14. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to be made to meet the specified requirements.
 15. Upon completion of the remedial work, the Testing Firm shall repeat all of the tests on components previously found deficient on the first test or any additional

test if they be required. Have all remedial Work accomplished as may be required by second and/or additional tests.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600.
- B. All materials and equipment shall be shipped, stored, handled and installed in such manner as not to degrade quality, serviceability, or appearance.
- C. Protect all work, the Owner's property and the property of others from injury or loss caused by operations associated with the Work of this section. Make good any such injury or loss, at no cost to the party suffering the injury or loss.

1.08 PROCEDURE

- A. Secure all required permits, inspections, and approvals and pay all costs and fees.
- B. Unless the Specifications state "No Substitutions", substitutions will be considered for any specified item.
- C. Coordinate safety program with that of the General Contractor. Cooperate with other Subcontractors to establish lines, levels, openings, chases, clearances, and locations to avoid interference; and to protect the Work.
- D. Deliver all materials as needed to avoid delays.

1.09 INTERPRETATION OF DRAWINGS

- A. Listing of Drawings does not limit responsibility of determining full extent of Work required by the Contract Documents. Refer to Architectural, HVAC, Electrical, Structural, and other Contract Drawings and other sections that indicate types of construction in which Work shall be installed and Work of other trades with which Work of this section must be coordinated.
- B. Except where modified by a specific notation to the contrary, the indication and/or description of any item, in the Contract Drawings or Specifications or both, carries with it the instruction to provide the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete Work.
- D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the Contract Drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the Contractor shall provide

all other components and materials necessary to make the systems fully complete and operational.

- E. Data that may be furnished electronically by the Engineer (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for the Engineer's sealed or stamped construction documents.

1.10 DISCREPANCIES IN DOCUMENTS

- A. Where Contract Drawings or Specifications conflict or are unclear, advise the Engineer in writing before Award of Contract. Otherwise, the Engineer's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies thus resolved.
- B. Where Contract Drawings or Specifications do not coincide with manufacturers' recommendations or with applicable codes and standards, alert the Engineer in writing before installation. Otherwise, make changes in installed Work as the Engineer requires at no additional cost to the Owner.
- C. If the required material, installation, or Work can be interpreted differently from drawing to drawing, or between Contract Drawings and Specifications, this Contractor shall provide that material, installation, or Work which is of the higher standard.
- D. Provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the Contractor has failed to notify the Engineer of the situation as specified, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.
- E. In cases covered by Paragraph (D) above, where the Contractor needs engineering guidance, submit a sketch identifying his proposed solution and the Engineer shall review, note if necessary, and approve the sketch.

1.11 MODIFICATIONS IN LAYOUT

- A. Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other Work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. Check Contract Drawings as well as Shop Drawings of all trades to verify and coordinate spaces in which Work of this section will be installed.
- C. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

- D. Make reasonable modifications in layout and components needed to prevent conflict with Work of other trades and to coordinate as specified. Systems shall be run in a rectilinear fashion.
- E. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to the Engineer for review and approval.

1.12 RECORD DRAWINGS

- A. As work progresses and for duration of Contract, maintain complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design. Record valve tags as they are installed. In addition, take photographs of all concealed equipment in gypsum board ceilings, shafts, underground (buried) piping routes and supports and other concealed, inaccessible work. At completion of work, make copies of photographs with written explanation on back. These shall become part of Record Documents.
- B. At completion of work prepare a complete set of record drawings on AutoCad format, showing all systems as actually installed. The design tracings will be made available for the contractor's copying, at his expense, into electronic media reproducible files to serve as backgrounds for the drawings. The quantity of design tracings which are made available shall in no way be interpreted as setting a limit to the number of drawings necessary to show the required information. Contractor's professional draftsman shall transfer changes to electronic disks; submit the disks and three sets of prints to Architect for comments as to compliance with this section.
- C. THE ARCHITECT WILL NOT CERTIFY THE ACCURACY OF THE RECORD DRAWINGS - THIS IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
- D. This trade shall submit the record set for approval by the building department in a form acceptable to the department, when required by the jurisdiction.
- E. Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

1.13 MANUFACTURER'S SERVICES

- A. Provide manufacturer's services for testing, training and start-up of the following equipment:
 - 1. Energy Recovery Units
 - 2. Makeup Air Units
 - 3. Boiler Burner
- B. The time required for each system shall be as specified in this section. The time specified shall be used as directed by the Engineer and shall not be used by the manufacturer or contractor for field adjustments due to manufacturing or shipping defects.

1.14 ELECTRICAL WORK

- A. Except for electrical apparatus specifically called for as part of this Section, all wiring, conduit, switches and controllers required will be provided under DIVISION 16 - ELECTRICAL. (See specification paragraph 15500.2.20.G. for additional information.)
- B. All electrical apparatus and controls furnished as a part of the Work of this section shall conform to applicable requirements under DIVISION 16 - ELECTRICAL. Enclosure types shall be as indicated on the Contract Drawings.
- C. All electrical wiring and conduit necessary for the connections from the SCADA system dry contacts shall conform to the requirements of and be furnished by DIVISION 16 - ELECTRICAL. Enclosure types shall be as indicated on the Contract Drawings.
- D. All motors furnished under this section shall be furnished by the manufacturer of the equipment served and shall be mounted and aligned so as to run free and true. Each motor shall be built to conform to the latest applicable NEMA, ANSI and IEEE standards for the type and duty of service it is to perform.
- E. Each motor shall be designed to operate on 60 Hz., and each shall be expressly wound for the voltage specified. Each motor shall operate successfully as rated load and frequency with a voltage variation of plus or minus 10% of voltage specified.
- F. All motors shall be provided with adequate starting and protective equipment as specified, and each shall have a terminal box of adequate size to accommodate the required conduit and wires.
- G. Electrical Subcontractor shall furnish and install a 120 VAC circuit for a SCADA interface panel for the boiler plant. Panel shall be located in the Boiler Room.
- H. All electrical apparatus furnished under this section shall be approved by UL and shall be labeled or listed where such is applicable.

1.15 WARRANTIES

- A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this section. Such warranties shall be in addition to and not in lieu of all liabilities, which the manufacturer and the contractor may have by law or by provisions of the Contract Documents.
- B. All materials, equipment and work furnished under this section shall be guaranteed against all defects in materials and workmanship for a minimum period of 1 year commencing with the Date of Substantial Completion and Final Acceptance by the Owner. Any failure due to defective material, equipment or workmanship which may develop, shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.
- C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Contract Drawings.

- D. Upon receipt of notice from the Owner of the failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be placed.

1.16 SURVEY AND MEASUREMENTS

- A. Base all required measurements, horizontal and vertical, from referenced points established by the Contractor and be responsible for correctly laying out the Work required under this section of the Specification.

1.17 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01610 and as specified herein.
- B. All manufactured materials shall be delivered to the Project Site in original packages or containers bearing the manufacturer's labels and product identification.
- C. Protect materials against dampness. Store off floors, under cover, and adequately protected from damage.
- D. Deliver products to the Project Site and store and protect same as recommended by the manufacturers'.
- E. Inspect all HVAC equipment and materials, upon receipt at the Project Site, for damage and correctness.

1.18 PROTECTION OF WORK AND PROPERTY

- A. Care and protect for all Work included under this section until it has been tested and accepted.
- B. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment.
- C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this section and make good damage thus caused.

1.19 SAFETY PRECAUTIONS

- A. Comply with all of the safety requirements of OSHA throughout the entire construction period of the Project.
- B. Provide and maintain proper guards for prevention of accidents and any other necessary construction required to secure safety of life and/or property.

1.20 SPARE PARTS

- A. Furnish spare-parts data for every component that is required to be maintained for normal service of equipment furnished. The data shall include a complete list of parts and supplies, with current unit prices and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified hereinafter to be furnished as part of the Contract; and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 180 days at the particular installation. The foregoing shall not relieve the contractor of any responsibilities under the guarantees specified herein.

1.21 HOISTING, SCAFFOLDING AND PLANKING

- A. The Work to be done under this section of the Specifications shall include the furnishing, set-up and maintenance of all derricks, hoisting machinery, scaffolds, staging, planking, ladders, etc. as required for the Work.

1.22 SLEEVES, INSERTS, ANCHOR BOLTS, AND PLATES

- A. Be responsible for the location of and the maintaining in proper position all sleeves, inserts and anchor bolts supplied and/or set in place. In the event that failure to do so requires cutting and patching of finished Work, it shall be done at this Subcontractor's expense without any additional cost to the Owner.

1.23 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

- A. The HVAC Subcontractor shall provide all supplementary steel, including channels and supports required for the proper installation, mounting and support of all HVAC equipment, piping, etc., required by the Specifications.
- B. Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Engineer.
- C. The type and size of the supporting channels and supplementary steel shall be determined by the HVAC Subcontractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.
- D. **All steel used for supplementary steel, channels and supports shall be 316 stainless steel.**

1.24 CERTIFICATES OF INSPECTION/APPROVAL

- A. Furnish upon completion of all Work, certificates of inspections from the manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be in satisfactory operating conditions.

1.25 ACCESSIBILITY

- A. All Work shall be installed so that parts requiring inspection, operation, maintenance and repair are readily accessible. Minor deviations from the Contract Drawings may be made

to accomplish this, but changes of substantial magnitude shall not be made prior to receipt of written approval from the Engineer.

1.26 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 accessory and support.
 2. "Install" shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting, proper location 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, drains, hangers and other accessories relative to such piping.
 6. "Concealed" shall mean hidden from sight in chases, furred spaces, shafts, embedded in construction or in crawl space.
 7. "Exposed" shall mean not installed underground or concealed as defined above.
 8. "Furnished by others" shall mean materials or equipment purchased and set in place under other sections of the general 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 of the specification shall be in compliance with work of other trades.

PART 2 - MATERIALS

2.01 PIPE, FITTINGS VALVES AND STRAINERS

- A. Hydronic heating supply and return piping 2" and smaller shall be Type L copper pipe with sweat joints. Pipes 2-1/2" and larger shall be A53 seamless or ERW pipe with carbon steel butt weld fittings.
- B. Fuel oil piping shall be schedule 40 A53 seamless piping with malleable iron threaded fittings or Type L copper tubing with wrought copper sweat fittings.
- C. Refrigerant piping shall be type ACR copper tubing with silver brazed joints and wrought copper fittings.

- D. Condensate drain piping shall be Type 1, Grade 1, Class 12454-B, Schedule 40 polyvinyl chloride (PVC) pipe conforming to ASTM D-1785. Drain piping shall have Schedule 40 PVC socket fittings conforming to ASTM D-2466. All joints between pipe and fittings shall be solvent cemented joints conforming to ASTM D-2235 and ASTM D-402. Provide protection for PVC piping exposed to weather from ultraviolet radiation.
- E. Valves for hot water and fuel oil services shall be 125 psi unless noted otherwise. Provide balancing valves on the return lines from coils, unit heaters air handlers, ERVs and where shown on Drawings.
1. Valves shall have name of manufacturer and guaranteed working pressure cast or stamped on bodies. Valves of similar type shall be by single manufacturer. Provide chain operators for valves 7 feet and higher above floor.
 2. Valves on insulated piping shall have 2" extended stems.
 3. Provide butterfly valves for shutoff service on hot water services 2-1/2" and larger. **Do not use butterfly valves for balancing service.**
 - a. Valves shall be rated 175 psi maximum working pressure, iron body, threaded-lug with resilient EPDM seats, bronze disc and 416 stainless stem, by Centerline, DeZurik, Keystone, or Bray.
 - b. Valves 6" and larger shall have gear or chain operators.
 - c. Valves smaller than 6" shall have seven-position lever or chain operators.
 - d. Test valves at 110% of rated pressure.
 4. Provide bronze-body ball valves with reinforced teflon seats, seals, bearings and packing for shutoff on chilled, hot and condenser water services in sizes 2" and smaller. **Do not use ball valves for balancing service.** Valves on insulated piping shall have 2" extended stems. Valves shall be by Apollo, Cannon, Nibco, Milwaukee, or Watts. Valves shall be rated 600 psi wog.
 5. Combination Balancing/Flow Measurement/Shut-off Valves (See Water Specialties for Pump Balance and Shutoff Valves)
 - a. Valves shall be Y-pattern style with multi-turn handwheel and shall be capable of being installed in any direction without affecting flow measurement and shall provide the following functions:
 - 1) Precise flow measurement.
 - 2) Precision flow balancing.
 - 3) Positive shut-off with no drip seat.
 - 4) 3/4" drain port suitable for hose bib fitting. (Sizes 2" and below.)
 - b. Valves shall have four, 360^o adjustment turns (2" and below), eight, 360^o adjustment turns (2-1/2" - 6"), twelve, 360^o adjustment turns (8", 10"), and sixteen, 360^o adjustment turns (12"), twenty, 360^o adjustment

turns (14"), and twenty-two, 360° adjustment turns (16"). Handwheels shall have digital indicators with hidden memory and tamper-proof setting features.

- c. Valves 2" and below shall be non-ferrous, pressure die-cast, non-porous metal copper alloy, with soldered or threaded ends.
 - d. Valves 2-1/2" and over shall be ductile iron body with all other metal parts of non-ferrous copper alloy. End connections shall be flanged or grooved.
 - e. Pressure ratings shall be 300 psi for 2" and below and 250 psi for flanged and 350 psi for grooved ends.
 - f. Each valve shall have pressure/temperature readout ports with EPDM seals and attached shut-off valves.
 - g. One, computerized hand-held, balancing meter shall be furnished to the Owner. The Testing and Balancing Contractor shall utilize this instrument for his work. The meter shall include the following:
 - 1) Flow measurement direct in GPM.
 - 2) Differential pressure measurement.
 - 3) Temperature measurement.
 - 4) Automatic calibration.
 - 5) Automatic air purging.
 - 6) Extended data logging functions.
 - h. Balance valves 2" and under shall be Tour and Anderson Model STAS. Valves 2-1/2" and over shall be Tour and Anderson Models STAF-SG or STAG. The handheld meter shall be Tour and Anderson Model CBI with PCB data logging features. Balance valves manufactured by Armstrong or Victaulic shall be considered equivalent.
6. Check valves sized 2-1/2" and larger shall be iron body, flanged ends, bronze mounted, swing pattern. Check valves 2" and smaller shall be bronze, screwed ends, swing pattern. Check valves for hot water, chilled water and condenser water pump discharge shall be spring loaded, silent check, by APCO, Milwaukee, Mueller or Stockham.
7. Relief valves shall be brass with external lever, ASME-approved. Pipe discharge to floor drain with open connection at floor. Pipe refrigerant relief devices through roof to atmosphere.

F. Strainers

- 1. Strainers 2" and smaller shall be 250 lb. bronze body, stainless steel, screen with 20 mesh screen opening, Y-pattern, screwed ends, Sarco Type BT, Mueller, Watts or Armstrong.

2. Strainers 2-1/2" and larger shall be 125 lb., cast iron body, stainless steel screen with manufacturer's recommended screen openings, Y-pattern, flanged, Sarco Type AF-125 or equivalent by Mueller, Watts or Armstrong.
3. Provide blow-off valve on each strainer.
4. Pump suction strainers 2" and smaller shall have 0.062 screen openings. Pump suction strainers 2-1/2" and larger shall have 0.125 screen openings.
5. Strainer gaskets shall not contain asbestos.

2.02 HANGERS AND SUPPORTS

- A. All hangers and supports shall be 316 stainless steel (SS).
- B. Provide pipe stands, supports, hangers and other supporting devices in accordance with ANSI B31.9 and ANSI/MSS SP-58-2009, as necessary to support work required by Contract Documents.
- C. Secure vertical piping to building construction to prevent sagging or swinging.
- D. Space hangers for horizontal piping as follows:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1-1/4"	3/8"	7 ft.-0"
1-1/2 and 2"	3/8"	9 ft.-0"
2-1/2 and 3"	1/2"	10 ft.-0"
4 and 5"	5/8"	12 ft.-0"
6"	3/4"	12 ft.-0"

- E. Horizontal copper tubing shall have maximum hanger spacing of 5 ft. for tubing 1-1/4" dia. and smaller and 9 for tubing 1-1/2" and larger. Maximum spacing for PVC pipe hangers shall be 4'.
- F. Reduce spacing to a maximum of 10'- 0" apart, regardless of pipe size, as necessary for fittings, valves and other concentrated loads.
- G. Support piping 4" dia. and larger from structure with pipe roll hangers with adjustable steel rod hangers, sized to accommodate insulation.
- H. Support piping 3" dia. and under from structure with Carpenter and Patterson Fig. 100 clevis hangers or approved equal.
- I. Hangers shall be by Carpenter and Patterson, F & S, or Anvil Int. Figure numbers of Carpenter and Patterson are specified to establish standards of quality for performance and materials.
- J. Pipe supports for 4" and larger pipe and insulated high-temperature piping shall have welded inserts of equal thickness to insulation to prevent compression of insulation. Other insulated pipe shall have 12", 14 GA shields at hangers, composed of 180° coverage of galvanized sheet metal and high density, pre-formed, rigid insulation. Where rollers are required, shield shall be steel pipe.

- K. All hangers on insulated piping shall be sized to fit the outside of the covering. Provide spacer blocks and 16 gauge SS protection shields (12 inches long) at hangers, when pipe is installed.
- L. Hangers for horizontal lines shall be vertically adjustable to obtain pitch requirements.
- M. In concealed locations where piping is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, shield plates shall be installed over the piping. The plates shall consist of 16 gage steel fastened in place over the pipe and shall extend not less than 2 inches above sole plates and below top plates.
- N. Duct hangers shall be in accordance with the "HVAC Duct Construction Standards" published by the Sheet Metal and Air Conditioning Contractors National Association, Incorporated (SMACNA).
- O. E. Where support points are required to avoid other Work, provide a system of channels and angles between support points as required. Provide all necessary supports and cross framing. No part of piping, ductwork, equipment, and the building shall be stressed beyond its normal allowable working strength.

2.03 UNIONS

- A. Unions for PVC pipe 2 inch and smaller shall be Schedule 40 PVC.
- B. Unions for steel pipe for hydronic service shall be class 150 cast iron.
- C. Unions for steel pipe for fuel oil service shall be malleable iron.

2.04 PIPING SPECIALTIES

- A. Provide dielectric couplings or flanges in all copper to ferrous transitions.
- B. Sleeves
 - 1. Provide sleeves at all penetrations. Sleeves shall be aluminum or 316 stainless steel except in concrete as noted below. Sleeves shall be sized to allow 1/2 inch of annular space between the covering (or bare pipe) and the inside of the sleeve.
 - 2. Pipe penetrations of walls below grade shall be sleeved and sealed using Thunderline Link-Seal wall sleeves and seals.
 - 3. Pack the annular space with non-combustible (as defined by ASTM E136) fire stopping material, and seal with non-combustible caulking flush with finished surface.
 - 4. Sleeves in concrete construction shall be 316L steel pipe, except where passing through exterior walls and slabs-on-grade they shall be ductile iron. Sleeves passing through floors shall project two inches above the finish floor and sleeves passing through walls shall be trimmed flush with the wall surface.

2.05 WATER SPECIALTIES

A. Provide water specialties by Spirotherm, Bell & Gossett, Taco or Amtrol as follows.

1. ASME constructed, approved and stamped diaphragm expansion tank with replaceable diaphragm of capacity shown on Drawings designed and tested for maximum allowable working pressure of 125 psi in accordance with ASME code for unfired pressure vessels. Expansion tank shall be factory-charged as required for system.
2. Furnish and install at all high points and as indicated, air release valves on the hot and/or chilled water systems. Valves shall be equal to Spirotop "Quick Air Release". All valves shall be cast brass, rated for 150 psig design pressure and 270°F operating temperature. Units to include non-ferrous floats, stainless steel linkage and a Viton seal which closes against a brass spring operated seat. Alternate units shall be high capacity cast iron type with brass shut-off valve if using other than Viton, spring operated type air release. Alternates must be rated for 150 psig working pressure and 250°F operating temperature.
3. Furnish and install as shown on the drawings a Spirotrap air separator for the hot water heating system. Separators shall be fabricated steel, rated for 150 psig design pressure and be selected for less than 1 foot of water pressure drop and velocity not to exceed 4 feet per second through the unit at specified GPM. Performance curves from the unit manufacturer shall be furnished as part of the submittal for each unit. Units to include internal copper coalescing medium to facilitate maximum air elimination and suppress turbulence. Alternate units shall be furnished with galvanized steel strainer and stainless steel collector tube for a similar purpose. Provide integral high capacity float actuated air vent at top fitting of tank. Alternates must include cast iron float actuated air vent rated at 150 psig which shall be threaded to the top of the fitting. Unit shall have bottom blow down connection.
4. Furnish and install a Multi-Purpose Valve at the outlet of each centrifugal pump. Valve shall consist of a Class 125 ductile iron body, flanged ends, convertible flanged body configuration, replaceable stem seal packing, non slam check valve, flow metering valve with memory stop, and stop Valve. Water pressure drop shall be 12' head maximum. Size shall be 2-1/2" or as called out on plans. Valve shall be type MPV 025-4 by Taco or approved equal.
5. Furnish and install a Suction Diffuser at the inlet to each centrifugal pump. Suction diffuser shall consist of a Class 125 ductile iron body with flanged ends, stainless steel mesh strainer, integral cast straightening vanes, disposable startup strainer, removable cover plate, blow down port, and magnetic insert. Maximum pressure drop shall be 5 " head. Size shall be 3" x 3" or as called out on plans. Valve shall be type SD030030-5 by Taco or approved equal.

2.06 EQUIPMENT INSULATION

A. General

1. Apply insulation after systems have been tested, proved tight and approved by Architect. Remove dirt, scale, oil, rust and foreign matter prior to installation of insulation.
2. No leaks in vapor barrier or voids in insulation will be accepted.
3. Insulation shall be Certain-Teed, Knauf, Manville or Owens Corning and shall be installed in strict accordance with manufacturer's recommendations.

4. Insulate the following equipment:
 - Expansion tanks
 - Air separators
 - Multipurpose valves
 - Suction Diffusers
 - Duct-mounted coils
5. Insulation shall be 1-1/2" thick fibrous glass rigid block or semirigid board rated for temperature intended. Insulation shall be formed or fabricated to fit equipment. Ensure tight fit. Bevel edges and butt and stagger joints.
- B. Secure with bands or wires at intervals recommended by manufacturer, no more than 12" centers. Provide corner angles.
- C. Set cellular glass insulation and seal joints with bedding compound. Fill mineral fiber joints with insulating cement.
- D. Apply two coats of adhesive with fibrous glass cloth embedded in first coat before application of second. Dry film thickness of finish shall be 1/8". Apply insulating cement over coated insulation; do not coat removable sections.

2.07 CENTRIFUGAL PUMPS

- A. General Requirements
 1. Provide, where shown on drawings, centrifugal pumps, of capacities types and configurations shown on schedules. Acceptable manufacturers shall be:
 - Taco
 - Armstrong
 - Bell and Gossett
 - Gould
 - Wilo
 2. Provided that they meet the requirements of this specification and the performance requirements shown on the schedules (with equal or less horsepower requirement than the pump shown on the schedules). Pumps, other than the scheduled model, may also be rejected, which operate in an inappropriate portion of their performance curves, including but not limited to, operating in the rightmost third of the curve.
 3. Pumps shall be designed specifically for intended classes of service, with non-overloading characteristics throughout the design curve (motors shall not operate in their service factor). Impeller shall be statically and dynamically balanced. Impeller size shall be no more than 90 % of casing size. Pump shall be factory tested at operating conditions, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Installation instructions shall be included with pump at time of shipment.
 4. Coordinate with manufacturer of water treatment to ensure that normal life of pumps and components shall not be foreshortened by water treatment.
 5. Provide, under the work of the mechanical section, flexible connections (if shown on details) and vibration isolation components for all pumps. See the vibration isolation paragraph of these specifications for specific requirements.
 6. Provide steel channel base for each pump.

7. Motors shall be high efficiency type, see motor and starter paragraph of these specifications for requirements.
- B. Pump Types and Materials of Construction
1. General:
 - a. For all types of pumps listed below, bearing frame and pump internals shall be serviceable without disturbing motor or connected piping.
 - b. For all types of pumps listed below, provide mechanical seals with carbon rings and ceramic faces, stainless or brass metal parts, stainless springs and synthetic rubber bellows. Seals shall operate satisfactorily to 225°.
 - c. Unless otherwise stated in the schedules, all pumps shall be single stage.
 - d. Provide tappings for pressure gauges at inlet and discharge of all in line and split case pumps.
 - e. All couplings for variable speed pumps shall be capable of operating under all conditions without fatigue.
 - f. Pumps shall have shaft grounding rings.
 2. End Suction Pumps
 - a. End suction pumps shall be based mounted, horizontally coupled with vertically split cases. Materials of construction shall be for a bronze fitted pump including cast iron casings, bronze shaft sleeves, alloy steel shafts and bronze enclosed impellers. Provide regreasable or permanently lubricated ball bearings, casing wear rings, drains and vents, coupling guards and steel baseplate.

2.08 BOILER-CAST IRON SECTIONAL

- A. Provide cast-iron sectional, 3 pass pressure fired Boiler/Burner unit for forced hot water heating service as manufactured by Burnham, Weil McLain or Smith Cast Iron Boilers, complete with Burner mounting plate; Insulated Metal Jacket; Burner mounted Control Panel; Boiler Trim and Instruments and Oil Burner.
- B. Boiler/Burner unit shall be performance tested and certified by I=B=R. Boiler shall be designed and tested to meet the minimum efficiency requirements of 80% Combustion Efficiency for Natural Gas and 83% Combustion efficiency for No. 2 fuel oil as mandated by the National Energy Policy Act of 1992 and ASHRAE-90.1
- C. Boiler shall be constructed for 80 PSI Maximum Water Working Pressure in accordance with the ASME Section IV Rules for Construction of Heating Boilers. Individual sections shall have been subjected to a hydrostatic pressure at the factory before shipment and they shall be marked, stamped or cast with the national Board Standard.
- D. Set boiler foundations upon concrete pad furnished under Division 3.
- E. Provide 16 gauge steel raised lip drip pan of sufficient size to cover the area under the Burner, filter and piping. Provide approved absorbent material.

- F. Boiler shall be furnished knocked down unit for field erection in strict accordance with the manufacturers instructions and recommendations. Boilers shall be installed utilizing acceptable ASME piping practices and requirements.
- G. Provide trim and instruments as follows:
1. Provide combination water pressure and temperature gauge, and ASME-rated pressure relief valve.
 2. Provide automatic low water cut-off with manual reset.
 3. Provide electronic operating temperature controller.
 4. Provide limit temperature controller to limit boiler water temperature.
 5. Provide boiler air vent.
- H. Oil Burner
1. Burner shall incorporate all the necessary devices and controls to provide a complete fuel combustion system which shall bear Underwriters Laboratories seal of approval. Boiler shall be furnished with a flame retention type pressure atomizing, forced draft burner arranged for Full modulation firing with Pre-Purge and Proven Low Fire Start.
 2. Oil burner shall be equipped with a fuel unit driven off the blower motor shaft. Pump pressure shall be 300 PSI for easier ignition and better combustion at low input. Fuel unit shall have 2-stage pumping gears, self-contained pressure regulating valve and shall be suitable for 3450 RPM service with a suction vacuum of 15" inches of Mercury. Two (2) approved safety shutoff oil valves shall be provided integral to the Burner.
 3. All Controls, motor starters, relays, switches and Pilot lights shall be installed within a Burner mounted control panel. External lights, switches and components shall all be wired to a numbered terminal strip without splices and the panel shall be complete with the following controls and devices:
 - a. Electronic Micro-Computer type Primary Control equipped with LED sequence status lights. Provide a timed pre-Purge Cycle; Trial for Ignition; with 3 second Flame Failure response time with non-recycling safety shutdown upon loss of Main Flame at point of supervision and a post-Purge Cycle.
 - b. Use for Full Modulation Burners: Manual/Automatic selector switch with manual potentiometer and SPST Burner Service Switch. Provide the following factory installed isolating load relays:

- 1) Alarm relay to initiate a remote alarm on Control Lockout. Relay to be wired to "BOILER OFF" alarm/strobe light located elsewhere in the building.
 - 2) Combustion air damper relay. One (1) relay per Burner.
- c. Pilot Lights to indicate:
- 1) "Power On"
 - 2) "Main Fuel"
 - 3) "Flame Failure"
4. Furnish and install an approved quality fuel oil filter for the Burner, Garber screw-in type, Model 11BV-MK with a flow handling capacity of not less than 90 GPH of oil filtering rate. Furnish and install a vacuum at the oil filter complete with a short nipple and gauge cock.
 5. Furnish and install Webster OSV at pump suction as required by 527 CMR 4.00 and in accordance with the valve manufacturers recommendations and instructions. Furnish and install all new fusible link oil valves, swing check valves, thermal cutoff switches and emergency burner shutoff switches as required by previously specified State and Local Codes.

I. Control Panel

1. All Controls, motor starters, relays, switches and Pilot lights shall be installed within a Burner mounted control panel built to meet or exceed NEMA-1 standards. External lights, switches and components shall all be wired to a numbered terminal strip without splices and the panel shall be complete with the following controls and devices:
 - a. **Integrated Boiler Control System that includes boiler operating, safety and limit controls as well as control of the System Circulating Pump and System Standby Circulating Pump. As an option, an integrated control that encompasses Boiler and System and Standby Circulating Pump operation (including Warm Weather Shutdown and Outdoor Air Temperature Supply Water Temperature Rest) such as Tekmar or Johnson Controls may be furnished, installed, wired and verified operational per the Sequence of Operation section of these paragraphs.**
 - b. Electronic Micro-Computer type Primary Control equipped with sequence status lights. Provide a timed Trial for Pilot; timed Trial for Main Flame with 4 second Flame Failure response time with non-recycling safety shutdown upon loss of Main Flame at point of supervision. Provide Pre and Post Purge cycles.
 - c. For full modulation, provide Manual/Automatic selector switch with manual potentiometer, and 4PDT Fuel Changeover Switch with center "Off" position. Provide the following factory installed isolating relays:

- 1) Alarm Relay to initiate a remote alarm on Control Lockout. One (1) relay per Burner. To initiate "BOILER OFF" alarm/light elsewhere in the building and specified under another portion of this Contract.
- 2) Combustion air damper relay. One (1) per Burner.

d. Pilot Lights to indicate:

- 1) "Power On"
- 2) "Main Fuel"
- 3) "Flame Failure"

- a) Burner shall be furnished Direct Spark ignition from a 12,000 Volt ignition transformer when firing on Oil.
- b) Burner shall always return to the Low Fire position for ignition and a combustion air proving switch shall be mounted on the Burner interlocked to close the Main Fuel Valve in the event of a loss of combustion air.

J. Control Wiring

1. Provide electrical burner control wiring in rigid conduit, as required by burner manufacturer's recommendations and in accordance with the wiring diagrams. All safety control switching shall be accomplished in the hot ungrounded conductor in accordance with State and Local Codes. All wiring for Boiler and Burner shall be rated for the maximum operating temperature to which it may be exposed. All wiring between components shall have copper conductors not less than 18 AWG and constructed in accordance with the NEC/NFPA 70.
2. An electrical thermal switch fused to break the ungrounded conductor in the main circuit at 165° shall be installed in the main power line within six feet over the top of the Burner. If the ceiling above the Burner exceeds 12 ft. in height, an additional thermal switch shall be installed on the ceiling and series connected with the lower switch. Fuse protection for the control circuit shall be provided. A manually operated remote heating plant shutdown switch shall be furnished and installed just outside the Boiler room door and shall be marked for easy identification. If there is more than one (1) Boiler room door, there shall be a switch located at each door. Shutdown switch(es) must be wired to disconnect all power to the Boiler controls.
3. Control wiring shall include, but shall not be limited to, connections to:
 - a. Limit switches: high, operating controls and modulating burner.
 - b. Low water cutoff and pump controller.

- c. Emergency shutoff switch.
- d. Stack temperature thermocouple sensor in breeching.
- e. High and low oil pressure switches (when provided).
- f. Fresh air intake automatic control damper interlocked to burner circuit.
- g. Provide fusible control circuit transformer.
- h. Coordinate with boiler sequence of operation.

K. Furnish, install and wire a panel mounted SCADA interface controller processor equal to Conductor Hydronic Sequencer by Thermal Solutions. Processor shall include dry contacts for run status and alarm status to SCADA system.

L. An authorized representative of the Boiler or Burner manufacturer shall perform the initial start-up, final adjusting and testing of the Burner and Controls in the presence of the Installing Contractor and the Owners Operating Personnel.

2.09 BREECHING AND STACK (PREFABRICATED)

A. PRESSURE RATED CHIMNEYS AND VENTS

1. Provide round all fuel rated air or fill insulated to limit skin temperature to 95°F, prefabricated double-wall duct breeching for water heater furnished under Section 15400 and for boilers and other mechanical equipment furnished under Section 15500 that burns gas or oil, by Ampco, Metalvent, Metal Fab or Metalbestos.
2. This contractor shall coordinate with the Plumbing subcontractor, to ensure that if a water heater using forced draft venting is submitted, a stack designed for positive pressure will also be submitted. Do not submit Type B gas vents for water heaters with forced draft burners.
3. Breeching shall be aluminized steel outer jacket and aluminum internal liner (for gas); stainless steel (for oil) with integral spacers or insulation.
4. Provide fire stop fittings at wall and ceiling penetrations.
5. Joints shall be vapor-tight with locking groove slip joints with locking tabs and bands.
6. Provide high temperature expansion fittings between flue and structural penetrations.
7. Provide aluminized water-tight insulated thimble, exit cone, supporting hardware, cleanouts, and drain sections.
8. System shall be Metalbestos Model PS, Metalfab, or Metalvent.

B. SUBMITTALS: Submit the following

1. Catalog cuts

2. Sizing calculations
3. Installation drawings
4. Installation instructions
5. Warranty

2.10 ENERGY RECOVERY UNITS

A. Provide a horizontal rotary wheel air-to-air energy recovery ventilator as manufactured by Haakon, Climate Craft, Greenheck, or equal. Unit shall be manufactured for outdoor construction because of wet environment. The unit shall include a rotary exchanger, supply air and exhaust air blowers, motors with starters and relays, air filters, heating coil and specified options, including Airflow Measuring Stations in the Outdoor Air and Exhaust Air streams.

B. References

1. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
2. ASTM E1332 Standard Classification for Determination of Outdoor-Indoor Transmission Class
3. SMACNA HVAC Duct Construction Standards—Metal and Flexible
4. ARI 1060 Rating Air-To-Air Energy Recovery Ventilation Heat Exchangers
5. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes
6. NEMA MG1 Motors and Generators
7. AFBMA 9 Load Ratings and Fatigue Life for Ball Bearings
8. ARI 410 Forced-Circulation Air-Cooling and Air-Heating Coils
9. UL 1995 Heating and Cooling Equipment
10. ASHRAE 52-76 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI/ASHRAE Approved) (for Filters)
11. ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality

- C. Service for the unit shall be available locally either directly from the manufacturer or from the manufacturer's certified local representative. Provide two hours of on-site startup service and instruction.
- D. Submittals
1. Drawings shall include accurately scaled CAD drawings of the entire unit with plan and elevation views and any required sub section or component thereof. Drawings shall be made available in electronic format either electronically or on disk.
 2. Product performance data shall include unit dimensions, weights, capacities, component performance data, electrical data, construction details, required clearances and service access dimensions, field connection requirements and data, static pressure drops, methods of vibration isolation, included gages, performance data for each blower, and unit surface material and finish.
 3. The submittal shall provide information on filters including pressure drop, efficiency, media description, frame details, and filter gage information.
 4. Submittal shall include electrical data for the unit including full load amps for each unit component, maximum circuit ampacity, breaker and disconnect size, transformer size, and wiring diagrams for control panel wiring and unit component wiring that indicates factory and field installed wiring.
 5. Submittal shall include the manufacturers recommended installation instructions.
- E. Construction
1. Unit shall have an all-welded base frame constructed from aluminum or galvanized steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester. The frame shall include formed supports constructed from welded structural steel under blowers and other components.
 2. A 16 gauge interior floor shall be installed on the base frame. The floor shall be insulated and a 22 gauge galvanized steel sub-floor shall be installed under the insulation. Floor insulation shall be 2" thick and consist of a load-bearing, rigid, closed-cell foam core laminated to a black glass reinforced mat facer.
 3. All cabinet walls, access doors, floor and roof shall be fabricated of double wall, impact resistant, panels insulated with fiberglass or foam.
 4. Cabinet frame exterior shall be of formed 18 gauge (minimum) galvanized steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester or aluminum of equivalent thickness. Panels (fixed and access) to be of 18 gauge steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester or aluminum of equivalent thickness. Frame and panels to have an internal liner of 22 gauge (minimum) galvanized steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester or the equivalent in aluminum and be sealed with silicone sealant to provide a complete vapor barrier and non-contaminating surface to all air streams. Unit exterior and interior finish

shall be galvanized steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester or aluminum of equivalent thickness.

- F. Insulation: Insulation shall be at least 2-inches thick, have a minimum density of 1-1/2 pounds/cubic foot and have a minimum R-value of 7.5. Foam insulation shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F. Insulation shall meet the flame and smoke generation requirements of NFPA-90A.
- G. Rotary Air-To-Air Heat Exchanger
 - 1. Rotary air-to-air heat exchanger sensible recovery performance and leakage must be clearly measured and certified by AHRI in accordance with AHRI Standard 1060. The wheel's Exhaust Air Transfer Ratio, as measured and certified by AHRI, shall be 2.0 or lower. Exchanger shall be hygroscopic, mounted in housing with purge sector, variable speed drive, multifunction control system, and full season operational control.
 - 2. The unit must be provided with a factory set, field adjustable purge sector. The purge sector shall be designed such that, as measured according to AHRI Standard 1060, the Outdoor Air Correction Factor is less than 1.11 at a pressure differential of 0.00 inches w.g. This performance shall be certified and published by AHRI.
- H. Drive System/Speed Control
 - 1. The rotor drive system shall consist of an adjustable belt around the rotor perimeter driven by an AC motor with gear reduction. The variable speed drive shall be specifically designed for heat wheel applications and include: an AC inverter, soft start/stop, rotation detection w/alarm contacts, automatic self cleaning function, and self testing capability.
 - 2. The speed controller shall be capable of accepting a potentiometer, VDC, or MA control signal.
 - 3. Motors shall be premium efficient, ODP, T-frame, 1750 rpm nominal with a minimum service factor of 1.15 mounted on an adjustable base.
 - 4. Motors, blowers, and frames shall be coated with covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester.
 - 5. Supply and Exhaust air blowers shall be forward curved DWDI class I for quiet efficient operation arranged in a draw through configuration relative to exchanger. Motor and blower are to be mounted on common frame, isolated from the unit case with seismic restrained and flexible duct connections. Motors and blowers shall have Variable pitch sheaves.
- I. Airflow Measuring Stations shall consist of an airflow sensor such as an array or ring sensor, transmitter, and processor capable of transmitting the airflow quantity to the unit controls for display, logging and balancing.

J. Heating Coil

1. Unit shall be furnished with a hot water coil installed in the reheat configuration. Coil shall have capacity and performance shall be as scheduled on the drawings.

K. Air Filters: Outside and Return air filters shall be MERV 8 when evaluated under the guidelines of ASHRAE Standard 52.2-2017. Initial resistance to airflow shall not exceed 0.31" w.g. at an airflow of 500 fpm. The filter shall be classified by Underwriters Laboratories as UL Class 2. Filters shall be mounted within unit in galvanized holding frames upstream of exchanger and accessible through access panels or doors

L. Dampers:

1. Actuated Dampers shall have heavy duty extruded aluminum frames, 4" extruded aluminum air-foil blades mounted on brass shafts, supported and inter-connected by fiberglass reinforced nylon gears.
2. Low leakage dampers shall have hollow (thermoplastic elastomer (TPE)) rubber jamb seals built into both the blades and the frame. The side casings shall enclose the gears with ABS plastic covers that also serve as seals in the closed position.
3. Outside Air Shut-Off Dampers: Outside air dampers shall be mounted on the inlet of the unit and operated by a spring return, direct-coupled on-off actuator with an end switch to be interlocked with the supply air motor relay. Dampers shall have parallel blades.
4. Exhaust Air Shut-Off Dampers: Exhaust air damper shall be mounted on the outlet of the unit and operated by a spring return, direct-coupled on-off actuator with an end switch to be interlocked with the return air motor relay. Dampers shall have parallel blades.
5. Energy Wheel Bypass Dampers: Dampers shall be mounted at the wheel and operated by spring return direct coupled actuator arranged to bypass the wheel when the outdoor air temperature is appropriate for economizer operation.
6. Two Position Spring Return Actuators shall be direct coupled type which require no crankarm and linkage and be capable of direct mounting to the damper jackshaft. The actuators must be designed so that they may be used for either clockwise or counterclockwise fail-safe operation. Actuators shall use a brushless DC motor and be protected from overload at all angles of rotation. Actuators shall have reversing switch and manual override on the cover, and be protected from overload at all angles of rotation. As required, 1 or 2 SPDT auxiliary switches shall be provided having the capability of being adjustable. Actuators with auxiliary switches must be constructed to meet the requirements for Double Insulation so an electrical ground is not required to meet agency listings. Run time shall be constant and independent of torque. Actuators shall be UL listed and CSA certified, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards.

M. Electrical

1. Electrical controls shall include for belt drive units: motor starters with overloads, fused branch circuit breakers, control transformer for low voltage controls, service switch, and terminal points/blocks all contained in a NEMA 3R, unit-mounted control panel.
2. A single main un-fused disconnect switch for single point power connection shall be provided. The disconnect switch shall be mounted through the access panel so that power will have to be shut-off before the access door can be opened.
3. The motor power and branch circuits shall be protected by circuit breakers so replaceable fuses will not be necessary.
4. All wiring and controls shall be factory tested before shipment.
5. The unit wiring diagram shall be provided in the panel.

N. Controls

1. Integral microprocessor controller, programmable and adjustable with both Ethernet and RS-485 communication ports.
2. A panel-mounted Touch-Screen Human-Machine Interface (HMI) device shall also be installed inside the unit and will allow users to change all unit operating parameters, execute schedules, and change control program variables.
 - i. **Furnish remote wall mounted panel microprocessor, including remote start/stop, occupied/unoccupied scheduling, alarm status and reset control, and supply air temperature reset. The panel shall be NEMA 4 construction.**
 - ii. Furnish factory mounted Airflow Measuring Stations in the Outdoor Air and Exhaust Air streams for balancing airflows.
3. Units shall come with factory mounted electronic speed control providing soft-start/stop, rotation detection and alarm, and self-cleaning jog functions.
4. **ERV controller shall include a digital output (dry contacts) for connection to the SCADA system. System shall indicate run status and alarm status.**
5. The operational control system shall use remote temperature sensors mounted in the entering and leaving sides of both airstreams to monitor exchanger performance. Setpoints shall be adjustable at the provided HMI or by the building management system. The DDC controller shall modulate rotor speed to:

- a. Prevent frost build-up. The controller shall monitor the temperature in the exhaust airstream leaving the exchanger and modulate wheel rotational speed to prevent the temperature from dropping below an adjustable, pre-programmed setpoint.
- b. Outside Air and Exhaust Air Shut-Off dampers shall be operated by a two position spring return direct-coupled actuators with end switches to be interlocked with the supply and exhaust air motor relay or relays, respectively. Actuators to be controlled by the DDC control board.
- d. Blowers shall be provided with motor starters with overloads controlled by the microprocessor.

2.11 MAKEUP AIR UNITS

- a. Provide a horizontal fan coil Makeup Air Unit as manufactured by Greenheck, Haakon, Climate Craft, or equal. Unit shall be manufactured for outdoor construction because of wet environment. The unit shall include an enclosure, 2" MERV 8 filter with a clean filter pressure drop of 0.31" w.g.; hot water heating coil, supply air blower, motor rated for VFD service, disconnect switch and specified options, including an Airflow Measuring Station in the Outdoor Air stream. Capacity and performance shall be as scheduled on the drawings.
- b. Unit shall have an all-welded base frame constructed from aluminum or galvanized steel covered with a chemical resistant coating equal to Greenheck Hi-Pro Polyester. The frame shall include formed supports constructed from welded structural steel under blowers and other components.
- c. A 16 gauge interior floor shall be installed on the base frame. The floor shall be insulated and a 22 gauge galvanized steel sub-floor shall be installed under the insulation. Floor insulation shall be 2" thick and consist of a load-bearing, rigid, closed-cell foam core laminated to a black glass reinforced mat facer.
- d. All cabinet walls, access doors, floor and roof shall be fabricated of double wall, impact resistant, panels insulated with fiberglass or foam.
- e. Cabinet frame exterior shall be of formed 18 gauge (minimum) galvanized steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester or aluminum of equivalent thickness. Panels (fixed and access) to be of 18 gauge steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester or aluminum of equivalent thickness. Frame and panels to have an internal liner of 22 gauge (minimum) galvanized steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester or the equivalent in aluminum and be sealed with silicone sealant to provide a complete vapor barrier and non-contaminating surface to all air streams. Unit exterior and interior finish shall be galvanized steel covered with a chemical resistant coating equal to Greenheck Hi-Pro-Polyester or aluminum of equivalent thickness.
- f. **MAU controller shall include a digital output (dry contacts) for connection to the SCADA system. System shall indicate run status and alarm status.**
- g. **Furnish remote wall mounted panel microprocessor, including remote start/stop, occupied/unoccupied scheduling, alarm status and reset control, and supply air temperature reset. The panel shall be NEMA 4 construction.**
- h. Heating Coil

1. Unit shall be furnished with a hot water coil installed upstream of the blower. Coil shall have capacity and performance shall be as scheduled on the drawings.

2.12 SPLIT SYSTEM DIRECT EXPANSION HEAT PUMP (SMALL)

- A. The variable capacity, heat pump system shall be a ductless split system as indicated. The system shall consist of multiple evaporators, a two-pipe refrigeration distribution system using PID control. The outdoor unit is a direct expansion (DX), air-cooled air-conditioning system with variable speed driven compressors using R-410A refrigerant. LG, Climatemaster, Mitsubishi or approved equal. Daikin is not acceptable. Unit cabinet shall be 20-gauge galvanized steel, with prime coat and two part epoxy finish.
- B. Provide interconnecting piping.
- C. Provide 24-inch high elevated stand for outdoor condensing unit to mitigate impact of snow blockage.
- D. Integrated inverter driven compressor in the outdoor unit and the electronic linear expansion valve (LEV) position for precise capacity control.
- E. Provide contactor, 24 V control transformer, blower relay, lockout relay and low voltage terminal board and remote mounted deadband-type day-night thermostat with sub base.
- F. Provide circuit to lock compressor off when safety controls have been activated. Unit shall not be restartable until room thermostat has been turned off and on.
- G. Provide factory mounted air filters.
- H. The drain pan shall be constructed to inhibit corrosion and fully insulated. Drain outlet shall be located on pan as to allow complete and unobstructed drainage of condensate. The unit as standard shall be supplied with solid-state electronic condensate overflow protection conforming to UL 508 that shuts off the unit when the primary drain is blocked. Mechanical float switches will not be accepted.
- I. Insulate evaporator and compressor compartment panels with 1 1/2 lb. fibrous glass insulation.
- J. Provide either direct drive ECM or belt driven evaporator blowers with common shaft and three sealed ball bearings. Belt-driven evaporator blower motor shall be 1750 rpm, three phase, with inherent overload protection or starter with quick trip heaters and sealed ball bearings.
- K. Provide compressors with crankcase heater to prevent oil dilution on off cycle, and suction line thermostat to stop compressor when suction line temperature falls below setpoint.
- L. The unit shall have controls provided by the manufacturer to perform input functions necessary to operate the system.
- M. Wall mounted, hard wired, programmable remote controller kit.
- N. Install piping according to manufacturer's recommendations.
- O. Both refrigerant lines shall be insulated from the outdoor unit to the indoor Fan Coils.
- P. Provide factory inspection of the installation and correction of the installation as required to satisfy the factory's recommendations.

- Q. Install piping according to manufacturer's recommendations.
- R. Both refrigerant lines shall be insulated from the outdoor unit.
- S. Provide factory startup.
- T. Provide factory trained inspection of the installation and correction of the installation as required to satisfy the factory's recommendations.

2.13 WALL MOUNTED ELECTRIC HEATERS (AS APPLICABLE)

- A. Provide wall mounted electric heaters as manufactured by Broan, Qmark, Electromode, or approved equal. Basis of design is Q Mark Model CWH1101DSF.
- B. Heaters shall consist of the following:
 - 1. Steel enclosure with heavy steel grille.
 - 2. Integral thermostat with a range of 40 to 85 deg F.
 - 3. Manual reset thermal overload.
 - 4. On-off power switch for service.
 - 5. Permanently lubricated fan motor.

2.14 HOT WATER UNIT HEATERS

- A. Provide Horizontal hot water unit heaters as manufactured by Sterling, Trane, Vulcan, or approved equal.
- B. Unit heaters shall consist of a 20 gauge die formed steel casing with a baked on lead free chromate free polyester melamine base, totally enclosed fan cooled motor with resilient mounting, thermal overload protection and permanently lubricated sleeve bearings. Fan blade shall be aluminum spark proof and fan guard shall be welded steel, zinc plated or painted. Unit heater shall be furnished with horizontal individually adjustable louvers.

2.15 DUCTWORK

- A. Provide all sheet metal ductwork required for the various supply and exhaust air systems. Unless otherwise indicated on the Contract Drawings or in these specifications, ductwork shall be aluminum and all ductwork and sheet metal plenums shall be constructed meeting the requirements of ASTM B 209, lock-forming quality. All ductwork, except where specified otherwise herein, shall be fabricated in accordance with the "HVAC Duct Construction Standards for Metal Ducts" published by the Sheet Metal and Air Conditioning Contractors National Association, Incorporated (SMACNA), 2 inch water gauge Pressure Class.
- B. Ductwork for Odor Control, such as the exhausts from the Gravity Thickener Tanks and the Sludge Conveyor to the Odor Control Fan, shall be FRP.

- C. Ducts shall be true to the inside dimensions indicated on the Contract Drawings. Cross break all duct panels over 12 inches wide. Support ducts rigidly and securely. Support horizontal ducts not over 8 feet on center. Ducts shall be straight and smooth on the inside with neatly finished joints and all transverse joints and longitudinal seams of all low pressure ducts shall be sealed in conformance with SMACNA seal classification B.
- C. Elbows narrower than 16 inches shall be full radius elbows with inside radius equal to the dimension of the duct in the plane of the elbow or offset. Elbows wider than 16 inches may be full radius elbows or square elbows with air foil section turning vanes (Duct Manual Figure 2-3) and 6 inch inside radius. Vanes shall be "Runner" Type 2, 3 1/4 inches on centers. Install outside vane flush against the outside of the elbow.
- D. Transitions in duct mains and branches shall be made with sides sloping at not more than 1 inch in 7 inches on the side of the transformation for diverging transitions and 1 inch in 4 inches for converging transitions. Transitions in ductwork to pieces of equipment shall be made with a 20 degree maximum angle projected from the straight duct side on a diverging transition and a 30 degree maximum angle projected from the straight duct side on a converging transition. Any conditions requiring deviations from the above shall be brought to the attention of the Engineer for approval.
- E. All notches for connecting sections of duct, including longitudinal seam notches, shall not be cut any deeper than 1 7/8 inches to insure tight corners in 2 inch deep slip joints.
- F. Slips shall be at least 2 gauges heavier than the duct and all joints shall be made in a neat and workmanlike manner and in all cases shall be tight. All ducts shall have all joints sealed with EC-800 as manufactured by 3M, Hardcast or approved equal.

2.16 DUCTWORK ACCESSORIES

- A. Duct Flexible Connections: Provide 6 inch metal edge ventglas or thermafab flexible connections at fan and unit inlets and outlets. Leave 1 inch minimum slack, (this means 1/2 inch standing fold). Duct openings shall be lined up on either side of flexible connections.
- B. Wire Mesh Screen: 1/2 inch x 1/2 inch 316 series stainless steel welded wire mesh.
- C. Volume Dampers
 1. Provide volume dampers where indicated on the Contract Drawings.
 2. Dampers less than 12 inches in height shall be Young Regulator manual adjustable rectangular opposed blade dampers.
 3. Dampers 12 inch and larger in height shall be opposed multi-blade equal to Greenheck, Nailor, or Vent Products.
 4. Damper frame shall be constructed of 316 series stainless steel channel with minimum thickness of .050 inches. Opposed damper blades shall be 316 series

stainless steel with minimum thickness of .050 inches and shall include reinforcing ribs. Each blade shall be supported in the damper frame by individual Teflon axle bearings, and shall be driven by stainless steel connecting slide linkage controlled by 3/8 inch square steel control shaft.

5. Damper blades shall be 2 gauges heavier than adjoining ductwork, and shall be riveting to supporting rods. Hem over edges parallel to rods.
6. Brackets shall be galvanized metal, secured to ductwork with sheet metal screw with locking quadrant arms. Provide 2 inch handle extension for all dampers on externally insulated ductwork.

D. Sheet Metal Access Panels

1. Provide access panels of the proper size and at all locations in ductwork necessary to service control devices, fan bearings and as required to service all systems.
2. Access panels shall have foam gasketing, fixed hinges and compression type latches as manufactured by Ventlock, Duro-Dyne or approved equal. Access doors for insulated ducts shall be insulated with 1-inch thick 1 ½ lb density coated duct liner.

E. Louvers

1. Louvers shall be aluminum wind driven rain resistant with a minimum 45% open area and 0.15" w.g. pressure drop at full design airflow such as Ruskin EME520DD.

F. Air Filters

1. Unless otherwise specified, air filters shall be equal to a Farr 30/30 prefilter by Camfil and a final filter equal to Ultrasolve by Camfil or approved equal. Prefilter shall be 2" thick and shall have a clean pressure drop of 0.31" w.g. and shall be MERV 8. Final filter shall be 4" thick with a clean pressure drop of 0.17" MERV 13. Furnish and install a filter frame for filters in the ductwork at the unit inlet.

G. Diffusers, Registers and Grilles

1. Drum Louver:
 - a. Aluminum construction.
 - b. 1 1/4-inch margins, mitered corners, and countersunk mounting holes.
 - c. Single deflection.
 - d. Vertical front blades.
 - f. Mill finish.
 - g. Louver to be provided with integral opposed blade type damper adjustable from face.
 - h. Nailor 45DL-O.

2. Exhaust Registers, Exhaust Grilles:
 - a. Minimum 22 gauge type 316 stainless steel construction.
 - b. 1 1/4-inch margins, mitered corners, and countersunk mounting holes.
 - c. Fixed vertical zero deflection bars.
 - d. Mill finish.
 - e. Register to be provided with integral opposed blade type 316 stainless steel damper adjustable from face.
 - f. Nailor 6755-HD.

H. Control Dampers

1. Damper Assembly: Damper shall conform to SMACNA HVAC Duct Construction Standards. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall consist of a combination of sections. Damper shall be 316 stainless steel. Flat blades shall be made rigid by folding the edges. Provide blades with compressible seals at points of contact. Provide channel frames of dampers with jamb seals to minimize air leakage. Dampers shall not leak in excess of 10 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity. Moving parts of operating linkage in contact with each other shall consist of dissimilar materials. Damper axles shall be 0.5 inches minimum plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by non-ferrous dissimilar thrust bearings. Pressure drop through dampers shall not exceed 0.05 inch water gage at 1,000 fpm in the wide-open position. Frames shall not be less than 2 inches wide. Dampers shall be tested in accordance with AMCA 500-D.
2. Operating Links: Operating links external to dampers, such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators or dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, or stainless steel. Mating parts shall consist of dissimilar materials. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crank arms shall control the open and closed positions of dampers.

2.17 FIBERGLASS REINFORCED PLASTIC (FRP) DUCTWORK – SLUDGE CONVEYOR EXHAUST

- A. The following is a specification for glass fiber reinforced process ducting and fittings for products intended for use in aggressive chemical environments.
- B. ACCEPTABLE MANUFACTURERS: Viron® International Corporation or approved equal
- C. DESIGN STANDARDS

1. Fiberglass reinforced plastic ductwork and accessories shall be constructed and inspected according to the following standards.
 - a. NBS PS 15-69: Standard for Contact-Molded Reinforced Polyester Chemical Resistant Process Equipment.
 - b. ASTM E 84-89: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - c. ASTM C 582-87: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic Laminates for Corrosion Resistant Equipment.
 - d. ASTM D 2563-70: Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
 - e. ASTM D 2996-88: Standard Specification for Filament Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
 - f. ASTM D 4097-88: Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical Resistant Tanks.
 - g. SMACNA Thermoset FRP Duct Construction Manual: First Edition, June 1997.

In the event of conflict between these references, the most appropriate and stringent source shall be followed.

D. QUALITY ASSURANCE

1. All FRP duct components shall be fabricated by qualified, experienced personnel with a minimum of 5 years' experience with the lay-up, fabrication and joining of FRP materials.
2. Beside meeting the requirements of this section, resins used in the fabrication of the FRP ductwork shall be approved and applied in accordance with the resin vendor's published technical criteria.
3. Factory Inspection:
4. The Owner shall maintain the right to tour the FRP duct fabrication facility anytime that fabrication is being performed on ductwork intended for the project.
5. The fabricator shall notify the Owner when production has been completed on the first 50 lineal feet of fabricated ductwork. Any time after that date, the Owner may exercise the option, without advanced notice, to tour the plant and inspect all stages of fabrication to ensure that quality control is being maintained.
6. This visitation and inspection option shall remain in effect throughout the entire cycle of production for materials used on this project.
7. Factory Supplied Test Sample: The fabricator shall provide a minimum of three sample specimens for mechanical property tests and lamination lay-up analysis. Test specimens shall be submitted to the vendor of the resin used in the duct construction process.
8. Acceptance of Fabricated Ductwork:
9. Acceptance of factory fabricated ductwork shall be based on laboratory analysis of the factory-supplied and field-supplied test sample specimens and Owner's inspection of the ductwork during the fabrication procedure.
10. No ductwork shall be installed on the project until the Owner approves all test results to verify the fabricated product complies with the technical requirements specified herein.
11. The installing contractor shall bear the costs required by the resin vendor for performing the duct sample tests indicated herein.
12. All factory and field test sample specimens shall be analyzed at the laboratory of the resin vendor to determine:
 - a. Tensile and flexural strength
 - b. Barcol hardness
 - c. Glass content
 - d. Edge compression properties
 - e. Thickness measurement
 - f. Visual quality inspection of laminate
13. Cure development testing shall be performed on each duct section of each production run, in accordance with ASTM D 3418. Testing shall be performed at a minimum of each side midpoint at 1/3 and 2/3 straight wall distances on both the inner and outer surfaces (16 points total) of each duct section.

- a. A visual quality inspection of laminate shall be performed on each duct section in accordance with ASTM D 2563. Acceptable ductwork shall have no visual surface defects greater than Level III, smooth with no glass fibers exposed. There shall be no foreign inclusions, dry spots, air bubbles, cracks, crazing, pinholes, or delamination. Inspections shall be done and recorded by the fabricator and the installing contractor.
- b. If the duct samples fail to meet the requirements of the resin vendor's technical data, or meet the fabrication steps of these specifications, The fabricator shall comply with the following additional test steps:
 1. Test all pieces manufactured during the production run.
 2. Submit a list of three independent testing laboratories for selection by the Owner of one laboratory to provide a separate opinion.
 3. Contact with the chosen laboratory for services for the same test procedures described above on ten new sample specimens removed from ductwork stockpiled on the project construction site.
- c. Written acceptance by the Owner will provide necessary clearance of stockpiled material to be installed by the installing contractor.
- d. Written rejection by the Owner of any or all of the ductwork shall constitute noncompliance. The fabricator shall remove all nonconforming material from the construction site and replace with new material fabricated to conform to these requirements. Test sample specimens shall be taken from all the ductwork fabricated as replacement to nonconforming material, and tests will be repeated.

E. DESIGN CRITERIA

1. **Duct Pressures:** FRP exhaust ductwork shall be suitable for 5 inches W.C. negative and 4 inches positive internal pressures.
2. **Stiffening:** All rectangular duct sections shall be constructed with integral stiffeners which limit maximum deflection to ½ inch across any span when subjected to -5.0 inches W. C. static pressure.
3. **Exhaust Contaminants:** The duct system will be designed to withstand airstream contaminants typically found in Wastewater Pump Station Wet Wells.
4. **Field Joints:** Field joints shall be butt and wrap type wherever possible. All joints shall be constructed to ensure the bottoms of adjacent duct sections are relative to each other such that no pockets or low spots are created where condensed liquid can collect. Internal wraps shall include a minimum 20 mil synthetic veil in contact with the airstream. External wraps shall include a gel coat with UV inhibitors.
5. **Duct Length:** To the extent possible, the length of the duct sections shall be constructed so that the field joints are minimized while shipping is optimized.
6. **Packaging and Loading:** All ductwork and components shall be packaged and loaded to protect against damage during shipping, offloading and handling.
7. **Shipping:** All ductwork shipments will be coordinated with the installing contractor.
8. **Unloading and Storage:** Upon receipt at the jobsite, the installing contractor shall be responsible for unloading, inventory, and inspection of the ductwork for damage caused in transit. The duct components shall be stored in a clean, dry location until installed.
9. **Warranty:** The ductwork shall have a one-year guarantee carried by the fabricator that will provide for repair or replacement of defective materials at no cost to the owner.

F. FRP DUCTWORK CONSTRUCTION

1. Internal Corrosion-Resistant Surface: The interior liner in contact with the contaminated exhaust airstream shall be a minimum of 100 mil thick and constructed of materials resistant to the chemicals listed in paragraph E.3 above. The corrosion liner shall be laid-up as a separate corrosion barrier from the intermediate structural layers.
2. The internal liner shall be formed with a 10 mil C-glass veil for superior corrosion resistance. Two layers of 1.5 ounce per square foot chopped strand mat and spray-up chopped borosilicate glass shall make up the balance of the internal liner to achieve 100 mil total thickness.
3. The corrosion liner shall gel completely prior to continuing with the structural layer.
4. Resin used for the internal corrosion-resistant liner shall be Reichhold Dion Ver 9300 FR or equal. Resin-to-glass ratios shall be 90% resin, 10% glass.
5. The resin shall carry a flame spread rating of 25 or less, and smoke contribution rating of Unrated (in excess of 1000) with the addition of 3% antimony trioxide.
6. Intermediate Structural Layer:
 - a. The intermediate layer of duct wall thickness shall be fabricated by either filament wound or hand lay-up techniques to the dimensional thickness and strength as required by NBS PS 15-69 standards.
 - b. Resin for the intermediate structural layer shall be Reichhold VER 9300 FR or equal. Resin to glass ratios shall be 66% resin, 33% glass.
 - c. The resin shall carry a flame spread rating of 25 or less, and smoke contribution rating of Unrated (in excess of 1000) with the addition of 3% antimony trioxide.
 - d. The outer surface shall be relatively smooth with no exposed glass fiber ends.
7. External Layer:
 - a. The exposed external surface of all FRP ductwork installed whether indoors on grade or on the roof, shall provide protection against ultraviolet degradation and weather erosion. The duct shall carry a flame spread rating of 25 or less and a smoke contribution rating of Unrated (in excess of 1000).
 - b. All ductwork shall be identified by a finished appearance in the white color spectrum. Gel coat color shall be white.
 - c. External duct protection shall be provided by an ultraviolet stabilizer added to the final coat of resin that also incorporates paraffinated wax curing elements and color pigment.

G. DAMPERS

1. Exhaust branch duct balancing dampers shall be manufactured using the same materials as the ductwork. Round dampers shall be single butterfly blade type; rectangular dampers shall be parallel blade type. Blade shaft shall be fiberglass with Teflon shaft seals. All dampers shall be suitable for 6 inches WC pressure differential. Blade shaft shall be designed to provide a 10:1 safety factor for operating torque requirements. The shaft shall be glassed into the damper blade, such that the center portion of the blade is significantly thicker than the outer perimeter with a smooth, even taper from the center to perimeter. Dampers shall be by The fabricator. Manual dampers to be equipped with manual stainless steel adjustable locking handles or worm gear operators. Automatically

controlled dampers to be equipped with automatic electric or pneumatic actuators supplied by the Controls Subcontractor and installed by HVAC Subcontractor.

H. FABRICATION

1. All ductwork to be supplied as butt and wrap joints except as necessary for connection to equipment and dampers. All butt and wrap joints shall be constructed to ensure the bottoms of adjacent duct sections are relative to each other such that no pockets or low spots are created where condensed liquid can collect.
2. Butt joints over 24" diameter shall be internally, as well as externally wrapped. Internal wraps shall include a minimum 20 mil synthetic veil in contact with the airstream. External wraps shall include a gelcoat finish as specified above.
3. Strength of the butt joint shall be at least equal to that of the duct. Total minimum width of the joint shall be 3" for 1/8" thickness, 4" for 3/16" thickness and 6" for 1/4" thickness.
4. Where flanges are necessary, they shall be made by hand lay-up. The face of the flange shall be smooth with no projections or depressions greater than 1/32" and shall be perpendicular to the duct centerline within 1/2 degree. Machine facing of the back of the flanges is not acceptable. Flange thickness shall be in accordance with ASTM D 4097-88. Flange height shall be a minimum of 2 inches. The duct wall at the hub of the flange shall be a minimum of 1.5 times the nominal duct thickness and taper to the normal thickness over a distance of at least one flange width. Fillet radius shall be a minimum of 3/8" at the point where the hub meets the back of the flange.
5. Flange drilling, nuts, bolts, washers, and gaskets shall be provided by the installing contractor.
6. Drains shall be installed at locations indicated on the drawings. Drains shall be 1" diameter FRP 1/2 threaded couplings glassed into the bottom of the duct. The fitting shall be trimmed flush with the interior surface of the duct and the duct shall be recoated at the connection.
7. Access openings shall be provided where located on the drawings and shall be rigidly framed and fitted with airtight covers which can easily be removed and installed. Cover plate and end caps shall be flanged as described in paragraph 2.3 A.4, a minimum thickness of 1/4", and shall be reinforced as necessary to comply with design pressure criteria of the system. Access doors will be complete with Type 304 stainless steel hardware and full-face type gaskets. Gaskets shall be chemically resistant to the contaminants listed in attached data sheets.
8. Flexible connections and expansion joints shall be provided by the installing contractor where shown on the drawings.

I. INSTALLATION

1. Installation to be by HVAC Subcontractor.
2. Field quality control, inspections, tests, and cleaning shall be by others.

2.18 VIBRATION ISOLATION

A. Manufacturer Responsibility

1. Manufacturer of vibration equipment shall have the following responsibilities:
 - a. Guarantee specified isolation system deflections.

- b. Provide installation instructions, drawings and field supervision to ensure proper installation and performance of systems.

B. Quality Assurance

1. All vibration isolators shall have calibration markings or some method to determine adjustment, the actual deflection under the imposed load after installation and adjustment.
2. All isolators shall operate within the linear position of their load vs. deflection curves. Load vs. deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.
3. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than $\nabla 10\%$.
4. Substitution of internally isolated equipment in lieu of the isolation specified in this section, is acceptable provided all conditions of this section are met. The equipment manufacture shall provide a letter of guarantee stating that the specified noise and vibration levels will be obtained or the cost of converting to the specified external vibration isolation shall be born by the equipment manufacturer.
5. The following specifications describe spring hanger with 30 degree misalignment feature. This requirement is mandatory. Replace any hangers without the 30 degree capability at no additional cost to the Owner.

C. Description

1. All vibration isolation devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with intent, structural design, performance, and deflections of the base manufacturer.
2. Acceptable manufacturers of vibration isolation products shall be: Mason Industries, Amber Booth Company, Peabody Noise Control, Korfund Dynamics Corporation, Vibration Mountings and Equipment, Vibration Eliminator Co., provided they meet the requirements of the Specifications. Mason Industries model numbers have been used in the Specifications to establish quality of components, but are in no way to limit competitive bidding by other manufacturers.
3. Refer to Table A at the end of this Article for application of the various types listed to appropriate equipment and efficiency level.

D. Vibration Isolation Types

1. Vibration Isolators

a. Type A: Spring Isolator Mason Industries Type SLF

- (1) Having a minimum OD to OH of 0.8:1.
- (2) Springs cadmium plated, hardware cadmium plated and all other metal parts hot-dip galvanized.
- (3) Reserve deflection (from loaded to solid height) of 50% of rated deflection.
- (4) Minimum ¼ inch thick neoprene acoustical base pad on underside.
- (5) Designed and installed so that ends of springs remain parallel.
- (6) Non-resonant with equipment forcing frequencies or support structure natural frequency.

2. Mason Ind. Type ND or Rails Type DNR

a. Type E: Elastomer hanger rod isolator.

- (1) Molded (min. 1 ¾ inch thick) neoprene element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a minimum of 0.35 inches.
- (2) Steel retainer box encasing neoprene mounting capable of supporting equipment up to four times the rated capacity of the element.

3. Mason Ind. Type WF

a. Type J: Steel Rails.

- (1) Steel members of sufficient strength to prevent equipment flexure during operation.
- (2) Height saving brackets as required to reduce operating height and cradle the unit.

E. Execution

1. General: Isolation systems just be installed in strict accordance with the manufacturer's written instructions. Vibration isolator shall not cause any change of position of equipment resulting in stress on equipment connections.
2. Equipment Installation

- a. Equipment shall be isolated as per Table A below.
- b. Additional requirements:
 - (1) After the entire installation is complete, and under full operational load, the isolators shall be properly adjusted. Verify that there are no short circuits of the isolation. The equipment shall be free in all directions.
 - (2) Install equipment with flexibility in wiring.

TABLE A

Equipment	Mounting	Isolation	Deflection	Base
Energy Recovery Unit	Clg	A	0.75	J
Makeup Air Unit	Clg	A	0.75	J
Unit Heater	Clg	E	0.30	-

NOTES:

- 1. "ISOL" and "BASE" column indicates letter type as it appears in the Specifications.
- 2. "MTNG" refers to method of support of equipment from the structure.

2.19 INSULATION

- A. All insulation, adhesives, tape, etc. shall conform to NFPA 90A. No voids in insulation will be permitted.
- B. Pipe Insulation.
 - 1. Insulation shall comply with ASTM E84 or UL 723.
 - 2. Insulation shall have a thermal conductivity of 0.245 at 75 deg. F mean temperature and shall have a 25/50 Flame Spread and Smoke Developed Index.
 - 3. Insulation shall include antimicrobial protection for the inhibition of mold and mildew growth.
 - 4. Installation shall meet manufacturer's recommendations. Seal butt joints with insulation manufacturers approved adhesive.
 - 5. Outside above ground insulation shall be protected with two coats of approved vinyl lacquer coating over woven glass mesh adhered to insulation with Insulcolor or approved equal lagging adhesive, as recommended by manufacturer.

6. Hot water supply and return lines up to 1-1/4" shall be insulated with 1-1/2" thick fiberglass pipe insulation. Hot water supply and return lines larger than 1-1/4" shall be insulated with 2" thick fiberglass pipe insulation. Insulation shall be a high performance assembly of fiberglass with an ASJ equal to Micro Lok by Johns Mansville or approved equal.
7. Refrigerant suction lines, hot gas bypass lines, and outdoor liquid lines shall be insulated with 1" thick rigid closed cell foam insulation, AP/Armaflex, Manville, Owens Corning or approved equal.

C. Duct Insulation

1. 2" thick, semi rigid fibrous glass boards with factory applied fire retardant foil reinforced kraft vapor barrier facing. Multiple layers shall be applied to result in an installed insulating value of R-12.
2. Insulation density shall be 3 lb./cf with maximum K factor of 0.23 at 75°F mean temperature.
3. Impale insulation on mechanical fasteners applied to duct surface on 12" centers. Use at least two rows of fasteners on each side of duct. Provide fastener rows within 3" of seams and edges. Secure insulation with suitable speed washers or clips firmly embedded in insulation. Provide additional fasteners as necessary on cross broken ducts.
4. Extend insulation to standing seams, reinforcing, and other vertical projections 1" and less; do not carry over. Vapor barrier jacket shall be continuous across seams, reinforcing and projections. Insulation and jacket shall be carried over projections that exceed insulation thickness.
5. Transverse joints shall be butted tightly. Longitudinal joints shall be butted, ship lapped or 45° mitered. Seal joints with 4" wide strips of approved vapor barrier patch material and adhesive, or with approved pressure sensitive vapor barrier tape.
6. Cover breaks, ribs and standing seam penetrations with patch of jacket material no less than 2" beyond break; secure with adhesive and staple. Seal staples and joints with brush coat of vapor barrier coating.
7. Fill voids in insulation at jacket penetrations and seal with vapor barrier coating.
8. Seal and flash terminations and punctures with fibrous glass cloth between two coats of vapor barrier coating.
9. Terminate vapor barrier and extend insulation at standoff brackets.
10. Outdoor ductwork shall be jacketed with a weatherproof covering equal to VentureClad.

2.20 AUTOMATIC CONTROLS

A. General:

1. Provide a complete standalone electric/electronic temperature control system for each piece of HVAC equipment.
2. If a piece of HVAC equipment requires microprocessor control and microprocessor control is not available from the HVAC equipment manufacturer, then Terminal Equipment Controllers from Tekmar, Honeywell, Johnson Controls or other approved vendors shall be furnished, installed, connected and programmed by the HVAC Subcontractor to provide the functionality described in the Sequence of Operation in the following sections.

B. Scope:

1. Control system shall consist of thermostats, humidistats, temperature sensors, microprocessor controllers, automatic valves and dampers, damper operators, control panels, electrical wiring and other components required to fill intent of Specifications and provide for complete and operable system. Control equipment shall be fully proportioning, except as noted otherwise. Sequence of operation shall be as indicated below.
2. In general this Specification morning warm-up is intended to cover following: occupied-unoccupied control, Boiler and Circulating Pump hot water controls and interlocking of fans and equipment.

C. The HVAC Subcontractor shall furnish, install or provide electric automatic control devices as indicated on the drawings and in these specifications.

D. Furnish and Install:

1. Automatic damper actuators. (Unless furnished with equipment)
2. Temperature Control Valves (Unless furnished with equipment)
3. Outdoor air inlet temperature sensor for ERVs.
4. Outdoor air discharge temperature sensor for ERVs.
5. Remote Wall Mounted Controller for ERV units.
6. Discharge temperature for ERV units.
7. Discharge temperature for MAU.
8. Microprocessor for MAU.
9. Microprocessor for Boiler and circulating pumps.
10. Programmable thermostats for Split System Heat Pumps.
11. Thermostats for unit heaters.

E. Submittals

1. The following shall be submitted for approval:
 - a. Data sheets for control system components.

F. Instruction and Adjustment

1. Upon Completion of the Work, the HVAC Subcontractor shall:

- a. Completely adjust and ready for use: thermostats, controllers, actuators and other components and equipment provided under this section.
- b. Furnish operation and maintenance manuals covering function and operation of control systems on project for use by Owner's operating personnel. Competent technician shall be provided for instruction purposes.
- c. Provide adequate instruction (not less than 2 hours) to the Owners personnel by means of a competent technician. Obtain written confirmation from the Owner that adequate instructions for each system has been provided in an acceptable manner.

G. **All temperature control wiring, wiring connections and rigid conduit shall be provided by DIVISION 15 - HVAC. This includes control wiring from the Boiler Burner Control Panel to the SCADA interface panel in the Boiler Room. All control wiring shall be run in rigid conduit. Conduit and wiring for power connections (including 120 VAC for SCADA interface panels) will be provided under DIVISION 16 - ELECTRICAL. Conduit and wiring for SCADA between contacts in panels and equipment and the SCADA system will be provided under DIVISION 16 - ELECTRICAL.**

H. Provide components factory ordered for this project. Rebuilt equipment, warehoused equipment, or earlier generation equipment shall not be acceptable. Electrical and electronic shall have a NEMA 250 Type 4 enclosure in accordance with NEMA 250 unless otherwise indicated on the Contract Drawings. Actuators shall operate within limit ratings of minus 35 to 150 degrees F.

I. Actuators. Provide electric spring return actuators. Actuators shall function as required within 85% to 110% of their power supply rating. Actuators shall fail to their spring return positions on signal or power failure. Actuators shall have visible position indicators. Actuators shall open or close the devices to which they are applied within 60 seconds after a full scale signal input change. **All actuators shall be 24 VAC. HVAC Subcontractor shall provide all required 120/24 volt transformers for controls.**

1. Damper actuators shall be rated for at least 125% of the motive power necessary to operate the connected damper. The actuator stroke shall be limited by an adjustable stop in the direction of the return stroke. Actuators shall be provided with mounting and connecting hardware.
2. Confirm voltage with DIVISION15 prior to ordering actuators.

J. Thermostats

1. 25-Amps, 120 - 240 VAC

2. 22 - Amps, 277 VAC
3. Positive Snap-Action Switch for Heating Control
4. SPDT Contacts
5. NEMA 4X Weatherproof Enclosure
6. 40 - 100°F Temperature Range
7. 2.5°F Differential
8. Chromalox model WCRT-100

K. Humidistats

1. Honeywell model H46 model humidistat.
2. Fully enclosed, dust free, SPST, snap-acting switch
3. Impact- resistant, molded plastic cover mounts on wall
4. Positive on and off settings permit manual operation of controlled equipment.
5. 120 VAC, 7.5 A
6. 240 VAC, 15.0 A
7. Differential: 4 To 6 Percent RH
8. 50 To 125 Degrees F
9. Operating Humidity Range: 20 To 80 Percent RH
10. Dial Control

L. Temperature Sensors and Transmitters

1. Temperature sensors shall conform to the following minimum standards. Additional specifications are given for specific applications below.
 - a) Sensors shall be accurate to $+0.25^{\circ}\text{F}$ over minimum operating ranges.
 - b) Sensor, associated circuitry and readout shall have minimum resolution of 0.25°F .
 - c) Sensors shall withstand ambient temperatures of -30°F to 240°F , but performance requirements must be met only for ranges specified.
2. Provide thermistor (1000 ohms or greater) or resistance temperature detector (RTD) sensors, for the following applications and minimum operating ranges.
 - a) Wall Mount Space Sensor 40°F to 100°F
 - b) Duct Mount Sensor 20°F to 120°F
 - c) Chilled Water Sensor 32°F to 80°F
 - d) Condenser Water Sensor 40°F to 100°F
 - e) Hot Water Sensor 32°F to 210°F
3. Provide thermistor (1000 ohms or greater) or resistance temperature detector (RTD) sensors, for outside air temperature measurement. Sensor shall be mounted in 24 hour shade location, in proximity to a light colored wall, in an aspirated enclosure insulated with foam from thermal transfer with adjacent structure. Sensor shall operate within the following minimum range: -20°F to 120°F .
4. Provide averaging resistance temperature detector (RTD) sensor only, for mixed air measurement. Sensor shall provide a minimum duct coverage of 1 foot per 2

feet of duct. Sensor shall not come in direct contact with coils. The sensor shall operate within the following range: 30°F to 120°F.

2.21 SEQUENCE OF OPERATION

A. Control sequences of operation shall be as follows:

B. HOT WATER BOILER

- a. Boiler and Burner Safety and Limit control shall be performed by factory furnished, mounted and wired controls, including low water cutout, high temperature cutout, flame failure and burner lockout.
- b. An Integrated Boiler Control System shall provide supervisory and operational functions for the boiler, burner, system circulating pump, and system backup pump. These functions shall include:
 - i. Outdoor Air Temperature Reset of Hot Water Supply Temperature. Supply water temperature shall vary from 180 deg F at 10 deg F outdoor temperature to 140 deg F at 55 deg F outdoor temperature.
 - ii. Warm Weather Shutdown (Setpoint of 60 deg F)
 - iii. Control of System Circulating Pump and Backup Pump, including startup and shutdown from Outdoor Air Temperature and lead/lag operation. In the event of a pump motor failure, the standby pump shall be started.
- c. The SCADA Boiler interface panel shall communicate the run status and alarm as noted in paragraph 2.08.K.

C. ENERGY RECOVERY UNITS

- a. The following sequence of control shall be programmed into the controller by the manufacturer at the factory.
- b. Provide a relay contact for the SCADA system to enable/disable the unit operation. The unit shall be locally started manually and run continuously until manually shut off. A remote wall mounted two position switch with pilot light shall control the unit as follows: when the switch is in the “Low Vent” (Unoccupied) position the unit fans shall run at a speed that provides 6 air changes in the served space. When the switch is in the “High Vent” (Occupied) position, the unit fans shall run at a speed that provides 12 air changes in the served space.
- c. The unit’s programmable DDC controller shall modulate the heat recovery wheel and hot water coil in sequence to control supply air temperature. Supply air temperature is reset between occupied (60-degrees) or unoccupied (50-degrees) temperature setpoints by a remote two-position wall mounted manual switch.
- d. The unit Outdoor Air supply damper shall be controlled to open to supply an airflow equal to ½ the maximum airflow (“Low Vent”) as measured by the Airflow Station in the Outdoor Air Intake when the wall switch or SCADA input is set to Low Vent. The unit Outdoor Air supply damper shall be controlled to

open to supply an airflow equal to the maximum airflow (“High Vent”) as measured by the Airflow Station in the Outdoor Air Intake when the wall switch or SCADA input is set to High Vent. The duct mounted static pressure sensor will control the supply fan motor speed to maintain a static pressure in the duct sufficient to supply the space supply airflows noted on the drawings.

- e. The unit exhaust fan shall be interlocked with the supply fan control to exhaust an amount of air that equals the Outdoor Air airflow. Airflow quantity shall be verified by the exhaust Airflow Station.
- e. A signal from the smoke detector mounted in the supply air duct shall shut down the unit and alarm to the Fire Alarm Control Panel. Upon shutdown the Outdoor Air and Exhaust Air dampers shall close.
- f. When the outdoor air temperature is above 50 deg F but below 76 deg F, the wheel shall be stopped and the bypass dampers shall open to allow outdoor air to bypass the wheel and flow directly into the served space.

D. MAKEUP AIR UNIT/ODOR CONTROL FAN

- a. Provide a relay contact for the SCADA system to enable/disable the unit operation. The unit shall be locally started manually and run continuously until manually shut off. On a call to start a unit, the outdoor air damper will open 100%, and the heating coil control valve will modulate to maintain discharge air temperature setpoint as sensed by a discharge air temperature sensor(user adjustable), and the Odor Control Fan shall start via a hard wired interlock. The Makeup Air Unit supply fan shall be run at a speed sufficient to makeup the exhaust airflow in the space. The MAU Airflow Station shall provide the input to verify the supply fan airflow matches the exhaust. If a unit fails to start, as sensed by a current sensor, an alarm will be generated. On detection of smoke in the supply duct, alarm will be generated to the Fire Alarm and unit will be shut down by hardwired interlock. Duct mounted smoke detector shall be monitored, and respective alarms will be generated on detection of low discharge temperature.

E. SPLIT SYSTEM HEAT PUMPS

- 1. The fan coil unit consists of a fan, connecting piping and wiring and outdoor condenser DX system. The unit is standalone controlled using electric actuation.
- 2. The fan coil units may be furnished with various controls. The HVAC Subcontractor may utilize the features of the equipment that is installed to accomplish this sequence of operation, however, the contractor is ultimately responsible to provide the entire sequence of operation.
- 3. Occupied
 - a. The fan coil units are started and stopped based on a time of day schedule. A wall mounted temperature sensor maintains constant space temperature by modulating either heating or cooling.

- b. The unit shall shut off when the primary condensate drain is blocked. The system shall utilize solid-state electronic condensate overflow protection conforming to UL 508.

4. Unoccupied (Normal Off)

- a. In the heating mode and space temperature falls below the setback temperature the fan starts and the heating is modulated on to achieve setpoint. The system goes back to the unoccupied mode when setpoint is reached.
- b. In the cooling mode and space temperature rises above the setup temperature the fan starts and the cooling coil is modulated on to achieve setpoint. The system goes back to the unoccupied mode when setpoint is reached.

F. HOT WATER UNIT HEATERS:

- a. A local thermostat will open the control valve and cycle the fan to maintain space temperature setpoint. A pipe mounted aquastat on the supply pipe will prevent the unit heater from starting if the pipe temperature is below 100 deg F. (adjustable)

PART 3 - EXECUTION

3.01 GENERAL

- A. Install all items specified under this section according to the manufacturer's requirements, shop drawings, the details as shown on the Contract Drawings and/or as specified.
- B. Install all Work so that parts requiring inspection, replacements, maintenance and repair shall be readily accessible. Minor deviations from the Contract Drawings may be made to accomplish this, but any substantial change shall not be made without prior written approval from the Owner.
- C. Equipment bases mounted on concrete slabs and pads, or mounted on stands, gratings, platforms, or other, shall not be set in any manner, except on the finished and permanent support.
- D. Support of equipment on studs or other means, and the placing or building of the supporting slab, pad, pier, stand, grating, or other "to the equipment", is prohibited.
- E. Concrete supporting structures shall have been constructed and cured a minimum of 14 days before equipment is mounted.

3.02 OPENINGS

- A. The responsibility for determining the exact size and location of openings is part of the Work of this section. If this responsibility is not met, cutting and patching to achieve the correct size and location of openings and chases is part of the work of this section.

3.03 CUTTING AND PATCHING

- A. Do all cutting and patching required except cutting and patching of finish (visible) materials. Cutting and patching of masonry walls, partitions, ceilings and floors is included. Concrete cutting shall be done with abrasive wheels or saws, and coring with a diamond core bit. Jackhammers are prohibited.

3.04 CONNECTIONS TO EQUIPMENT

- A. Connections shall be provided by the HVAC Subcontractor unless otherwise indicated. Unless otherwise indicated, the size of the connections to each piece of equipment shall be not smaller than the connections on the equipment. No bushed connections shall be permitted. Change in sizes shall be made with reducers or increasers only.
- B. A shutoff valve shall be furnished and installed at each hydronic supply branch feeding every piece of HVAC equipment.
- C. A shutoff/balance valve shall be furnished and installed at each hydronic return branch from every piece of HVAC equipment.
- D. All main branch pipes from risers shall have isolation valves near shafts.
- E. Furnish and install and isolation valves on the refrigeration lines for each piece of refrigeration equipment. Each ACCU and each Fan Coil Unit shall be separately isolated.

3.05 SUPPORTS

- A. General
 - 1. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while supporting the load.
- B. Pipe Hangers and Supports
 - 1. Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69, except as specified as follows:
 - a. Types 5, 12, and 26 shall not be used.
 - b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe and if the clamp bottom does not extend through the insulation and the top clamp attachment does not contact the insulation during pipe movement.

- c. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- d. Type 20 attachments used on angles and channels shall be furnished with an added malleable iron heel plate or adapter.
- e. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- f. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.
- g. Vertical pipe shall be supported at intervals of not more than 15 feet, except that pipe shall be supported not more than 8 feet from end of risers, and at vent terminations.
- h. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

3.06 PIPE EXPANSION

- A. The expansion of pipes shall be provided for by changes in the direction of the run of pipe to produce expansion loops and doglegs.

3.07 BOILER ERECTION AND CLEANING - HOT WATER

- A. Install boiler in accordance with manufacturer's instructions. Provide for expansion and contraction of hot water mains connected to boiler with anchors at suitable points and swing joints. Feedwater, make-up water and water treatment shall be introduced into boiler through return piping.
- B. Clean internally as specified in Section VI of ASME Boiler Pressure Vessel Code. Use boil-out compound of caustic soda or trisodium phosphate at one pound 50 gallons of water as follows:
 - 1. Remove pressure relief valve. Pour solution into boiler through tapping and replace relief valve.
 - 2. Start burner and circulate water throughout system and terminal heaters.
 - 3. Allow water temperature to reach operating temperature, at least 180°F and vent system.
 - 4. Circulate water for five hours or as directed by Architect.
 - 5. Stop burner and drain system.

6. Remove pressure relief valve, wash boiler water side surfaces with high pressure water and drain residue. Replace pressure relief valve at completion.
7. Refill system with fresh water and start burner. Bring water temperature to at least 180°F and vent system to eliminate entrained air.
8. Place boiler in service or on standby as required by Architect.
9. Repeat cleanout as directed by Architect and until no contaminants remain in system.

C. Provide two copies of ASME Section VI to Owner.

3.08 BURNER LIGHTOFF, ADJUSTMENT AND PRESSURE TEST

A. Provide services of factory-trained burner service technician to perform lightoff, adjustment and control checkout in presence of Gas Inspector and gas company representative. Instruct Owner's personnel in boiler/burner operation.

B. Burner lightoff and adjustment shall include combustion efficiency tests using batch or electronic analyzing apparatus, in presence of Architect.

C. Test data shall include:

1. Burner input and proper rate.
2. Control operating tests including adjustment and check out of limits, switches, operating controls, interlocks, low water cutoff devices and alarms, gas valves, pressure regulators, scanners and combustion controls.
3. Purging boiler and pilot operation tests; tests for venting.
4. Percent CO₂ in flue gas.
5. Gross and net stack temperatures. Presence of CO (if any) and adjustment to reduce as necessary.
6. Steady-state combustion efficiency; burner adjustments to provide optimum efficiency. Setting and adjustment of pressure overfire at slide damper, to manufacturer's specifications.

D. Pressure Tests

1. Subject pressure parts to hydrostatic test of 125 psi at factory. Field tests shall be limited to no more than maximum intended working pressure.
2. Furnish equipment, piping, labor, staging, fittings, valves, hoses and other material required to perform hydrostatic tests as directed.

3. Perform hydrostatic test of at least 40 psig for 5 hours. Tests shall be of duration necessary to satisfy Architect and Boiler Inspector that boiler has been erected correctly with no leaks.
4. Provide glass front frame in boiler room for Certificate of Inspection.
- E. Record readings on check sheet and provide copy to Architect.
- F. Record all readings listed above for lowest firing rate.
- G. Provide reference card (Lynn Products) at burner; note combustion data test readings.

3.09 DUCTWORK

- A. Installation shall be according to SMACNA HVAC DUCT CONSTRUCTION STANDARDS, latest edition unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA HVAC DUCT CONSTRUCTION STANDARDS, latest edition unless otherwise specified. Friction beam clamps indicated in SMACNA HVAC DUCT CONSTRUCTION STANDARDS, latest edition unless otherwise indicated shall not be used. Supports shall be attached only to structural framing members. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.
- B. Dust Control: To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's Work. Temporary protection shall remain in place until system is ready for startup.

3.10 AIR AND WATER SYSTEMS BALANCING

- A. The building shall be essentially complete with final ceiling, walls, windows, doors and partitions in place. Doors and windows surrounding each area to be balanced shall be closed during testing and balancing operations. Air and water systems shall be complete and operable with piping, registers, ducting, diffusers, returns, terminals and control components in place. Fans shall be operational. Air motion and distribution from air terminals shall be as shown. All data including deficiencies encountered and corrective action taken shall be recorded. If a system cannot be adjusted to meet the design requirements, promptly notify the Engineer in writing.
- B. The procedures followed for balancing of the air and water systems shall comply with and shall include the documentation forms of one of the following:
 - a. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

- b. AABC: "National Standards for Total System Balance."
- c. SMACNA: "HVAC Systems Testing, Adjusting and Balancing."

C. Air Systems

- 1. Each system shall be adjusted until all flow quantities are within plus 10% and minus 0% and the results shall be recorded. Dampers shall be checked for tight shutoff. Air leakage around dampers shall be verified. Fans shall be checked for correct direction of rotation and proper speed shall be verified.
- 2. General Balancing Methods
 - a. Air flow adjustments shall be made by first adjusting the fan speed to meet the design flow conditions. Flows shall be checked at all supply and exhaust outlets. All flows shall be recorded before and after each adjustment.

C. Control Systems

- 1. Testing, adjusting, and balancing of the systems shall be coordinated with the control system installation. All control components shall be verified to be properly installed and operating as specified before proceeding with testing, adjusting, and balancing. Verification shall be in accordance with AABC MN-1.
- 2. Adjustment of the temperature controls shall be coordinated by the person in charge of the balancing and adjusting and shall be performed coincidental therewith. Simulate a complete cycle of operation for each system.

D Water Systems

- 2. Water Balancing and Adjusting
 - a. Balancing shall not begin until systems have been installed complete, including pumps, piping, valves and coils.
 - b. Make adjustments as required to deliver water volumes at coils and equipment within 5% of design flow, or as required to properly balance cooling and heating loads throughout conditioned areas.
 - c. Adjustments in water volumes shall be made in manner satisfactory to Architect.
 - d. Report on system performance shall include:
 - 1) Manufacturer, size, type, location including room number, and zone of each coil and piece of equipment.
 - 2) Design and actual water flow.
 - 3) Complete nameplate data for each piece of equipment reported.
 - 4) Complete identification of data.

3.11 BASES AND SUPPORTS

- A. In addition to supports and hangers as mentioned in Section 05500, provide all bases and supports not part of the building structure, of required size, type, and strength, as approved by the Engineer, for all equipment and materials furnished by him. All equipment, bases and supports shall be adequately anchored to the building structure to prevent shifting of position under operating conditions.
- B. All concrete foundations and all concrete supports will be provided by the General Contractor. Furnish shop drawings and templates for all concrete foundations and supports for setting all required hanger and foundation bolts and other appurtenances necessary for the proper installation of his equipment.

3.12 CONCRETE SUPPORT PADS

- A. The HVAC Subcontractor shall forward to the General Contractor (GC) approved submittals of all HVAC equipment requiring concrete support pads. The submittals shall include the locations and size of anchor bolts. GC shall form and pour 4 inch high support concrete pads with the embedded anchors. Pads shall extend a minimum of 6 inches beyond the equipment footprint.

3.13 MISCELLANEOUS IRON AND STEEL

- A. All Work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets, and framework shall be properly sized and firmly constructed.
- B. Measurements shall be taken on the job and worked out to suit adjoining and connecting Work. All Work shall be by experienced metal working mechanics. Members shall be straight and true and accurately fitted. Scale, rust, and burrs shall be removed. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other trades as directed by them.
- C. Members shall be generally welded, except that bolting may be used for field assembly where welding would be impractical.
- D. All shop fabricated iron and steel work shall be cleaned and dried and given a shop coat of paint on all surfaces and in all openings and crevices.

3.14 PLACING IN SERVICE

- A. At the completion of performance tests and following approval of test result, recheck all equipment to see that each item is adequately lubricated and functioning correctly.

3.15 CLEANING AND ADJUSTING

- A. During the progress of the Work, clean up and remove all oil, grease, and other debris caused by the Work performed under this section.
- B. At the conclusion of the Project, clean and repair all areas and finishes as installed or affected by this installation of Work under this section.
- C. Equipment: Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension.

3.16 INSULATION

A. Application - General

- 1. Installation: Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of the Specifications are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if aforementioned cleaning does not restore the surfaces to like new condition, the insulation may be rejected, and if rejected, shall be immediately removed from the jobsite. Joints shall be staggered on multilayer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA-01 standard plates except where modified herein or on the Contract Drawings.
- 2. Firestopping: Where pipes pass through fire walls and fire partitions, the penetration shall be sealed with firestopping materials as specified.
- 3. Flexible Cellular Insulation: Flexible cellular insulation shall be installed with seams and joints sealed with a contact adhesive. Flexible cellular insulation shall not be used on surfaces greater than 200 degrees F.

B. Pipe Insulation Installation

- 1. General: Pipe insulation shall be continuous and installed on fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used.
- 2. Pipes Passing Through Sleeves
 - a. Pipe insulation shall be continuous through the sleeve.

- b. An aluminum jacket with factory applied moisture barrier shall be provided over the insulation wherever penetrations require sealing.
- c. Where penetrating interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.
- d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.
- e. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

3. Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69 whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.
- b. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible cellular insulation shall conform to ASTM C 921, Type 1, and is allowed to be of a different material than the adjoining insulation material.

4. Flexible Cellular Pipe Insulation: Flexible cellular pipe insulation shall be tubular form. Sweat fittings shall be insulated with miter cut pieces the same size as on adjacent piping.

C. Duct Insulation Installation

- 1. Insulate supply and exhaust ductwork outdoors from the roof or wall penetration to ERV, MAU and AHUs to a value of R-12. Cover outdoor ductwork with weatherproof jacketing equal to VentureClad.
- 2. Insulation shall be attached by applying Class 2 adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- 3. For ducts and plena, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18-inch centers and not more than 18 inches from duct corners.

4. Insulation shall be impaled on the mechanical fasteners where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hanger. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.
 5. Jacket overlaps shall be secured under the overlap with Class 2 adhesive and stapled on 4 inch centers. Staples and seams shall be coated with a brush coat of vapor barrier coating.
 6. Breaks in the jacket material shall be covered with patches of the same material as the vapor barrier. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with Class 2 adhesive and staples. Staples and joints shall be sealed with a brush coat of vapor barrier coating.
 7. At jacket penetrations such as hangers and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor barrier coating.
 8. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor barrier coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
 9. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.
- D. Duct Test Holes: after duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.17 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Operation and Maintenance Manuals shall be provided in accordance with Section 01730.
- B. All operating equipment installed under this section shall be placed in operation and shall function continuously in an operating test for a period of one week without shutdown due to mechanical failure or necessity of adjustment. Prior to scheduling the Project Final Inspection and after completion of all installation and running adjustments, perform all work required to place the equipment in complete operating condition to meet all requirements under the Specifications.
- C. During this running test period, deliver to the designated representative of the Owner, through the Engineer, 6 complete sets of operating, service and replacement data for all equipment which will require operating maintenance or replacement and one copy of this literature shall be available during the instruction of the operating personnel while the other is checked for completeness by the Engineer.

3.18 TRAINING

- A. Conduct a training course for the maintenance and operating staff. The training period of eight (8) hours normal working time shall start after the system is functionally complete but before the final acceptance tests. The training shall include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. The Engineer shall be given at least 2 weeks advance notice of such training.
- B. During all working hours of the one-week operating test, instruction personnel shall be available for and provide thorough and detailed training to the Owner's operating and maintenance personnel in operation, maintenance and adjustment of all equipment installed.
- C. Give sufficient notice to the designated operating personnel of the owner in advance of this period. Upon completion of instruction, obtain from such representatives written verification on that which the above-mentioned instruction has been performed, such verification to be forwarded to the Engineer.

END OF SECTION

DIVISION 16

SECTION 16000

BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes all labor, materials, tools, equipment, and accessory items and performing all operations necessary to furnish and install the complete electrical work in accordance with this section of these specifications, the drawings and the standards of the applicable codes listed herein.
- B. The work shall include, but not be limited to, furnishing and installation of equipment and items listed below and installation only of items furnished under other sections of these specifications.
 - 1. Conduit, wire and electrical connections are required on certain items specified in sections of these specifications other than the electrical section. This Contractor shall examine all sections of these specifications to determine the complete scope of the electrical work.
 - 2. Raceways and fittings
 - 3. Wires and cables
 - 4. Variable Frequency Drives
 - 5. Miscellaneous equipment
 - 6. Panelboards
 - 7. Lighting systems
 - 8. Grounding systems
 - 9. Fire Alarm system
 - 10. Demolition of existing electrical systems.
- C. Mount and wire operator's stations, power conversion equipment, and motor control systems furnished under other Divisions of these Specifications.
- D. Install and make all field connections to variable frequency drives, process instrument panels and other control panels furnished under other Divisions of these Specifications.
- E. Mount and wire process instruments and control cabinets furnished under other Divisions of these Specifications. Furnish and install all conduit, wire and interconnections between process instrumentation primary elements, transmitters, local indicators and receivers. Mount and wire all lightning and surge protection equipment at process instrumentation transmitters and receivers.

- F. Mount and make field connections to “packaged” equipment furnished under other Divisions of these Specifications.
- G. Provide conduit and power wiring for all HVAC (Heating, Ventilation and Air Conditioning) and Plumbing equipment furnished under other Divisions of these Specifications.
- H. Documents Applicable to the Work of this Section:
 - 1. Division 0 of the Contract Documents (Contract Forms and Requirements).
 - 2. Division 1 of the Technical Specifications.
 - 3. Technical Specifications: Section 16000 - Basic Electrical Requirements, and the following sub-sections:
 - a. Section 16060 – GROUNDING SYSTEM
 - b. Section 16085 – MISCELLANEOUS EQUIPMENT
 - c. Section 16120 – WIRE AND CABLES
 - d. Section 16130 – RACEWAYS AND FITTINGS
 - e. Section 16442 – PANELBOARDS
 - f. Section 16495 – VARIABLE FREQUENCY DRIVES
 - g. Section 16500 – LIGHTING SYSTEM
 - h. Section 16721 – FIRE ALARM SYSTEMS

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Circuit breakers
 - 2. Variable Frequency Drives
 - 3. Dry type transformers
 - 4. Panelboards
 - 5. Lighting fixtures
 - 6. Disconnect switches
 - 7. Control stations
 - 8. Miscellaneous equipment
 - 9. Fire Alarm System
- B. The manufacturer's data sheets with product designation or catalog numbers shall be submitted for the following material:
 - 1. Wire
 - 2. Conduit
 - 3. Receptacles
 - 4. Boxes and fittings
- C. Submit all other data as specified herein.

- D. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section 16000.
- E. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.
- F. Prior to submitting shop drawings for lighting fixtures, verify the type of ceiling suspension systems being installed. Notify Engineer of any discrepancies between fixture type specified and suspension system. Additional cost rising from failure to notify the Engineer will be the responsibility of the Contractor.
- G. Operation and Maintenance Manuals - Prepare manuals in accordance with Section 01730.
- H. Record Drawings - Prepare as specified in Part 1 of this Section.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600 and as specified herein.
- B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If stored for more than two weeks, the equipment shall receive all maintenance considerations required by the manufacturer for the proper storage of equipment. Proper storage in this context shall include the provision of heaters and dehumidifiers to keep the equipment dry at all times. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the Owner. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, or shall be replaced at no additional cost to the Owner.

1.04 DESIGN CRITERIA

- A. Service Characteristics
 - 1. Primary Utility Voltage: 13.8KV
 - 2. Secondary Building Voltage - High Level: 480/277 V
 - 3. Secondary Building Voltage - Low Level: 120/208V
 - 4. All equipment and wiring shall be suitable for the applied voltage.
- B. Requirements of the Regulatory Agencies
 - 1. The final, complete installation shall comply with all state and local statutory requirements having jurisdiction. The Contractor shall arrange for all necessary permits, pay all fees and arrange for all required inspections by local authorities. In general, all work shall comply with the requirements of the National Electrical

Code, all state codes and the codes and ordinances of the city or town in which the work is to be done.

C. Tests and Settings

1. Test all systems furnished under DIVISION 16 - ELECTRICAL and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the system.
2. Make all circuit breaker and motor circuit protector settings based on the connected equipment manufacture's recommendations.
3. The following minimum tests and checks shall be made prior to the energizing of electrical equipment. A certified test report shall be submitted stating that the equipment meets and operates in accordance with manufacturer's and job specifications, and that equipment and installation conforms to all applicable standards and specifications.
 - a. Testing of protective relays, static devices, transfer switches, circuit breakers and motor circuit protectors for calibration and proper operation and settings.
 - b. Over potential, high potential, insulation resistance and shield continuity tests for cables.
 - c. Mechanical inspection of switches, transfer switches and circuit breakers.
4. The Engineer shall be immediately notified of any unfavorable test results or indication of faulty equipment. No piece of equipment shall be energized until the test data is evaluated and the equipment is proven acceptable.
5. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to be made to meet the specified requirements.

1.05 RELATED WORK NOT INCLUDED

- A. Concrete work, including concrete electrical duct encasement, is included under DIVISION 3 - CONCRETE of these Specifications.

1.06 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions etc. When located in formed concrete walls locate all necessary slots for electrical work and form before concrete is poured.
- B. Provide waterproof sealing for the penetrations through exterior walls, etc.

- C. Provide fireproof sealing for penetrations through fireproof walls, etc.
- D. Foam type fire and water proofing is not allowed.

1.07 CUTTING AND PATCHING

- A. All openings required by the work of these Sections shall be planned for in advance. Any cutting and patching required by the lack of such planning shall be done by the General Contractor at the expense of this Contractor. It will be the responsibility of this Contractor to keep the General Contractor informed of all required openings.

1.08 CORING

- A. Provide all coring for conduits penetrating floors, walls, partitions etc.
- B. Provide waterproof sealing for the penetrations through exterior walls, etc.
- C. Provide fireproof sealing for penetrations through fireproof walls, etc.
- D. Foam type fire and water proofing is not allowed.

1.09 ELECTRICAL HAZZARDOUS CLASSIFCATION AND NEMA RATINGS FOR ELECTRICAL INSTALATION AND ENCLOSURES

- A. Unclassified, NEMA Type 12 for Building interior except as noted below.
- B. Unclassified, NEMA Type 4X for Building interior for a radius of 15' within a room around process equipment.
- C. Unclassified, NEMA Type 4X for Building exterior.
- D. Class 1, Division I, NEMA Type 7 for within Gravity Thickener Tanks.

1.10 INTERPRETATION OF DRAWINGS

- A. The Drawings are not intended to show exact routing of conduit runs or terminations. Contractor shall determine exact location of conduit terminations by examinations of approved shop drawings. The Contractor shall not reduce the size or number of conduit runs indicated on the drawings.
- B. The final routing of raceways shall be determined by structural conditions, interferences with other trades and by terminal locations on apparatus. The Engineer reserves the right of a reasonable amount of shifting at no extra cost up until time of roughing in the work.
- C. Locate pull boxes, panelboards, control pushbuttons, terminal cabinets, safety switches and such other apparatus as may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the drawings in locations which are found to be inaccessible, advise the Engineer of the situation before work is advanced to the point where extra costs will be involved.

- D. Each three-phase circuit shall be run in a separate conduit unless otherwise shown on the drawings.
- E. Unless otherwise approved by the Engineer conduits shown exposed shall be installed exposed; conduits shown concealed shall be installed concealed.
- F. Where circuits are shown as “home-runs” all necessary fittings and boxes shall be provided for a complete raceway installation.
- G. In general, wiring and raceway systems for lighting, receptacles, fire alarm, telephone and intercommunications systems are not indicated on the drawings but shall be furnished and installed under this section.
- H. Each branch circuit shall have its own neutral, dedicated to that circuit. A common neutral for more than one single phase circuit is not allowed.
- I. Verify with the Engineer the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- J. Any work installed contrary to drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.
- K. The locations of equipment, fixtures, outlets, and similar devices shown on the drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- L. Circuits on three phase panelboards shall be field connected to result in evenly balanced loads on each phase.
- M. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.
- N. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical system shown. Additional circuits shall be wherever needed to conform to the specific requirements of the equipment.
- O. All connections to equipment shall be made as required, and in accordance with the approved shop and setting drawings.
- P. Schematic diagrams shown on the drawings indicate the required functions only. Standard circuits of the particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic drawings shown. Additional wiring or conduit required for such deviations shall be furnished at Contractor's expense. Contractor must ensure that all components necessary to accomplish the required function are provided.

1.11 SIZE OF EQUIPMENT

- A. Investigate each space in the structure through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the structure.
- B. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the manufacturer shall be required to brace the equipment suitable, to insure that the tilting does not impair the functional integrity of the equipment.

1.12 WORK IN EXISTING STRUCTURES

- A. Each bidder or his authorized representatives shall, before preparing his proposal, visit all areas of the existing structures in which work under this bid is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that he or his representative has visited the buildings and structures and noted the locations and conditions under which the work will be performed and that he takes full responsibility for a complete knowledge of all factors governing his work.
- B. In general, any or all existing electrical equipment and services are to remain in operation and shall not be disturbed unless otherwise noted in these Specifications and/or on the drawings or as required for the proper execution of the work.
- C. In each area of the work, disconnect and carefully remove the existing electrical equipment and devices so noted. With the exception of items indicated as having to be re-used, all such existing equipment and device shall be turned over to the Owner. If not required by the Owner, remove them from the premises and site. All existing electrical equipment and devices indicated as not removed or abandoned are to be maintained in operation and any circuits disturbed by the construction shall be restored.
- D. Maintain existing electrical services and systems to and in the buildings throughout the project and all "down-time" shall be scheduled at least three weeks in advance with the permission of the Owner and such scheduling shall be rigidly adhered to.

1.13 TEMPORARY POWER AND LIGHTING

- A. The Electrical Subcontractor shall furnish and install feeders of sufficient size from the building's and or plant's power system for the electric light and power requirements for the project while under construction and until the permanent feeders and related equipment have been installed and are in operation. Temporary lighting shall be based on a minimum of one watt per square foot covering each and every square foot in the building. Sufficient wiring, lamps, and outlets shall be installed to insure proper lighting in all rooms, space, and stairwells. Minimum sized lamp used shall be 1500 lumens. Where higher lighting intensities are required by Federal or State Standards of Laws or otherwise specified, the above specified lumens shall be increased to provide these increased intensities.
- B. All necessary transformers, meters, cables, panelboards, switches, temporary lamp replacements and accessories required for the temporary light and power installation shall be provided by the Electrical Subcontractor.

- C. The Electrical Subcontractor shall provide and maintain in each area of the building and the building exterior, a feeder or feeders of sufficient capacity for the requirements of the entire floor and he shall provide a sufficient number of outlets, located at convenient points, so that extension cords of not over 50 ft. in length will reach all work requiring temporary light or power.
- D. The Electrical Subcontractor shall install and maintain the wiring and accessories for the portable trailer office of the General Contractor.
- E. All temporary electrical work shall meet the requirements of the National Electrical Code Article 305 Temporary Wiring, the Local Utility Company, and all Federal Standards and Laws.
- F. All temporary wiring and accessories thereto installed by the Electrical Subcontractor shall be removed after their purposes have been served.
- G. The General Contractor will pay for the cost of electric energy consumed by himself and by all of his Subcontractors, unless otherwise indicated.
- H. Provide all temporary lighting and power required above during the normal working hours of the project or a total of ten (10) hours per normal working day; Saturdays, Sundays and legal holidays are excluded. The ten hours per day shall include manning the temporary power and lighting 2 hour before and 2 hour after a normal eight (8) hour working day. In addition to the above, provide and maintain, to the satisfaction of the local authorities having jurisdiction, all temporary lighting and power that may be required for safety purposes. The Electrical Subcontractor will be compensated by the General Contractor for any additional standby time, materials or equipment required by the General Contractor or other Subcontractors beyond the normal working hours, as defined above.

1.14 RECORD DRAWINGS

- A. Record drawings shall be provided under this Section in accordance with Section 01780 and as specified herein.
- B. As work progresses and for the duration of the Contract, maintain a complete and separate set of prints of Contract Drawings at the job site at all times. On a daily basis, record work completed and all changes from original Contract Drawings clearly and accurately, including work installed as a modification or addition to the original design such as change orders, instructions issued by the Engineer, or conditions encountered in the field.
- C. Drawings shall show record condition of details, sections, and riser diagrams, and control changes. Schedules shall show actual manufacturer and make and model numbers of final equipment installation. Remove all superceded data to show the completed work. Accurately indicate the location, size, type, and elevation of new utilities and their relationship to other utilities.
- D. The Record Drawings will be used as a guide for determining the progress of the Work installed. They shall be inspected on a regular basis and shall be corrected immediately if

found inaccurate or incomplete. Requisitions for payment will not be approved until the Drawings are accurate and up-to-date.

- E. At completion of Work prepare a complete set of Record Drawings showing all systems as actually installed. The Contract Drawing electronic CAD files will be made available for this Contractor's copying, at his expense, into reproducible to serve as backgrounds for the Record Drawings. Provide all drawings necessary to show the required as-built information. Submit three sets of prints to the Engineer for comments as to compliance with this Section. Make all modifications so noted by the Engineer.
- F. Certify the accuracy of the record drawings. Record Drawings shall become the property of the Owner.
- G. When required by jurisdiction, submit the record set for approval by the Authority Having Jurisdiction in a form acceptable to the jurisdiction.

1.15 COMPONENT INTERCONNECTIONS

- A. Components of equipment furnished under this Specification will not be furnished as integrated systems.
- B. Analyze all systems components and their shop drawings; identify all terminals and prepare drawings or wiring tables necessary for component interconnection. Furnish two copies of interconnection wiring diagrams and tables to the Owner as part of the record drawings.
- C. Furnish and install all component interconnections.

1.16 MANUFACTURER'S SERVICES

- A. Provide manufacturer's services for testing, training and start-up of the following equipment:
 - 1. Variable Frequency Drives.
 - 2. The time required for each system shall be as hereinafter specified. The time specified shall be used as directed by the Engineer and shall not be used by the manufacturer or Contractor for field adjustments due to manufacturing or shipping defects.

1.17 MATERIALS

- A. Materials and equipment used shall be Underwriters Laboratories, Inc. listed wherever standards have been established by that agency. Written approval by the Engineer and local inspecting authority is required wherever UL Listed approval is not available.
- B. Manufacturer of Principal Equipment
 - 1. All lighting and power panelboards shall be made by one manufacturer.
 - 2. All conduit of a given type shall be made by one manufacturer.

3. All wire and cables of a given type shall be made by one manufacturer.
4. All three phase magnetic motor starters furnished shall be made by one manufacturer.

1.18 WARRANTY

- A. Provide warranty and guarantee on all equipment furnished and work performed for a period of one (1) year from the date of substantial completion.

PART 2 (NOT USED)

PART 3 (NOT USED)

- END OF SECTION -

SECTION 16060
GROUNDING SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes the furnishing and installing of a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as specified herein and as shown on the drawings.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Conduit
 - 2. Wire
 - 3. Ground bus bars

1.03 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600.
- B. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

PART 2 – PRODUCTS

2.01 CONDUIT

- A. Conduit shall be as specified under Section 16130 (Raceways and Fittings).

2.02 WIRE

- A. Wire shall be as specified under Section 16120 (Wire and Cables).

2.03 GROUNDING BUS BARS

- A. Provide a grounding bus bar next to or below the main distribution board or main disconnect, ground bus bar to be approximately 8” above finished floor.
- B. Grounding bus bars shall be copper, not less than ¼ inch by 2 inch by 24 inch.
- C. All lugs, bolts and nuts shall be silicon bronze.
- D. Buses shall be mounted to the room wall with standoff isolators, standoff brackets, and mounting bolts.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Grounding conductors shall be run with feeders where shown on the drawings or hereinafter specified.
- B. Liquid tight flexible metal conduit in sizes 1 inch and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps. Tie wraps shall be installed 12 inches apart and not more than 6 inches from ends.
- C. Connect the following equipment by separate wire or cable directly to the main electrical room grounding bus bar:
 - 1. Frame of each transformer
 - 2. Neutral of each transformer
- D. Connect the following equipment by separate wire or cable to the ground bus in the distribution equipment servicing the equipment:
 - 1. Panelboards
 - 2. Motors
 - 3. Control panels
 - 4. All feeders and branch circuits
- F. The following equipment shall be grounded through the metallic raceway systems with permanent and effective ground connections:
 - 1. All metal cases and support frames
 - 2. Lighting system
 - 3. 120 Volt motors
- G. All grounding connections shall be made by means of approved bronze clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A, or equal.
- H. Light fixture bases shall be furnished with a grounding point.

3.02 TESTING

- A. The grounding system shall be tested under this section.
- B. The equipment grounding shall be checked to insure continuity of the ground return path.
- C. The ground grid systems shall be tested using the three terminal fall in potential method. A minimum of eight test points for each ground grid system shall be submitted for review by the Engineer. The test points shall be made along a straight line from the grid system to the reference terminal. The distance between the grid system and the reference terminal shall be consistent with normal practices for ground testing.

- D. All test equipment shall be furnished hereunder and shall be similar to Biddle Earth Tester No. 250220 or equal.
- E. These tests shall be performed during the dry season. Tests shall be performed before loaming and seeding or paving work has been performed.
- F. The Contractor shall notify the Engineer immediately if the ground grid system exceeds 5 ohms.

3.03 CLOSEOUT ACTIVITIES

- A. Provide in accordance with Section 01700.

- END OF SECTION -

SECTION 16085

MISCELLANEOUS EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes the furnishing and installing of all miscellaneous equipment as specified herein and as shown on the drawings.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Surge Suppression Devices
 - 2. Disconnect switches
 - 3. Motor starters
 - 4. Transformers
 - 5. Control stations
 - 6. Enclosure types
 - 7. Wireway
 - 8. Relays
 - 9. Nameplates
 - 10. Floor Mats
 - 11. Warning Signs
- B. Operation and Maintenance Manuals - Prepare manuals in accordance with Section 01730.
- C. Record Drawings - Prepare as specified in Section 16000.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600.
- B. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

1.04 DESIGN CRITERIA

- A. All circuit breakers, magnetic motor starters, and fuses furnished under this section shall be of the same manufacturer for each type of equipment.

PART 2 – PRODUCTS

2.01 SURGE PROTECTION DEVICE (SPD)

A. Electrical Service SPD

1. Certify unit listed to UL 1449, 3rd Edition and UL 1283.
2. SPD shall be UL labeled as Type 1, intended for use without need for external or supplemental overcurrent devices. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
3. SPD to be enclosed, surfaced mount and to include surge counter, audible alarm and dry contact for remote status.
4. Minimum surge current capability (single pulse rated) per phase shall be 200kA
5. Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1000V	600V
480Y/277	1200V	1200V	2000V	1200V

6. Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277	15%	320V

7. SPD shall be installed per manufacturer’s installation instructions with lead lengths as short (less than 24”) and straight as possible. Gently twist conductors together.

2.02 DISCONNECT SWITCHES (VISIBLE BLADE TYPE)

- A. Visible blade type disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 pole with full cover interlock.
- B. Enclosure shall meet the area NEMA designation for which they are located.
- C. NEMA Type 12, 4X and 7 enclosures shall be as specified herein.
- D. Disconnect switches shall be as manufactured by Eaton Co., Square D, or General Electric Co.

2.03 DISCONNECT SWITCHES (TOGGLE TYPE)

- A. Toggle type disconnect switches shall be quick-make, quick-break with handle guard and lock-off feature.
- B. Switches shall be provided for resistance, non-motor type loads only. Switches shall not be installed where full load current of utilization equipment exceeds 18 Amperes.
- C. Switches shall be rated 20 Amperes at 600 Volts and 30 Amperes at 250 Volts, 60 Hertz, 2 or 3 pole.
- D. Enclosure shall meet the area NEMA designation for which they are located.
- E. NEMA Type 12, 4X and 7 enclosures shall be as specified herein.
- F. Disconnect switches shall be provided by Eaton Co., Square D., or General Electric Company.

2.04 MANUAL MOTOR STARTERS

- A. Manual starters shall be non-reversing, reversing or two speed type as shown on the drawings. Built-in control stations shall be provided where shown on the drawings.
- B. Enclosure shall meet the area NEMA designation for which they are located.
- C. NEMA Type 12, 4X and 7 enclosures shall be as specified herein.
- D. Provide handle guard kit with padlock provisions.
- E. Manual motor starters shall be as manufactured by the Eaton Co., Square D, or General Electric Co.

2.05 COMBINATION MAGNETIC MOTOR STARTERS FOR WALL MOUNTING

- A. Combination magnetic motor starters shall be a combination motor circuit protector and contactor. Contactors shall be three pole, three phase, 60 Hertz, 600 Volt, magnetically operated, full voltage non-reversing except as shown on the drawings. NEMA sizes shall be as required for the horsepower shown on the drawings. Disconnect switches shall be quick-make, quick-break with operating mechanism mounted on a fixed portion of the enclosure. Door mounted mechanisms will not be acceptable.
- B. Each motor starter shall have a 120 Volt operating coil and control power transformer. Three phase starters shall have three overload relays. Auxiliary contacts shall be provided as required.
- C. Overload relays shall be adjustable and manually reset.

- D. Control power transformers shall be sized for additional load where shown on the drawings. Transformer secondaries shall be equipped with time-delay fuses.
- E. Built-in control stations and indicating lights shall be furnished where shown on the drawings.
- F. Enclosure shall meet the area NEMA designation for which they are located.
- G. NEMA Type 12, 4X and 7 enclosures shall be as specified herein.
- H. Provide handle guard kit with padlock provisions.
- I. Combination magnetic motor starters shall be as manufactured by Eaton Co., Siemens Corp., or General Electric Co..

2.06 DRY TYPE TRANSFORMERS

- A. Dry type transformers shall be dry type, copper, two-winding with KVA and voltage ratings as shown on the drawings.
- B. Transformers shall be furnished with full capacity primary voltage taps as follows:
 - 1. 0.25 KVA to 2 KVA - None
 - 2. 3 KVA to 10 KVA - Two - 5 percent below normal.
 - 3. 11 KVA to 500 KVA - Two - 2-1/2 percent below normal and two 2-1/2 percent above normal.
- C. Transformers shall be designed for indoor or outdoor service as required for the locations shown on the drawings.
- D. Transformers shall be designed in accordance with ANSI, IEEE and NEMA standards.
- E. Normal efficiency transformers shall be furnished in sized to 15 KVA. Maximum temperature rise of transformers as measured by resistance above a 40 degree C ambient shall not exceed:
 - 1. 115 degree C for transformers rated up to 25 KVA.
 - 2. 80 degree C for transformers rated up to 500 KVA.
- F. Energy efficient transformers shall be furnished in ratings 30 KVA and larger and certified to meet DOE 10 CFR Part 431:2016. Temperature rise of transformers above a 40 degree C ambient shall not exceed 80 degree C.
- G. All insulating materials shall be in accordance with NEMA standards for a 220 degree C UL component recognized insulation system.

- H. Transformers shall be manufactured by Square D Co., General Electric Co., Hammond Corp., or equal.

2.07 CONTROL STATIONS

- A. Control stations shall be heavy-duty type, 30 mm, with full size operators.
- B. All control stations located at motors and where shown on the drawings shall have a padlock attachment for locking out the stop button or position.
- C. Enclosure shall meet the area NEMA designation for which they are located.
- D. NEMA Type 12, 4X and 7 enclosures shall be as specified herein.
- E. Control stations shall be CR104 Series by General Electric Co., or equal by Eaton Co. or Siemens Corp.

2.08 ENCLOSURE TYPE

- A. NEMA Type 12 enclosure shall be general purpose sheet steel.
- B. NEMA Type 4X enclosures shall be cast iron or stainless steel.
- C. NEMA Type 7 shall be cast iron.

2.09 WIREWAY

- A. Wireway shall be steel.
- B. Wireway shall be manufactured by General Electric Co., or equal by Siemens Corp or Hoffman Enclosures.

2.10 RELAYS

- A. Control relays shall be heavy duty machine tool type, with 10 Ampere, 300 Volt convertible contacts. Time delay relays shall be pneumatic, adjustable 0.2 to 180 seconds. Relays shall be Catalog No. 1CR122A as manufactured by the General Electric Co., equal by Eaton Company, or Allen Bradley Co.

2.11 NAMEPLATES

- A. Nameplates shall be provided for all special purpose tumbler switches, disconnect switches, remote control stations, motor starters, time clocks, panelboards, terminal cabinet, etc. to designate the equipment controlled and function.
- B. Nameplates shall be black and white laminated, phenolic material having engraved letters approximately 1/4 inch high, extending through the black face into the white layer.

- C. Nameplates shall be attached to the panel by self-tapping stainless steel screws or rivets.

2.12 FLOOR MATS

- A. Provide 1/4" x 36" corrugated all rubber insulating matting in front of new 480V power distribution equipment.
- B. Matting shall be proof tested to 20,000 volts and conform to ASTM D178-93.
- C. Matting to be manufactured by Biltrite or equal.

2.13 WARNING SIGNS

- A. Metal-enclosed switchgear, transformers, pull boxes, electric rooms, closets and similar locations and pieces of equipment shall be furnished with a warning sign. Sign shall read "DANGER HIGH VOLTAGE KEEP OUT!". Signs shall be as manufactured by Thomas & Betts, Seton, or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All field mounted devices shall be mounted four feet-six inches above the finished floor or grade. Devices shall be adequately supported on walls, columns or other supports. The Contractor shall furnish and install channel iron imbedded in the ground or floor to support devices where necessary.
- B. All control equipment shall be identified as to the equipment it controls. Provide lamacoid nameplates at all equipment.

- END OF SECTION -

SECTION 16120

WIRES AND CABLES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes the furnishing, installing and testing of all wire, cable and appurtenances as specified herein and as shown on the drawings. All wiring of a given type shall be the product of one manufacturer.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Wire
 - 2. Cable
 - 3. Terminations
 - 4. Lugs
 - 5. Wire and Cable Markers

1.03 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600.
- B. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

1.04 DESIGN CRITERIA

- A. Wire for single phase circuits shall be Type XHHW or THWN-THHN.
- B. Wire for three phase circuits shall be Type XHHW.
- C. Single conductor wire for control, indication and metering shall be Type THWN/THHN No. 12 or 14 AWG, stranded.
- D. Multi-conductor control cable shall be used for the underground system and shall be No. 12 or 14 AWG, stranded with an overall jacket.
- E. Wire for process instrumentation shall be twisted shielded pairs No. 16 AWG, stranded.
- F. Ground wires shall be Type THW, green. Bare ground wires shall be soft drawn copper, 98 percent conductivity.

1.05 MINIMUM SIZES

- A. Except for control and signal wiring, no wire smaller than number 12 AWG shall be used.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.
- B. All conductors No. 8 AWG and larger sizes shall be stranded.

2.02 600 VOLT WIRE

- A. Type XHHW shall be cross-linked polyethylene, as manufactured by Prysmian Cable Corp., Collyer Insulated Wire Co., The Okonite Co. or equal.
- B. Type THWN/THHN shall be as manufactured by Prysmian Cable Corp., Collyer Insulated Wire Co., The Okonite Co. or equal.
- C. Multi-conductor control cable shall be stranded, 600 Volt, cross-linked polyethylene insulated, neoprene jacketed, as manufactured by Allied Wire and Cable, or equal.

2.03 INSTRUMENTATION CABLE

- A. Process instrumentation wire shall be twisted pair, 600 Volts, polyethylene insulated, aluminum tape, tinned copper braid shielded, polyvinyl chloride jacketed, as manufactured by Okonite Co., Belden Corp., or equal.

2.04 CAT 6 CABLE

- A. Cable shall be CAT 6 type having four each individually twisted pair, 22 AWG conductors with a blue PVC jacket.

2.05 CONNECTORS AND TERMINAL LUGS

- A. Splices for No. 10 or No. 12 A.W.G. solid wires, such as for lighting branch circuits, shall be made with insulated wire connectors.
- B. Connectors and terminal lugs on wires No. 8 A.W.G. and larger shall be of the mechanical or clamp type.

2.06 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be “Omni-Grip” as manufactured by W.H. Brady Co., or equal.
- B. Wire and cables with diameters exceeding the capacity of the “Omni-Grip” shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by W.H. Brady Co., T&B Fasteners Inc., or equal.

- C. The "to" and "from" destinations shall be clearly identified on each cable at each termination and within manholes, pull boxes and junction boxes.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All conductors shall be carefully handled to avoid kinks or damage to insulation.
- B. All wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) shall be uniquely identified at each end with wire and cable markers.
 - 1. Where wiring originates from a motor control center or process control panel the wire identification number shall incorporate the terminal numbers used in the control center or panel and a number to identify the motor control center or panel.
 - 2. Wires shall be identified at both ends and at intermediate junction boxes, terminal cabinets, etc. Wire identification numbers shall be unique.
 - 3. A typed list of the numbers used at each motor control center and control cabinet shall be submitted with the as built drawings.
- C. Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. approved for use with the insulation specified.
- D. Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.
- E. Shielded instrumentation wire shall be installed in rigid steel conduit and pull boxes that contain only shielded instrumentation wire.
- F. Shielding on instrumentation wire shall be grounded at the transmitter end only.
- G. No more than three lighting circuits, each from a different phase, shall be connected to a common neutral.
- H. Cables penetrating fire rated floors, walls, etc. shall be fireproofed. Fireproofing material shall be U.L. classified for three hour fire rating. Fire-proofing system shall be as manufactured by 3M Co., Thomas & Betts, or equal.
- I. Power conductors (other than lighting & receptacle) shall be run continuous and splicing should be kept to a minimum. The Engineer should be informed of where splices will occur.
- J. All CAT6 cables shall be labeled, comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

3.02 TESTS

- A. All 600 Volt wire insulation shall be tested with a megohm meter after installation. Tests shall be made at not less than 500 Volts. Submit a written test report of the results to the Engineer.
- B. All CAT6 cables shall be tested for continuity by contractor per manufacturer's specifications.

- END OF SECTION -

SECTION 16130

RACEWAYS AND FITTINGS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes the furnishing and installing of complete raceway systems as specified herein and as shown on the drawings.
- B. All raceway systems shall be complete with fittings, boxes or cabinets, and necessary connections to result in a complete system.
- C. Aluminum materials shall not be used.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Raceways.
 - 2. Boxes and Fittings.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600.
- B. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

1.04 DESIGN CRITERIA

- A. Except where otherwise shown on the drawings, or hereinafter specified, all raceways installed exposed shall be rigid heavy wall galvanized steel conduit.
- B. PVC coated galvanized rigid steel conduit shall be used within the Gravity Thickener Tanks.
- C. PVC Schedule 40 conduit shall be used underground except as specified herein and where otherwise indicated on the drawings.
- D. When routing signal cables in raceways, maintain 12” spacing from power raceways and only cross at a 90 degree angle. All VFD power feeds to motors shall be routed in rigid steel material, NO EXCEPTION.

- E. Unless otherwise hereinafter specified or shown on the drawings, all boxes shall be metal.
- F. Exposed switch, outlet and control station boxes and fittings shall be cast or malleable iron.
- G. Concealed switch, outlet and control station boxes in dry-wall finished areas shall be pressed steel.
- H. Terminal boxes, cabinets, junction boxes, pull boxes and wireways used in areas designated as NEMA 4X shall be stainless steel 316, gasketed.
- I. Combination expansion-deflection fittings shall be used where conduits cross structure expansion joints. Refer to Structural drawings for expansion joint locations.
- J. Conduit wall seals shall be used where underground conduits penetrate walls or at other locations shown on the drawings.
- K. Fire stops shall be used where cables or conduits penetrate through fire resistant rated walls, floors, ceilings or partitions. All fire stopping shall be inspected by an owner hired special inspector.
- L. PVC coated rigid steel conduit sweeps shall be used where concealed PVC conduits rise up out of floor slabs.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Rigid Conduit
 - 1. Rigid heavy wall steel conduit shall be hot-dipped galvanized as manufactured by the Youngstown Sheet and Tube Co., Allied Tube and Conduit Corp., Wheeling-Pittsburgh Steel Corp., or equal.
 - 2. PVC conduit used underground shall be rigid polyvinyl chloride Schedule 40 as manufactured by Carlon, Phillips Petroleum Co., Triangle Pipe & Tube Co., Inc., or equal.
 - 3. PVC coated rigid steel conduit shall have a 0.040 inch thick, polyvinyl chloride coating permanently bonded to hot-dipped galvanized steel conduit, as manufactured by Calbond, Ocal, Robroy Industries, or equal.
- B. Liquidtight, Flexible Metal Conduit, Couplings and Fittings.
 - 1. Liquidtight, flexible metal conduit shall be Sealtite, Type UA, as manufactured by Anaconda American Brass Co., or equal by American Flexible Conduit Co., Inc., or equal.

2. Fittings used with flexible conduit shall be of the screw-in type as manufactured by Thomas and Betts Co., Crouse-Hinds Co., O.Z. Manufacturing Co., or equal.
- C. Flexible couplings shall be as manufactured by Crouse-Hinds Co., Appleton Electric Co., O.Z. Manufacturing Co., or equal.
- D. Boxes and Fittings
1. Pressed steel switch and outlet boxes shall be hot-dipped galvanized as manufactured by Raco Manufacturing Co., Adalet Co., O.Z. Manufacturing Co., or equal.
 2. All boxes including, but not limited to, terminal boxes, junction boxes and pull boxes shall be sheet steel unless otherwise shown on the drawings. Boxes shall be galvanized and have continuously welded seams. Welds shall be ground smooth and galvanized. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel screws. Boxes shall be as manufactured by Hoffman Engineering Co. or equal.
 3. All boxes and fittings used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal. The tensile strength of the bond shall be not less than 2,000 pounds.
 4. All boxes and fittings used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness as used on the coated steel conduit.
 5. Cast or malleable iron boxes and fittings shall be galvanized with cast galvanized covers and corrosion-proof screws as manufactured by the Crouse-Hinds Co., Appleton Electric Co., O.Z. Manufacturing Co., or equal.
 6. PVC boxes and fittings shall be as manufactured by Carlon, An Indian Head Co., O.Z. Manufacturing Co., or equal.
 7. Steel elbows and couplings shall be hot-dipped galvanized. Elbows and couplings used with PVC coated conduit shall be furnished with a PVC coating bonded to the steel, the same thickness as used on the coated steel conduit.
 8. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco Div., O.Z. Manufacturing Co., or equal.
 9. Conduit wall seals shall be Type WSK as manufactured by O.Z. Manufacturing, Co., or equal by Link Seal Co.
 10. Combination expansion-deflection fittings shall be Type XD as manufactured by Crouse-Hinds Co., or equal by Appleton Electric Co., O.Z. Manufacturing Co.

11. Conduit seal bushings shall be Type CSB as manufactured by O.Z. Manufacturing Co., or equal by Crouse-Hinds Co.
 12. Fire stops shall be Type CFSF as manufactured by O.Z. Manufacturing Co., or equal by Crouse-Hinds Co., Appleton Electric Co.
 13. Explosion proof conduit seals shall be Type EYS as manufactured by O.Z. Manufacturing Co., or equal by Crouse-Hinds Co. and Appleton Electric Co.
- E. Conduit Mounting Equipment. Hangers, rods, backplates, beam clamps, fasteners, etc. shall be hot-dipped galvanized iron or steel for all areas except for the wet well. Mounting equipment shall be as manufactured by B-Line Co., Thomas and Betts Co., Unistrut Corp., or equal.
- F. Conduit Mounting Equipment. Hangers, rods, backplates, beam clamps, fasteners, etc. shall be stainless steel for within the wet well. Mounting equipment shall be as manufactured by B-Line Co., Thomas and Betts Co., Unistrut Corp., or equal.
- G. Corrosion Protection for Galvanized Conduit located exterior to buildings shall be provided. Corrosion protection for galvanized conduit shall be cold galvanized zinc based paint as manufactured by L.P.S. Co., Los Angeles, California, CRS Chemicals, Drecher, Pennsylvania, or equal.
- I. Watertight Silicone Type Sealant. Sealant shall be non slumping type silicone meeting UL water leakage test, W Rating and have excellent adhesion characteristics to most construction surfaces, including: concrete, gypsum, metal, plastic, wood and insulation

PART 3 – EXECUTION

3.01 INSTALLATION

- A. No conduit smaller than 3/4 inch electrical trade size shall be used, nor shall any have more than three 90 degree bends in any one run. Approved factory elbows shall be used when sharper bends are necessary. Pull boxes shall be provided as required or directed.
- B. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.
- C. The ends of all conduits shall be tightly plugged to exclude dust and moisture while the buildings are under construction.
- D. Conduit supports shall be spaced at intervals of eight feet or less, as required to obtain rigid construction.
- E. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Plastic "CLIC" system supports are not acceptable. Multiple runs of conduits shall be supported on trapeze type

hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8 inch diameter. Wire hangers will not be accepted.

- F. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.
- G. All conduits on exposed work and concealed above hung ceilings shall be run at right angles to or parallel with surrounding wall and shall conform to the form of the ceiling. Diagonal runs will not be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true.
- H. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings.
- I. PVC conduits shall be installed using a fusing cement process. Conduits shall be water tight.
- J. Conduit terminating in gasketed enclosures shall be terminated with conduit hubs.
- K. Metallic heavy wall conduits shall be installed using threaded fittings. Threadless fittings may be used in isolated instances when approved by the Engineer.
- L. Liquidtight flexible metal conduit shall be used for all motor terminations and other equipment where vibration is present.
- M. PVC coated rigid steel conduits shall extend a minimum of 12 inches above finished slabs. Conduits penetrating walls shall be caulked gas tight on both sides.
- N. When a conduit has to be cut in the field, it shall be cut square using a hand or power hacksaw cutter, or an approved pipe cutter using knives. The use of pipe cutter wheels will not be permitted. The cut ends of the field cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory cut threads on conduits. Field cut threads shall be protected by a field applied cold galvanizing compound.
- O. Conduits entering buildings below grade shall be furnished with a conduit seal bushing.
- P. Concealed conduits in floor slabs and walls and encased in concrete envelope shall be run in direct line with bends of largest possible radius.
- Q. Ducts installed in concrete slabs shall be installed as specified in Section 03300 (Cast-In-Place Concrete). Ducts shall be arranged to minimize crossings.
- R. Ducts shall not be installed in slabs where the slab is below the highest known groundwater level.

- S. Where ducts terminate at panelboards, terminal cabinets, etc. panel of sufficient width and depth shall be provided to maintain the 2 inch spacing between ducts or wireways shall be provided below panels, cabinets, etc.
- T. A ground wire shall be run in all runs of electric metallic tubing and PVC conduit.
- U. All bends in PVC conduit shall be made using a hotbox and bending guide tool.
- V. Conduits run underground below the highest known ground water level shall not enter buildings below this groundwater level without first being run through a drain manhole, handhole, or exterior pull box.

- END OF SECTION -

SECTION 16442

PANELBOARDS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes the furnishing and installing of all panelboards as specified herein and as shown on the drawings. All panelboards shall be provided with the applicable NEMA enclosure in accordance with the Electrical Contract Drawings.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Panelboards, including construction details and enclosures
 - 2. Terminals and lugs
 - 3. Trim
 - 4. Buses
 - 5. Circuit Breakers
 - 6. Groundfault Circuit Interrupter
 - 7. Metering

1.03 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600.
- B. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

1.04 DESIGN CRITERIA

- A. Panelboard ratings shall be as shown on the drawings. All panelboards shall be rated for the intended voltage.
- B. Panelboards shall be in accordance with the Underwriter Laboratories, Inc. “Standard for Panelboards” and “Standard for Cabinets and Boxes” and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

PART 2 – PRODUCTS

2.01 PANELBOARD CONSTRUCTION

- A. Interiors
 - 1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, and buses. All wire connectors, except screw terminals, shall be of

the anti-turn solderless type and all shall be suitable for copper wire of the sizes indicated.

2. Interiors shall be designed such that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be such that circuits may be changed without machining, drilling or tapping.
3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.
4. A factory provided label shall be provided listing panel type, number of circuit breakers and ratings.
5. The main breaker shall be at the top or bottom of the bus construction and not a branch breaker.

B. Buses

1. Main bus shall be copper. Full size neutral bars shall be included. Phase bussing shall be full height without reduction. Cross connectors shall be copper. All buses shall be tinned.
2. Main bus shall be distribution phase sequence type configuration to allow installation of two or three pole circuit breakers at any location.
3. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
4. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.
5. Solderless main lugs or main circuit breakers shall be furnished as shown on the drawings.
6. Bus bracing to be at least equal to the interrupting rating of lowest rated circuit breaker installed in panel. Series rated breakers and panels shall not be acceptable.

C. Boxes

1. Recessed boxes shall be made from galvanized code gauge steel having multiple knockouts unless otherwise noted. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of four inches on all sides.
2. Surface mounted boxes shall have an internal and external finish as specified herein. Surface mounted boxes shall be field punched for conduit entrances.
3. At least four interior mounting studs shall be provided.
4. Panelboards shall be "door-in-door" construction.

D. Trim

1. Hinged door-in-door construction shall enclose all circuit breaker handles and shall be included in all panel trims.
2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48 inch in height shall have a vault handle and three point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike. A directory frame and card having a transparent cover shall be furnished on each door.
3. Trims shall be fabricated from code gauge sheet steel.
4. All exterior and interior steel surfaces of NEMA 1, 1A, 3R and 12 panelboards shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
5. Trims for flush panels shall overlap the box by at least 3/4 inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

E. Manufacturer

1. 120/208 Volt and 277/480 Volt three phase distribution panelboards rated for 1200 Amps and less shall be Pow-R-Line 4X type as manufactured by Eaton, or equal by Square D and General Electrical. Equipment layouts are based on the dimensions on the Eaton Power R-Line 4X distribution panelboards.
2. 120/240 Volt, single phase, 3 wire, and 120/208 Volt three phase, 4 wire branch circuit panelboards rated for 225 Amps and less shall be Pow-R-Line 1X type as manufactured by Eaton, or equal by Square D and General Electrical.

2.02 CIRCUIT BREAKERS

- A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the drawings. Circuit breaker mounting shall not exceed 78 inches above floor.
- B. Circuit breakers shall be molded case, bolt-in type.
- C. Circuit breakers installed in 120/240 Volt and 120/208 Volt panelboards shall have an interrupting capacity of not less than 10,000 Amperes, RMS symmetrical.
- D. Circuit breakers installed in 277/480 Volt panelboards shall have an interrupting capacity as shown on the Electrical Contract Drawings.
- E. Main circuit breaker shall be attached to the main vertical bus.

- F. Main and feeder breakers with frame rating of 250 Amps and greater shall have a solid state digital trip unit with adjustable long, short, instantaneous, and ground fault trip settings. Provide auxiliary contacts for trip status to remote alarm.

2.03 GROUND FAULT CIRCUIT INTERRUPTER (GFCI)

- A. GFCI shall be provided for circuits where indicated on the drawings. GFCI units shall be molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be U.L. listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time), and an interrupting capacity matching the circuit breakers in the panelboards.

2.04 DIGITAL POWER METER

- A. Main Distribution panelboard shall be metered with a digital power meter.
- B. Digital Power Meter
 1. Digital power meter shall be true RMS type power monitor with features to data log (30 days) and communicate remotely the AC amperes on each phase, voltage, harmonic distortion, watts, volt amperes, bars, power factor, frequency, demand watts, demand volt ampere and watt hours; and capable of providing alarm status for phase loss, phase on balance, phase reversal and provides all data to remote monitoring systems.
 2. The power meter shall communicate using Modbus RTU via a RS-485 port and Ethernet protocol via a RJ-45 port and be able connect to any host devices.
- C. Provide small control wiring, necessary fuse blocks, suitable numbering strips and terminal blocks as required
- D. Provide current transformers for each meter. Current transformers shall be wired to shorting type terminal blocks. All transformers used for metering shall meet the requirements of IEEE C12.11 and IEEE C57.13.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Boxes for surface mounted panelboards shall be mounted so there is at least ½ inch air space between the box and the wall.
- B. Circuit directories shall be typed identifying location and nature of load served.
- C. Panelboards installed in areas with finished walls shall be installed recessed into the wall with the front of the panel flush with the finished wall.

- END OF SECTION -

SECTION 16495

VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes furnishing all labor, materials, tools and equipment necessary to furnish and install Variable Frequency Drives (VFD) as shown on drawings, specified herein, or evidently required to complete the work.
- B. Refer to various DIVISION 11 – EQUIPMENT sections and contract drawing motor wiring diagrams for field device interface.

1.02 SUBMITTALS

- A. Shop Drawings and/or brochures shall be submitted to the Engineer in accordance with Section 01300.
- B. Submittals required under this section include, but are not limited to the following:
 - 1. Shop drawings showing complete fabrication and construction details, materials, electrical components, enclosures, input line reactors, harmonic filters, weights, dimensions, clearances, anchorage locations, piping and utility requirements, and step by step sequence of controls.
 - 2. Certified Performance and Efficiency Characteristics.
 - 3. The Contractor shall provide the VFD manufacturer with copies of all motor shop drawing submittals and or nameplate data. The VFD manufacturer shall review this data and shall certify in writing that the equipment has been coordinated with the variable frequency drives and motors for complete compatibility.
 - 4. Harmonic Analysis and written summary report.
 - 5. Complete master wiring diagrams, VFD layout drawings and control schematics, including required coordination with other electrical control devices operating in conjunction with each VFD and suitable outline drawings shall be furnished for each VFD being supplied for approval before proceeding with manufacture. Due to the complexity of the control functions, it is imperative the above drawings be clear and carefully prepared to facilitate interconnections with other equipment. Standard preprinted sheets or drawings simply marked to indicate applicability to this contract will not be acceptable.

1.03 DELIVERY, STORAGE AND HANDLING

- A. All materials and equipment shall be shipped, stored, and handled in accordance with Section 01600.
- B. The materials and components shall be stored on a flat, clean surface to prevent damage and shall be covered to prevent exposure to adverse conditions prior to installation.
- C. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

1.04 DESIGN CRITERIA

- A. The materials and equipment covered by this specification 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 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.
- C. Provide individual constant torque VFD's with LCL line filters, low harmonic drives, and soft starter by-pass. Each individual VFD requires all these devices to be factory mounted within its enclosure. Field mounting of drive related accessories is unacceptable.
- D. All equipment submitted shall be provided with enclosures that can be installed in the spaces shown on the drawings. Enclosures that exceed the allowable space provided shall be subject to rejection.
- E. Heat dissipation from VFD enclosures shall meet all requirements of the specifications.
- F. All VFDs shall be passive filtered low harmonic drives for the wastewater and water industry meeting the requirements of IEEE-519 as manufactured by ABB, Eaton or General Electric.
- G. Each VFD unit shall be U.L. listed or labeled.

1.05 HARMONIC REQUIREMENTS

- A. Under normal operating conditions, the line harmonics introduced into the power system from the AC VFD unit(s) shall be within the distortion limits as defined in IEEE 519 and less than %5 Ithd. The point of common coupling shall be the main distribution panel.

PART 2 – PRODUCTS

2.01 DRIVES

- A. This specification is intended to outline the overall physical features, performance and functional requirements of the VFD equipment required under this section, consisting of a variable speed adjustable frequency converter, by-pass contactor, filters, accessories,

and enclosure. The VFD system shall be fully tested by the manufacturer before initial startup with all components compatible in function and appearance.

- B. Variable Speed Adjustable Frequency Converter. The adjustable frequency drive shall be UL Listed solid state type in a NEMA 12 filtered enclosure and blower cooled. The filter element shall be of the removable and replaceable type for each drive unit. Front access shall be provided. Top, rear and side access shall not be required. The enclosure shall be coated with an epoxy resin base and acrylic resin enamel finish. The drive shall meet applicable provisions of DIVISION 16, ELECTRICAL, the National Electric Code and NEMA. The drive shall be arranged for 480 Volts plus 10 percent to minus 5 percent, three phase, 57 to 63 Hertz input converted into adjustable frequency/Voltage output in an ambient temperature of -10 to 40 degrees C. The VFD shall be capable of sustaining operation with a line voltage dip of 15 percent of normal operating voltage on a constant torque or variable torque load. During line dip the VFD shall automatically provide a speed drop allowing maximum capable speed for the duration of the input voltage dip. Each individual drive shall be mounted in a separate enclosure. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads. Each individual drive and associated equipment shall be mounted in a single and individual enclosure unless otherwise specified. The following features shall be included with each adjustable frequency drive:

1. Control. The control method shall be sinusoidal Pulse Width Modulation. Output Voltage shall be three phase, 480 Volts and output frequency shall be 0.1 to 66 Hz when shipped. Frequency shall be selectable by a digital keypad. The frequency resolution shall be 0.1 Hz and the accuracy shall be within 1.0 percent of the maximum frequency at 25 degrees plus or minus 10 degrees C. Voltage/frequency (V/f) characteristics shall be characterized by selectable patterns. Up to 82 control functions shall be programmed. The overload capacity shall be 110 percent continuous and a minimum two minute rating of 150 percent of rated current. The frequency setting signal shall be 4 to 20 mA. The VFD shall employ a full wave rectifier to prevent input line notching, DC bus choke, DC bus capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device. SCRs, GTOs and Darlingtion transistors are not acceptable.
2. Function. The adjustable parameters consisting of: accelerating time, decelerating time, upper and lower limit of output frequency, and 4 to 20 mA reference bias and reference gain shall be indicated on a digital display. Braking shall be achieved through capacitor charging and starting shall be achieved by external contact. The VFD shall be software configurable to automatically restart following power outage, overcurrent and overvoltage detection. Soft stall shall occur when motor runs continuously at overload.
3. Protection. The drive shall be protected from stalling, overcurrent, overload, short circuit, overvoltage, undervoltage, loss of one (1) phase of input power, instantaneous power failure (approximately 30 msec), overheating, fuse burnout protection and earth (ground) fault detection. The fault cause shall be displayed (flickering) for overcurrent, short circuit, overload, overvoltage, overheating and earth (ground) fault. There shall be a main capacitor charging indicator for

internal circuit. Fault shall be reset by a reset push button on the printed circuit board and an external reset contact.

4. Displays. The digital display shall be a 2 line, 40 character unit with readout in plain English. A separate LED indicator shall be provided for capacitor charge. Display shall be located on the door of the VFD enclosure.
5. Internally mounted set point control shall be provided to receive either a 4 to 20 mA or 0 to 10 vdc analog input control signal from a process panel to control the speed of the motor. An external digital display shall be provided outside of the inverter. The following control devices shall be available for external control of the inverter; frequency/speed meter, frequency setting variable resistor, knob for frequency setting variable resistor and drive switch. The drive shall be capable of receiving a dry contact input to override the analog input control signal and control the flow rate to 95%.
6. A bypass motor starter and VFD VFD/Bypass switch shall be provided to allow VFD bypass and straight in line full load motor operation. A solid state bypass soft start style motor starter shall be provided for all motors 30HP and greater. The line and load sides of the soft start motor starter shall be electrically isolated from incoming power and motor respectively with contactors in which will not close until the bypass switch is in the bypass position.
7. A lockable main load break disconnect switch interlocked with the enclosure door with through the door handle to provide positive disconnect of incoming AC power shall be furnished for each individual drive and enclosure. The circuit breaker shall be rated at a minimum 25,000 amperes at 480 volts, RMS symmetrical.
8. Each drive shall be provided with the following accessories:
 - a. "Local-Off-Remote" keypad switch for local/remote speed control. In the "Remote" mode, the motor speed shall be adjusted in response to the related remote 4 to 20 mA pacing signal. In "Local" mode the motor speed shall be adjusted in response to keypad entry speed and the VFD shall run when the "Hand-Off-Auto" selector switch is in "HAND". . In "Off" mode the VFD shall not run.
 - b. Provide a 4-20 mA speed feedback output signal.
 - c. Provide four (4) Type C dry contacts at each VFD for remote indication of motor running status.
 - d. "Hand-Off-Auto" selector switch located on the door of the VFD enclosure. In the "Auto" position the VFD shall be started and stopped remote via an external dry contact. In the "Hand" position the VFD shall run. In "Off" mode the VFD shall not run.
 - e. Elapsed time meters located on the door of the VFD enclosure.

- f. Provide two (2) type C contacts at each VFD for remote indication of VFD run and fault conditions.
- g. Motor running indicating light located on the door of the VFD enclosure.
- h. Motor off indicating light located on the door of the VFD enclosure.
- i. Drive failure indicating light located on the door of the VFD enclosure.
- j. Provide a bypass contractor operation indicating light located on the door of the VFD enclosure.
- k. All indication lights shall be LED push to test type.
- l. All time delay relays shall be true on and true off type that utilize the control signal for relay power.
- i. Provide all controls and accessories as shown on the equipment motor wiring diagrams in the contract drawings. Specialized interface relays supplied by the equipment manufacture shall be installed in the VFD cabinet by the VFD manufacture at the VFD manufacturing plant. Coordinate with the equipment manufacture for space requirements and delivery of the relays.

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 of these specifications.
- C. Installation of the equipment shall be in accordance with written instructions provided by the manufacturer and as approved.

3.03 PAINTING

- A. Shop painting and the surface preparation is a part of the work specified herein. Enclosures shall be coated with an electrostatically-applied epoxy enamel.

3.04 CLEAN UP

- A. Prior to start-up and field testing, all foreign matter shall be removed from the equipment. 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 field programming and startup for all the VFDs provided.

3.06 MANUFACTURER'S TRAINING

- A. Manufacturer's training shall be provided for training of Owner's personnel for each type of VFD provided in accordance with Section 01700.
- C. Manufacturer's Training of Owner's Personnel shall be a minimum of two (2) calendar days performed at the project site.

3.07 SPARE PARTS

- A. One set of spare parts shall be provided for each VFD size.
- B. Spare parts for each VFD Size:
 - 1. One (1) control interface.
 - 2. Three (3) fuses.
 - 3. One (1) VFD module each size provided without enclosure.

3.08 WARRANTY

- A. A manufacturer's warranty for three years shall be provided for each VFD.

- END OF SECTION -

SECTION 16500

LIGHTING SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes the furnishing and installing of complete lighting systems including panelboards, transformers, lighting fixtures, receptacles, switches, contactors, clocks and all accessories and appurtenances required as specified herein and as shown on the drawings.

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. Light Switches
 - 2. Receptacles
 - 3. Astronomical Time Clock Switch
 - 4. Lighting Fixtures
 - 5. Device Plates
 - 6. Emergency Lighting Battery Units and Exit Lights

1.03 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600.
- B. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

1.04 DESIGN CRITERIA

- A. All lighting fixtures shall be in accordance with the National Electrical Code and shall be constructed in accordance with the Underwriters Laboratories “Standards for Safety, Electric Lighting Fixtures.” All lighting fixtures shall be Underwriters Laboratories labeled.

PART 2 – PRODUCTS

2.01 WIRE:

- A. Wire shall be as specified under Section 16120, Wire and Cables.

2.02 CONDUIT

- A. Conduit shall be as specified under Section 16130, Raceways and Fittings.

2.03 PANELBOARDS

- A. Panelboards shall be as specified under Section 16442, Panelboards.

2.04 LIGHT SWITCHES

- A. NEMA WD 1, UL 20, Heavy-Duty, AC only general-use toggle switch.
- B. Rated 20 Amperes, 120/277 Volts for inductive and resistive loads.
- C. Motor rated up to 80 percent of ampere rating.
- D. Totally enclosed in a phenolic base and cover.
- E. U.L. and CSA Listed.

2.05 RECEPTACLES

- A. NEMA WD 1, UL 498, Heavy-duty general use receptacle.
- B. GFCI Receptacle: UL 943, Convenience receptacle with integral ground fault circuit interrupter and indication light that is lighted when device is not tripped.
- C. NEMA WD 6, straight blade type for rated current and phases as indicated on drawings.
- D. Weatherproof Cover Plate: NEMA 3R, thermoplastic white use type covers by Hubbell or equal.

2.06. ASTRONOMICAL TIME CLOCK SWITCH

- A. Astronomical Time Clock Switch shall be programmable astronomically controlled switch front LCD time display and programmable buttons mounted in a standard back box.
- B. The switch shall be 1-pole, 15 Amp rated and capable of 7-day week time scheduling, equal to Leviton VPT24-1PZ Vizia by Leviton or equal by Hubbell or Legrand.
- C. Operation: Exterior lights shall be energized when the astronomical dusk time of day dial is past time. The lights shall remain energized until either the "Off" time of day or astronomical dawn time of day is past time.

2.07 DEVICE PLATES

- A. Plates for shall be of the required number of gangs for the application involved and shall be Type 302 (18-8) stainless steel of the same manufacturer as the device.

2.08 LIGHTING FIXTURES

- A. Lighting fixture shall be LED illuminated and of type as shown on the drawings. The catalog numbers listed are given as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers will be acceptable.
- B. The fixture shall be tested to IESNA LM-79-08 and LM-80 Testing Standards at 25° C ambient temperature
- C. The LED package shall be designed around the lumen maintenance of 87% at 60,000 hrs. and is to be expected to achieve L70 at 100,000 hrs.
- D. The Light Engine shall be a high efficacy LED light engine equipped with brand-name LEDs available in outputs of 100%, 85%, 70% and 55%.
- E. The LED Drivers shall be Electronic Class 2, high efficiency, with the following power factor correction (PFC):
 - 1. Standard Non-Dimming Driver (PFC>0.95).
 - 2. Dimming Drivers (PFC>0.90).

2.09 EMERGENCY LIGHTING BATTERY UNITS AND EXIT SIGNS

- A. Emergency lighting units shall be fully automatic with 12 Volt nickel cadmium batteries. The wattage of the unit shall be sufficient to power the remote lamps as shown on the Contract Drawings, plus 20% spare capacity, for 1-1/2 hour upon loss of AC power. Units shall be designed for 120 Volt, 60 Hertz input and have an automatic clock timer and solid state charger, ready/off switch, press-to-test switch, amber "ready" light, red "charge" light and required number of supervisory relays.
- B. Provide Holophane DeSoto M802 series emergency lighting units with dual lighting heads. Units manufactured by Hubbell, Dual Lite or approved equal are also acceptable. Lighting heads shall be 12 volts, 20 watts, halogen type.
- C. Provide Holophane QM-LED series exit signs with LED lamps, nickel cadmium battery, and battery charger. White background with red lettering. Equivalent units manufactured by Dual Lite, Sure Lite or approved equal are acceptable.
- D. In NEMA 1, 12, 4, and 4x areas, provide remote wall mounted lamp heads ELA-DM802 sealed thermoplastic, 12 volts, 12 watts, halogen type with weatherproof mounting base by Holophane. Equivalent units manufactured by Hubbell, Dual Lite or approved equal are acceptable.
- E. In NEMA 7 areas, provide emergency lighting remote lamp heads Series DSHR, 12 volts, 12 watts halogen, by Holophane. Equivalent units manufactured by Hubbell, Dual Lite or approved equal are acceptable.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designated location and shall be completely wired ready for Connection to the branch circuit wires at the outlet. All pendant mounted fixtures shall be mounted plumb with floors and walls.
- B. When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.
- C. Flexible fixture hangers shall be used for all pendant mounted fixtures. Pendant mounted fixtures shall be supported from 3/4 inch galvanized rigid steel conduit.
- D. Receptacles and switches shall be mounted at 45” above finished floor.
- E. Mounting heights given are to the bottom of the fixture.

3.02 CLEANING UP

- A. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

- END OF SECTION -

SECTION 16721

FIRE ALARM SYSTEMS

1.00 PART 1 – GENERAL

1.01 SCOPE

- A. The work of this subsection includes the furnishing and installing of a complete addressable fire alarm system for the Solid's Handling Building as specified herein and as shown on the drawings. The system shall be capable of standalone operation and being networked via fiber optics with future fire alarm panels in the plant and act as one overall plant facility fire alarm system. The system shall be electrically supervised, connected, tested and left in first class operating condition.
- B. The system shall consist of, but shall not be limited to, fire alarm control panels and associated data highway, fire and smoke detection devices, manual pull stations, audible/visual alarms, alarm annunciator, fiber optic networking equipment, conduit, fittings, outlet boxes and wire, operating instructions and maintenance instructions.
- C. The General Contractor and Electrical Contractor shall meet with the local fire department prior to submitting any shop drawings for this project

1.02 SUBMITTALS

- A. Submit the following in accordance with Section 01300:
 - 1. The system riser diagram shall indicate every alarm control panel, terminal panel, actuating device, annunciator panel and the required interconnecting wiring with wire type, quantity and raceways sizes.
 - 2. Description of system operation, of each panel and device.
 - 3. Original copies of catalog cuts of all devices, modules, batteries, battery chargers, etc. Copies of internet based data shall not be acceptable.
 - 4. Battery load calculations for each panel.
 - 5. Operating instructions and maintenance procedures. Operating instructions shall be furnished separate from manufacturers standard catalog literature and shall include recommended customer troubleshooting procedures. Maintenance procedures shall be furnished separate from manufacturer's standard catalog literature and shall include battery maintenance, lamp and fuse replacement, detector periodic checking and reset procedures, and other applicable procedures.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Provide in accordance with Section 01600.

- B. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance.

1.04 DESIGN CRITERIA

- A. The equipment and completed installation shall be in compliance with local and national codes, authorities having jurisdiction, the local Fire Department, and in accordance with applicable sections of the latest edition of NFPA 72 for Fire Alarm Systems.
- B. All equipment shall be listed by National Fire Protection Association, Underwriters Laboratories and/or the Factory Mutual System.
- C. The equipment manufacturer shall have a local branch office within 75 miles staffed with trained, full time employees who are capable of performing testing, inspecting, repair and maintenance services for the life of the fire alarm system.
- D. All components of the system shall have been tested for compatibility with each other to ensure the system performs all intended functions.
- E. System Operation
 - 1. The operation of a manual station or activation of any automatic alarm initiating device (system smoke, heat) shall automatically:
 - a. Initiate the transmission of the alarm to an approved private monitoring station via a Digital Alarm Communicator/Transmitter (DACT).
 - b. Sound a code 3 temporal evacuation signal over all audio circuits.
 - c. Flash all visual signals throughout the building in a synchronized manner.
 - d. Flash an alarm LED and sound an audible signal at the Fire Alarm Control Panel (FACP). Upon Acknowledgment, the alarm LED shall light steadily and the audible shall silence. Subsequent alarms shall re-initiate this sequence.
 - e. Visually indicate the alarm initiating device type and location via the LCD display located at the FACP.
 - f. Automatically shut down or control HVAC equipment. Manual override controls and programmable relay interface shall serve as an interface to the HVAC equipment.
 - g. Activate the exterior weatherproof beacon.
 - h. Alert the facility SCADA system via a dry contact fire alarm output.
 - 2. The operation of a carbon monoxide detector shall automatically:

- a. Sound a code 4 temporal evacuation signal over the detector's sounder base.
 - b. Illuminate the red alarm LED on the detector.
 - c. Flash an alarm LED and sound an audible signal at the FACP and remote annunciator. Upon Acknowledgment, the alarm LED shall light steadily and the audible shall silence. Subsequent alarms shall re-initiate this sequence.
 - d. Visually indicate the alarm initiating device type and location via the LCD display located at the FACP.
3. The control panels shall perform auxiliary control functions on a common or zoned basis as required.
 4. All alarm initiating circuits, alarm indicating circuits and annunciator circuits shall be supervised against the occurrence of a break or a ground fault condition in the field wiring. These conditions shall cause a trouble buzzer to sound in the control panel until manually silenced by the buzzer silencing switch.
 5. Tripping of the smoke detection supply circuit breaker or a burned out zone lamp will also energize the trouble circuit.
 6. The trouble circuit shall be arranged for ringback operation to prevent switch disarrangement during normal supervisory conditions.
 7. The system shall also have the capability of indicating the specific alarm initiating device in the trouble condition.

C. System Wiring

1. The system shall be wired, connected, and left in first class operating condition. Wiring shall be provided and installed in accordance with the manufacturers drawings. The contract drawings indicate the devices required for each building, the types of devices to be installed, and the general method for connecting the system devices together. The actual number of wires to be installed in each raceway and the size of each raceway shall be in accordance with the manufacturer's drawings.
2. Initiating circuits shall be addressable type.
3. Addressable loop wiring shall support all devices shown and allow for a minimum of 25% spare capacity and be wired in a Class X style.
4. As a minimum, power supplies and notification appliance circuits shall operate all devices shown plus 25% spare capacity, and be wired in a Class A style.

D. System shall be addressable microprocessor based and shall provide the following features:

1. Sufficient memory to perform as specified and as shown for addressable system.
2. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors.
3. Capability of each addressable device being individually disabled or enabled from the panel.

1.05 SPARE PARTS

- A. Provide one detector and one audio/visual device of each type to the town at the conclusion of all work.

2.00 PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The basis of design is based on the Notifier NFS-320 fire alarm system similar networking type systems by Gamewell and Faraday are acceptable. Systems by Siemens and Simplex are not allowed.

2.02 FIRE ALARM CONTROL PANEL

- A. Provide and install Fire Alarm Control Panels (FACP). The system shall support analog/addressable devices, expandable in a true peer-to-peer network (multi-panel) configuration.
 1. Monitor all initiating devices, report to each network node, annunciate the alarmed device and its' location, capture elevators, conduct smoke control functions, and initiate the audio/visual evacuation signaling and control sequences as described herein.
 2. Conduct municipal notification as described herein.
 3. Initiating devices shall respond with their condition. Control relays shall be individually addressable by the system to respond automatically in the event of an alarm of related sensors. Manual override of control relays shall be individually addressable by the operator.
- B. Control Configuration: All fire alarm control portions of the system shall be housed in red locking, semi-flush mounted enclosures. All panel initiating and control status indicators shall be visible through a clear Lexan window. Access to the control panel shall be by keys issued to the Fire Department and authorized personnel. Each panel shall incorporate an operator interface, CPU, addressable loop interface cards, audio control/microphone, amplifiers, power supply and batteries to perform the system operation as described herein.

- C. Primary Operator Control: The FACP shall provide an operator interface module consisting of a backlit LCD display to display all system alarm, trouble and supervisory conditions, and shall provide common control switches for system status scrolling, alarm acknowledge, trouble acknowledge, reset, and system drill. The unit shall have LED indicators for Normal Power Status, Alarm, Supervisory, Trouble and Test/Program.

- D. Addressable Loop Interface: Provide an addressable loop interface card for each addressable signaling line circuit. Each circuit shall support digital communications with addressable field devices. The addressable loop interface shall support the following features and functions:
 - 1. Provide full digital communications with analog field devices.
 - 2. An integral alarm relay which will support alarm operation in the event of a failure of addressable loop data communications.
 - 3. The interface card shall support the retrieval of the following information from each individual analog system device:
 - a. Device serial number
 - b. Device address
 - c. Device type and personality code
 - d. Date of manufacture
 - e. Hours in use
 - f. Number of alarms and troubles
 - g. Time and date of last alarm
 - h. Amount of environmental compensation left/used
 - i. Last maintenance date
 - j. Current detector sensitivity values
 - k. Diagnostic information (trouble codes)

- E. Auxiliary Control / Annunciation: Provide auxiliary annunciator switch and LED modules for simple LED annunciation, zone disconnect, HVAC override, or other related monitoring and control functions. These are intended for use by the Fire Department during an event, or by authorized personnel during testing periods. Keypad entered commands for these functions shall not be an acceptable substitute. Alarm LEDs and zone disconnect switches shall be provided by type of device on a per floor/zone basis. Provide a minimum of 64 discreet programmable alarm LEDs, and 32 discreet programmable 2-position control switches with corresponding LED indicators.

- F. System Power Supplies: Integral system power supplies shall provide 12amps of 24VDC operating and emergency power to each panel. Each supply shall contain brownout, low battery detection, system ground fault, and LED indicators for loss of AC or CPU failure.

2.03 INTELLIGENT SYSTEM DEVICES

- A. Provide intelligent analog devices where shown and required. Each device shall retain operating characteristics in non-volatile memory and conduct algorithms to distinguish real fire conditions from unwanted nuisance alarms. All analog devices shall provide dual LED indicators, a green LED shall flash to denote active communication, and a red LED shall flash to denote an alarm condition. Devices shall be interchangeable with twist-lock

bases which may include a supervised remote LED output, fault isolation circuitry, or an auxiliary relay contact. In the event of an addressable loop communications failure, devices shall remain capable of initiating an alarm sequence.

- B. Multi-sensing Smoke Detector: Provide multi sensing analog smoke detectors where shown on contract drawings and required. Each detector shall employ photoelectric and thermal sensing principles.
- C. Heat Detectors: Provide fixed temperature 135 degrees F vapor-tight industrial grade units connected to monitor modules installed in all NEMA 4 and NEMA 4X areas.
- D. Carbon Monoxide Detector: Provide analog carbon monoxide detectors where shown and required. Each detector shall employ an electrochemical sensing cell. The detector shall have an red LED alarm notification and audio sounder base.
- E. Intelligent Manual Pull Stations: Provide intelligent addressable manual stations where shown on contract drawings and required. The station shall be double action type with screw terminals, toggle switch, and integral addressable electronics. The station shall be constructed of red Lexan with white raised letters and a key reset switch. The station shall be keyed alike to the FACP.
- F. Monitor Module: Provide addressable input monitor modules to monitor related systems or integrate conventional initiating devices onto the addressable loop.
- G. Control Module: Provide addressable output control modules to supervise and control conventional devices (indicating circuits, AHUs, door holders, electric door locks etc.) over the addressable loop. Control modules shall provide a supervised output rated for 1, 2 or 5 amps @ 24VDC and 120VAC, as required by the conventional device.
- H. Isolation Modules: Provide Isolator Modules to protect circuit integrity in the event of a wiring fault. Provide a minimum of one module per floor/zone, or one for every 25 devices; whichever is greater.

2.04 PRIMARY NOTIFICATION APPLIANCES

- A. Primary Notification Appliances: Flush mounted combination Audio/Visual Horn/Strobe type signaling appliances. Stand alone devices may be used to augment combination units when necessary. Specific audible and visual characteristics shall be as follows:
 - 1. Visual Signals shall be self-synchronizing xenon strobes in compliance with NFPA 72. Strobes shall an effective intensity rating of 15 candela in corridors and other areas up to 20' x 20', 30 candela in areas up to 30' x 30' and 110 candela in areas up to 50' x 50'.
 - 2. Audible Signals shall be horns in compliance with NFPA 72, 24 Volt dc polarized type with a minimum sound output shall be 90 db at 10 feet

- B. Exterior Strobe: Provide a flashing weatherproof strobe with a minimum 150,000 candlepower output where shown. The strobe shall be properly installed on a weatherproof backbox.

2.05 SYSTEM ACCESSORIES

- A. Monitoring Connection: Provide a Digital Alarm Communicator/Transmitter with phone line connections to an approved Central watch station.
- C. Terminal Cabinets: Provide fire alarm terminal cabinets where necessary. The cabinets, which shall have a removable hinged cover with key lock and red finish are intended to house analog/addressable modules and facilitate field wiring junctions.
- D. Remote Alarm Indicators: Provide remote LED indicators for smoke detectors where indicated on contract drawings. Provide a permanent label on each indicator identifying the device type and actual location.
- E. Auxiliary Power Supplies: Where the power requirements exceed that which is supplied by the FACP, auxiliary power supplies may be used. Each auxiliary power supply shall be supervised for loss of AC power and Battery Fail, and each notification circuit served shall be individually supervised.

3.00 PART 3 – EXECUTION

3.01 INSTALLATION

- A. Installation shall be supervised and tested by the system supplier. The work shall be performed by skilled technicians under the direction of experienced engineers, all of whom are properly trained and qualified.
- B. All wiring for the system shall be in accordance with Articles 760, 725, and 800 of the National Electrical Code and local electrical codes.
- C. Wiring shall be No. 14AWG Type XHHW copper type. All wiring shall be color coded. All wiring shall be tagged at each junction point. Proper connectors shall be installed at terminations to accept the No. 14 AWG wiring.
- D. Provide complete wiring and conduit between all equipment. All devices shall be mounted upon and splices made in UL listed boxes. Wiring splices and transposing or changing of colors will not be permitted. All wiring shall be installed in raceway as specified in SECTION 16130, RACEWAYS AND FITTINGS
- E. No conduit smaller than ¾ inch shall be installed.
- F. All fire alarm raceway system including junction boxes shall be painted red.
- G. Conduit sizes and wire quantities shall be suitable for the equipment furnished. The Electrical Subcontractor shall review the proper installation of each type of device with the equipment supplier.

- H. Fire Alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized as required for proper service. Circuits shall be labeled 'FIRE ALARM'.

3.02 FINAL TESTS / WARRANTY

- A. The system shall be fully tested by a UL certified testing company, in accordance with UL guidelines and NFPA standards. Each and every device shall be tested.
- B. A copy of the final test report and UL certificate shall be submitted indicating proper functioning of the system and conformance to the specifications. The test shall be performed by UL certified and factory-trained qualified technicians. Each and every device shall be tested, and standalone operation of remote panels shall be verified. Final testing [and UL certification] shall be performed by the same company that will hold and execute the Test and Inspection contract.
- C. The manufacturer shall guarantee all system equipment for a period of three (3) years from the date of final acceptance.
- D. The contractor shall guarantee all raceways and wiring to be free from inherent mechanical or electrical defects for one (1) year from the date of final acceptance of the system.

3.03 FIRE ALARM TEST AND INSPECTION CONTRACT

- A. Each contractor shall include as part of their base bid the cost of a one-year test and inspection contract. This contract shall provide for quarterly tests according to UL, NFPA and local requirements. Upon its' expiration, the contract shall be renewable by the town.

3.04 TRAINING

- A. The contractor shall provide the services of the manufacturer's representative for a period of 4 hours, during normal business hours, to instruct the owner's designated personnel and fire department response teams on the operation of the system.

- END OF SECTION -